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Supplier Document

Environmental Impact Statement In Situ Decommissioning of WR-1 at the Whiteshell Laboratories Site

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Revision 4

Accepted by: _____ 2022-12-15

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Environmental Impact Statement for the In Situ Decommissioning of WR-1 at the Whiteshell Laboratories Site

Pinawa, Manitoba

Revision 4

WSP GOLDER

Submitted to:
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1.0 INTRODUCTION

The Whiteshell Laboratories (WL) site at Pinawa, Manitoba was established in the 1960s by Atomic Energy of Canada Limited (AECL) to conduct nuclear research. The Whiteshell Reactor 1 (WR-1) provided a facility for engineering tests and scientific studies on alternative fuels, fuel channels and reactor coolants. Whiteshell Laboratories was also home to other significant research programs, including the Nuclear Fuel Waste Management Program, the demonstration reactor, and reactor safety analysis.

The WL site is located in southeastern Manitoba (Figure 1.0-1) and was operated for approximately 40 years under an operating licence issued by the Atomic Energy Control Board. In May 2000, the *Nuclear Safety and Control Act* (NSCA) came into force creating the Canadian Nuclear Safety Commission (CNSC). Since then, the WL site has been operated first under an operating licence and then under a decommissioning licence (since March 2002) issued by the CNSC. WR-1 is housed within the WR-1 Complex, which is located entirely within the WL site main campus (Figure 1.0-2). The WR-1 had a nominal thermal output of 60 megawatts (MW), approximately equivalent to 20 MW electric. The reactor operated from 1965 to 1985. A first phase of decommissioning occurred in the early 1990s and included the removal of easily mobilized radioactive material (e.g., fuel and fluids) and decontamination of the main floor and first sublevel space. Equipment was decommissioned and removed from the main reactor hall floor and one floor below-grade and placed in interim storage. The removal of fuel, liquids and equipment substantially reduced radioactivity. Activated materials and residual corrosion and fission products have been undergoing decay for over 30 years. Currently, WR-1 is under a storage with surveillance program.

In 1998, AECL made a decision to decommission the WL site. A Comprehensive Study Report (CSR; AECL 2001) under the *Canadian Environmental Assessment Act, 1992* was completed for the decommissioning project. The CNSC and Department of Fisheries and Oceans were the Responsible Authorities. The environmental assessment decision to approve the decommissioning project was announced by the federal Minister of the Environment in March 2002 and a decommissioning licence was issued.

In 2013, the Minister of Natural Resources announced plans to restructure AECL and move to a Government-owned, Contractor-operated management model. In 2014, AECL created Canadian Nuclear Laboratories (CNL), a wholly owned subsidiary of AECL, as the Site Operating Company and holder of all CNSC site licences to manage all work performed at AECL sites on behalf of AECL. In September of 2015, a contract was awarded to Canadian National Energy Alliance (CNEA) and ownership of CNL was transferred to CNEA. CNL retained ownership of all CNSC licences and is the operator of all AECL sites.

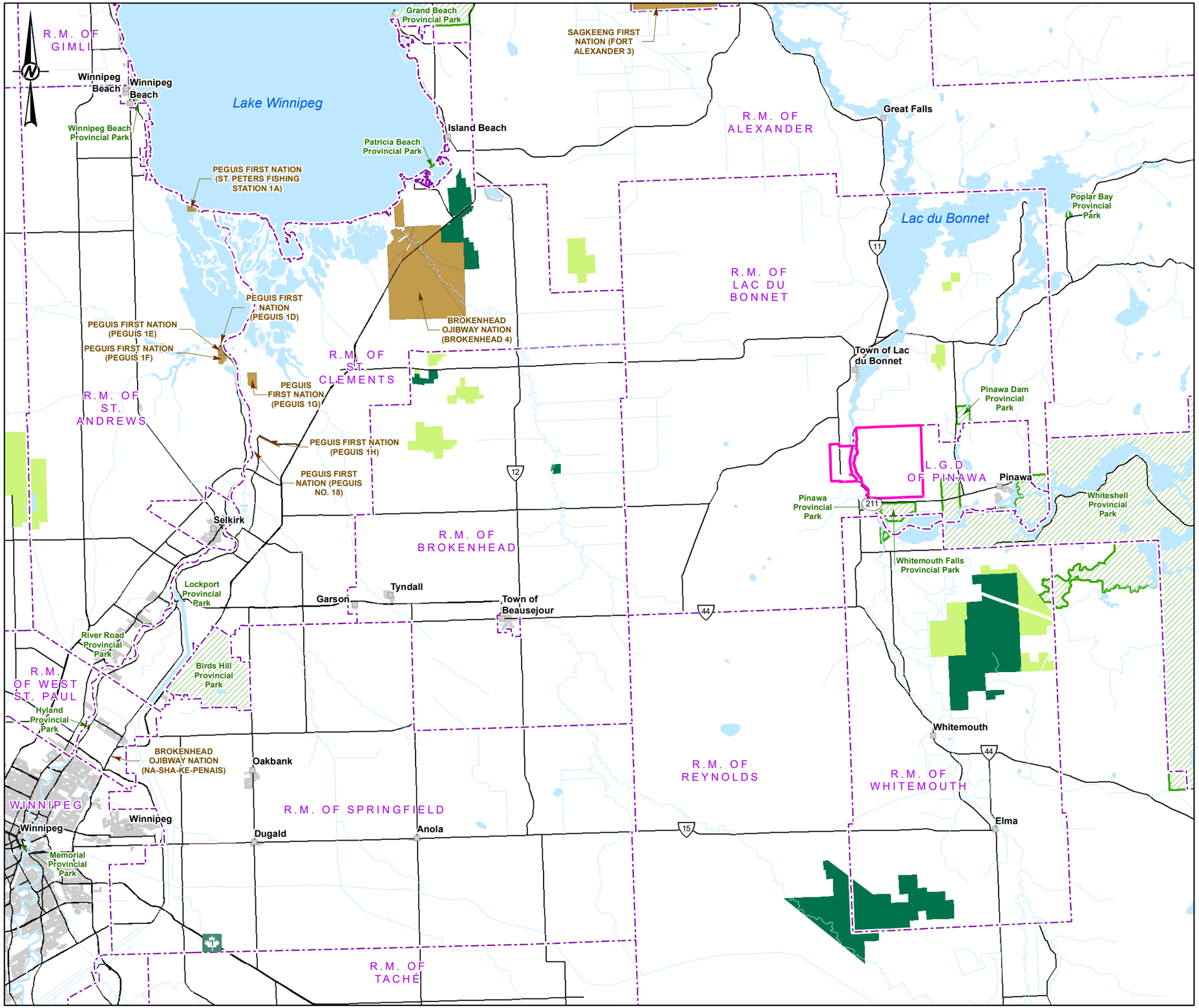
CNL is a private-sector company that is contractually responsible for the management, operation and decommissioning of nuclear sites, facilities and assets owned by AECL, which is a federal Crown corporation. CNL is performing the decommissioning of the WL site with the planned outcome of complete site closure by 2027. CNL is licensed to perform this work under a CNSC decommissioning licence. Enabled by the CSR approval and the site decommissioning licence, CNL is authorized to decommission WR-1 by means of dismantling and demolition.

CNL is now applying for an amendment to the current decommissioning licence to carry out In Situ Decommissioning of WR-1 at the Whiteshell Laboratories Site (the Project), rather than dismantling and demolition as previously assessed in the CSR. The in situ disposal (ISD) approach includes partial dismantling and demolition along with passive, permanent disposal of the below-grade portions of WR-1. ISD is a proven decommissioning approach that increases worker safety, provides protection of the environment and the public,

reduces interim storage and multiple handling, enables permanent nuclear liability reduction, and utilizes fewer resources. All other decommissioning activities as outlined in the CSR remain the same and are not the subject of this Environmental Impact Statement (EIS).

CNL is proposing the execution of this designated Project on land that is held in the name of AECL. As such, CNL is the proponent for the Project.

In situ disposal is a departure from the end-states defined in the CSR. As a result, the Project qualifies as a designated project under Section 37(b) of the Regulations Designating Physical Activities (SOR/2012-147) of the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) as a project related to "the long-term management or disposal of irradiated fuel or nuclear waste." A key element of the regulatory approvals process is the completion of an environmental assessment under CEAA 2012, the results of which are documented in this EIS. The environmental assessment is an iterative project planning process, intended to affirm that proposed activities will not cause significant adverse environmental effects. The assessment is completed to demonstrate that proposed activities can be safely completed in compliance with the prescribed protective limits, including radiological doses to workers and members of the public and the releases of contaminants to the surrounding environment. The environmental assessment considers the closure phase (which includes decommissioning and reclamation) and long-term performance during the post-closure phase (which includes institutional control and post-institutional control).



LEGEND

- WHITESHELL LABORATORIES SITE

BASE FEATURES

- CITY/TOWN
- MAJOR ROAD
- WATERCOURSE
- WATERBODY
- MUNICIPAL BOUNDARY
- FIRST NATION RESERVE

PROTECTED AREAS

- PROVINCIAL PARK
- ECOLOGICAL RESERVE
- WILDLIFE MANAGEMENT AREA

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY PROVIDED BY CNL (2016-11-22)
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
GENERAL LOCATION OF THE WHITESHELL LABORATORIES SITE

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0002	3	**1.0-1**

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Path: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0002_EIS_Sec1\20145046-0002-G-0001_Figure 1_0-1 General Location of WL Site.mxd

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LEGEND

WHITESHELL LABORATORIES

- WR-1 COMPLEX
- WHITESHELL LABORATORIES SITE
- WASTE MANAGEMENT AREA
- WHITESHELL LABORATORIES MAIN CAMPUS
- LANDFILL

BASE FEATURES

- CITY/TOWN
- TRANSMISSION LINE
- PROVINCIAL PARK

0 1,000 2,000

1:40,000 METRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY PROVIDED BY CNL (2016-11-22)
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT

CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT

EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE

WHITESHELL LABORATORIES SITE

CONSULTANT

WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/RRD
REVIEWED	KL
APPROVED	AB

PROJECT NO.	CONTROL	REV.	FIGURE
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1.1 Project Context

The WR-1 Complex (Figure 1.1-1, also known as Building 100) includes the WR-1 Building, the east annex and the service wing. The east annex and the service wing contain office space and supporting facilities. The WR-1 Building is seven storeys tall, with two storeys above-grade and five below-grade, and contains the WR-1 (Figure 1.1-2). The majority of the remaining contamination in WR-1 is located in the reactor core. Due to its small size, even when it was operating, WR-1 contained considerably less radioactive material than large power reactors.

The approved decommissioning approach for the WL site, as described in the CSR, was to remove all facilities with the exception of low-level waste trenches in the Waste Management Area (WMA), and existing contaminated river sediments, which may be managed through ISD (AECL 2001). The approved decommissioning approach for WR-1 proposed complete removal and remediation of the WR-1 Building (Licence No. NRTEDL-W5-8.00/2024). Prior to demolition of the WR-1 Building, all activated and contaminated components would have been removed, packaged and disposed at off-site facilities (AECL 2001). The facility structure would have been decontaminated and then demolished to achieve unrestricted release criteria. The dismantling and remediation activities previously approved for WR-1 Building included (AECL 2001):

- removal of reactor vault components;
- removal of process piping and equipment;
- transfer of radioactive waste to off-site facilities;
- decontamination of the building structure;
- demolition of the above-grade building structure; and
- remediation of the site to a “natural state.”

AECL's mandate is to manage its radioactive waste and decommissioning liabilities in a safe and environmentally responsible manner. AECL has asked CNL to perform the work, and in keeping with international best practices (IAEA 2004, 2006), the decommissioning timeframe has been accelerated with the goal of completing decommissioning of the WL main campus by 2027. Over the past 10 years, multiple buildings and facilities at the WL site have been decommissioned and the land remediated. In an effort to continue to safely reduce AECL's nuclear legacy liabilities and reduce the need for interim storage of radioactive waste, CNL began to investigate other options that would allow the WR-1 Building to be decommissioned safely. The new proposed approach is ISD, which allows CNL to decommission the WR-1 Building in a safe, compliant manner that reduces the need for interim storage and continued human intervention and provides protection of the public and the environment.

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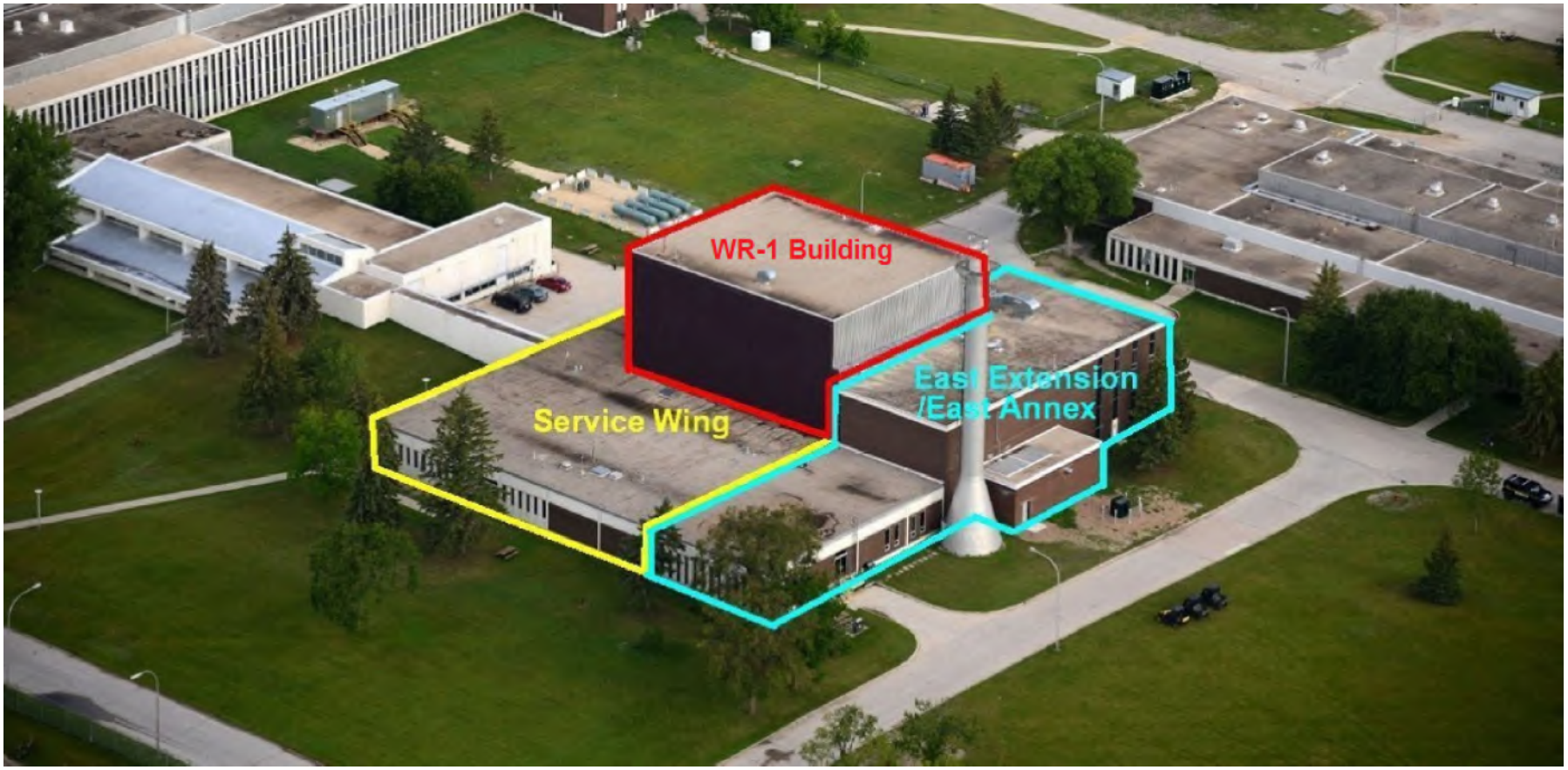

NOTE(S)

REFERENCE(S)

1. WR-1 COMPLEX: TECHNICAL DOCUMENT DOCUMENT {WLDP-26000-041-00 PAGE 6, REV.0}

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	-
PREPARED	PR/RRD
REVIEWED	KL
APPROVED	AB

TITLE
WR-1 COMPLEX

PROJECT NO.	CONTROL	REV.	FIGURE
20145046		3	**1.1-1**

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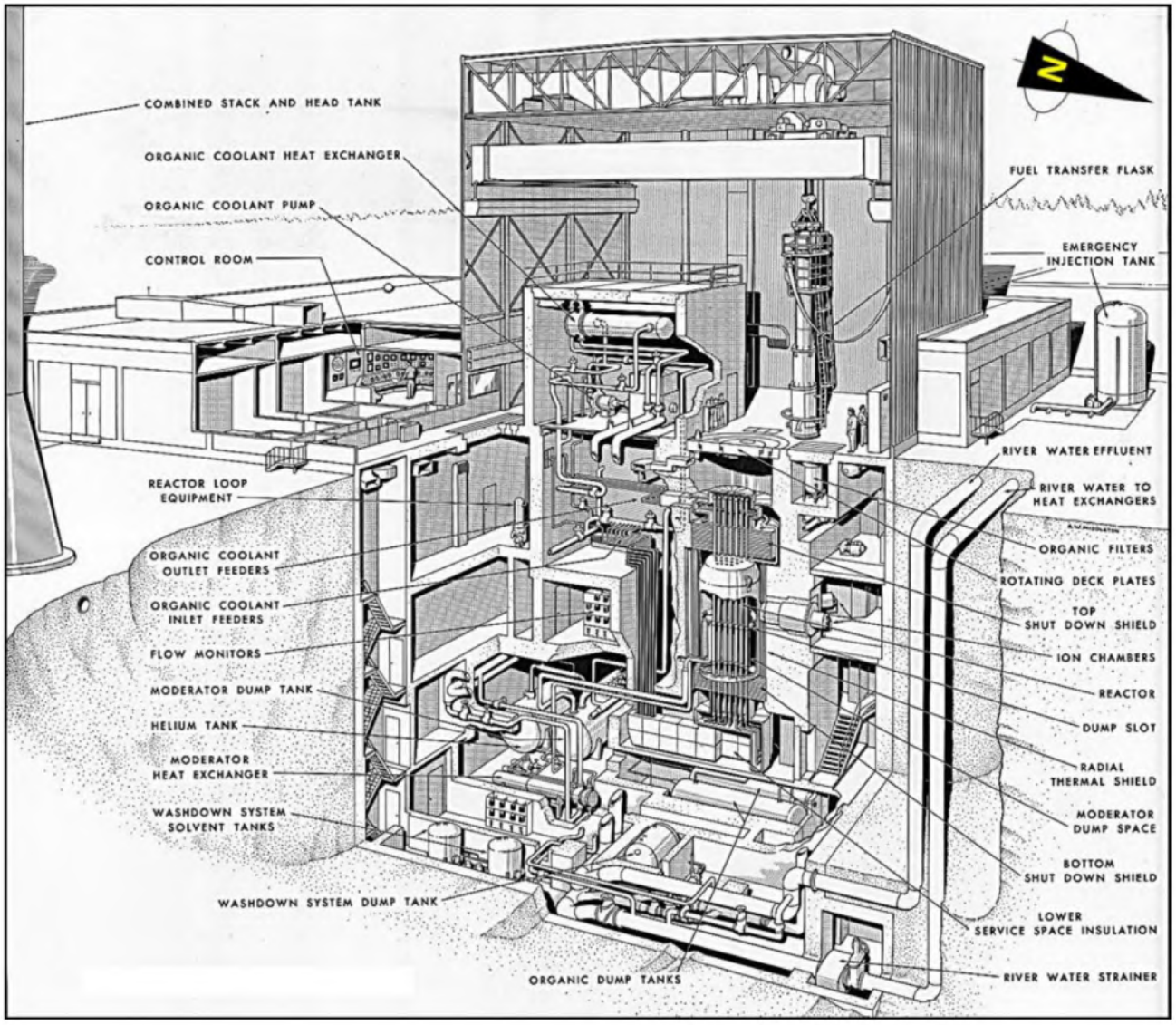

REFERENCE(S)
WR-1 BUILDING: DOCUMENT {WLDP-26400-DDP-001, PAGE 25, REV.3}

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
WR-1 BUILDING

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	--
PREPARED	PR/RRD
REVIEWED	KL
APPROVED	AB

PROJECT NO. 20145046 | CONTROL | REV. 3 | FIGURE **1.1- 2**

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1.2 Project Overview

CNL is proposing an ISD approach to the decommissioning of the WR-1 Building. The ISD system is a permanent, passive decommissioning end-state that uses multiple barriers to contain the waste, providing time for the radioactive materials to decay to safe levels. The below-grade reactor systems, components and structures will be permanently encased in grout. The above-grade structures will be demolished and removed. During decommissioning, consideration will be given to placing some equipment from the primary heat transport system that is currently located on the ground-level reactor floor to a below-grade position for incorporation in the disposal system. A concrete cap and engineered cover will then be constructed over the below-grade structure to resist intrusion and divert precipitation and surficial runoff.

The Project activities assessed in this EIS are limited to ISD of the WR-1 Building. Other decommissioning activities for the WL site, documented in the CSR, have not changed and do not need to be reassessed. Removal of the east annex and service wings of the WR-1 Complex were assessed as part of the CSR and are covered under CNL's existing decommissioning licence for the WL site (Licence No. NRTEDL-W5-8.00/2024). Some activities required prior to ISD, such as isolation of the WR-1 Complex and targeted remediation of hazardous materials, are also covered under CNL's existing decommissioning licence for the WL site.

The decommissioning activities for the WR-1 Building proposed as part of the Project and assessed in this EIS include:

- preparing the building and equipment for ISD;
- establishing temporary and supporting infrastructure;
- grouting of below-grade structures and systems;
- removing above-grade structures and systems, except for the east annex and service wings[1];
- installing a concrete cap and engineered cover over the grouted below-grade structures and systems;
- final site restoration;
- preparation for institutional control; and
- institutional control (includes both passive and active controls).

Details about each of the Project activities and components are provided in Section 3.0 Project Description.

CNL plans to start preparation and implementation of ISD in 2022, which includes grouting of below-grade structures and systems, removal of above-grade WR-1 structures and systems, installation of the concrete cap and engineered cover, and environmental controls and final site restoration (pending approval by the CNSC). The Project site will be turned over for institutional control in 2027. Institutional control includes active controls such as environmental monitoring and site surveillance, as well as passive controls such as access restrictions (e.g., physical barriers/fencing, signage, and land title instruments/deed restrictions). It is recognized that institutional control will continue until the CNSC, or the appropriate authority at the time, agrees it is no longer

[1] The removal of the east annex and service wing is included in CNL's existing decommissioning licence for the WL site, which is documented in the CSR, and is therefore not part of the Project.

needed. This is consistent with similar nuclear decommissioning projects completed by the United States Department of Energy such as:

- Feed Materials Production Center in Ohio;
- Mound Plant in Ohio; and
- Rocky Flats Plant in Colorado.

CNL recommends that institutional control continues for a minimum of 100 years. The 100-year timeframe is not related to the design life of the WRDF barriers. The 100-year active monitoring period was selected to ensure that sufficient opportunity is provided to verify the WRDF is performing as expected. After the institutional control period ends, the post-institutional control period begins and continues indefinitely. The assessment schedule for the proposed decommissioning activities is provided in Table 1.2-1.

Table 1.2-1: WR-1 Decommissioning Project Phases and Schedule

	Description	Planned Schedule
Closure Phase		
1	Preparation for ISD	2022–2025
	WR-1 Deactivation and Segregation Complete	2023
2	Grouting of Below-grade Systems and Structures	2025
	In situ Decommissioning Grouting Complete	January 2025
3	Removal of Above-grade Structures	2024-2025
	WR-1 Building Demolition and Decommissioning Complete	May 2025
4	Installation of Concrete Cap and Engineered Cover	July 2026
5	Final Site Restoration	2026
6	Preparation of Institutional Control	2026
	Site Turnover for Institutional Control and Monitoring	January 2027
Post-closure Phase		
7	Institutional Control	2027–2127 (minimum)
8	Post-Institutional Control	Beyond 2127

Note: Dates are subject to change pending receipt of environmental assessment and licensing approvals.

1.3 Project Location

The WL site is located in southeastern Manitoba, approximately 100 km northeast of Winnipeg (Figure 1.0-1). The WL site occupies 4,375 ha of land that was either privately owned or Crown land before the establishment of Whiteshell Laboratories. Currently, AECL, a federal government Crown corporation, holds the title to the WL site lands. Access to these areas has generally been restricted for security and safety. The WL site is within the boundaries of the Local Government District of Pinawa (Figure 1.0-1). The WL site contains several nuclear facilities, including WR-1, the WMA, and other nuclear and non-nuclear facilities and laboratories. The Winnipeg River passes through the WL site, with a small portion of the WL site located on the west side of the river. The Project is located entirely within the WL site (Figure 1.0-2). The approximate geographic coordinates of the Project are 50°10′ 46″N and 96°03′ 35″W.

The Winnipeg River is the dominant drainage feature in the area. At the WL site, the river is approximately 0.3 km wide, 7 m deep and flows in a northerly direction. Surface water runoff at the WL site drains into the Winnipeg River via natural and engineered drainage features, such as stormwater management system and ditches. The regional surficial geology comprises widespread deposits of till and glacio-fluvial and glaciolacustrine clay and silt materials. In the immediate vicinity of the WL site there are approximately 10 to 20 m of surficial overburden soils overlying Precambrian bedrock. Hydrogeological characterization at the WL main campus has shown overburden thickness in the area is up to 15 m thick. The stratigraphic units in sequence from bedrock upwards are silty sand till, clayey silt till, silty clay and an upper soil complex comprised of laminated clayey silt with minor interbeds of massive silty clay and up to 0.25 m of surface organics. The foundation of the WR-1 Building extends down to the bedrock. Groundwater flow at WR-1 is towards the Winnipeg River.

Terrestrial habitat at the WL site is diverse over short distances. Large tracts of wetland cover the easterly portions of the WL site, with black spruce common. Farther to the west are poorly drained clay plains, forested land including tree species such as ash and poplar, and agricultural areas. Land closer to the Winnipeg River includes gullies and ravines where beaver dams are common.

Nearby communities include the Town of Lac du Bonnet (9 km north of the WL site; population of approximately 1,300); the Local Government District of Pinawa (10 km east of the WL site; population of approximately 1,400); and Seven Sisters Falls (located 3.5 km south of the WL site and part of the rural municipality of Whitemouth; total population of approximately 1,550). The closest permanent residents to the Project reside to the west of the Winnipeg River along Highway 11, approximately 2 km from the WL site.

Aside from the operations and activities undertaken by CNL, other land uses of the WL site are prohibited due to restricted public access. No hunting or fishing is permitted on the WL site. Land use in the region includes forestry, recreation and tourism, hunting, trapping, fishing and agriculture (AECL 2001). Forestry is a strong industry in the region, although little, if any, forestry has occurred in the local area. The WL site is located 7 km northwest of the Whiteshell Provincial Park and 49 km southwest of the Nopiming Provincial Park, both of which are prime outdoor recreation areas in eastern Manitoba. Home and cottage development along the west side of the Winnipeg River suggests that waterways, scenery, trails and wildlife of the region are attracting vacationers and weekend campers. Sport fishing is very popular in the Winnipeg River. Agricultural operations in the region include cereal crop production, hay, flax, canola and alfalfa crops, and dairy and livestock production.

Historic treaties called the Numbered Treaties, which were agreements made between the Government of Canada and Indigenous Nations, cover much of the land in the region and set out continuing treaty rights and benefits. The majority of the WL site is located on Treaty 3 land. A small portion of the WL site that extends west of the

Winnipeg River falls on Treaty 1 land. Communities that are signatories to these Treaties and Treaty 5 have historical and current land use ties with the area. Anishinaabe and Ojibway communities with historical traditional territories in the area, and that have expressed some level of interest in the Project include the Sagkeeng First Nation and Brokenhead First Nations in Treaty 1; Black River and Hollow Water First Nations in Treaty 5; and Wabaseemoong Independent Nations in Treaty 3 (TRCM 2013; Ontario Ministry of Indigenous Affairs 2017). There are no reserve lands located within the WL site.

Indigenous Nations in vicinity to the WL site are described below and additional detail can be found in Section 6.8.1.5.2.2 Traditional Land Use by Indigenous Peoples.

- **Sagkeeng First Nation**, an Anishinaabe community, is the closest Indigenous Nation to the WL site. Sagkeeng reserve land is located 52 km directly downriver from the WL site and includes land parcels on either side of the Winnipeg River.
- **Brokenhead Ojibway Nation** is located near the southern basin of Lake Winnipeg, occupies three reserves: 44 km northwest, 55 km northwest and 73 km southwest of the WL site. Brokenhead is primarily surrounded by the Rural Municipality of St. Clements.
- **Black River First Nation** is an Ojibway community located along the eastern shoreline of Lake Winnipeg at the confluence of the Black and O'Hanly Rivers. The Black River reserve land is 75 km north of the WL site.
- **Hollow Water First Nation**, an Anishinaabe community, is located along the eastern shore of Lake Winnipeg approximately 113 km north of the WL site.
- **Wabaseemoong Independent Nations** is composed of four communities: Whitedog First Nation, serving as the main reserve parcel; One Man Lake; Swan Lake; and Agency 30 (shared with 12 other First Nations). Occupy four reserves: 80 km east, 85 km east, 95 km east and 140 km southeast of the WL site.

The Project is also located in the homeland of the Red River Métis, as represented by the Manitoba Métis Federation. Statistics Canada identified Métis residents in many communities in proximity to the Project. Métis communities that historically emerged in the region include:

- **Bas de la Rivière –**. Situated on both shores of the Winnipeg River and established in 1732, the community served as a wintering post and trading depot. Fishing and agriculture were particularly important in the area. Originally a North West Company outpost, following amalgamation with the Hudson's Bay Company in 1821, the post lost its importance as a provisioning and transportation hub. It became known as Fort Alexander and then eventually Pine Falls.
- **Berens River –** An initial trading post was built at the mouth of the river in 1814 and was a thriving Métis community until fishing was banned on Lake Winnipeg in 1970 as a result of mercury contamination.
- **Fort Alexander –** Built by the Hudson's Bay Company on the Winnipeg River to counter the North West Company's Fort Bas de la Rivière, this post also had ties to the Métis in the area (Barkwell 2016).

The Indigenous peoples within the area have resided at or near their respective reserve parcels since time immemorial (Sagkeeng Anicinabe n.d.). In the nineteenth century, Indigenous peoples living near Fort Alexander, present day Sagkeeng, were nomadic and would make frequent trips north to the Hudson's Bay post to trade and obtain food supplies (Sagkeeng First Nation 2000). The Winnipeg River has historically provided a network of travel routes for local communities (Petch 2005). Present day traditional land and resource use activities, including

trapping and wild rice harvesting, continue to supplement the diet and income of local Indigenous peoples in the region. Wild rice harvesting was originally for domestic purposes, but eventually became a commercial economy (Manitoba Hydro and Golder Associates Ltd. 2012). The following provides a summary of traditional land and resource use activities for each Indigenous Nation, with additional detail found in Section 6.8.1.5.2.2 Traditional Land Use by Indigenous Peoples.

Sagkeeng First Nation reserve is located where the Winnipeg River empties into Lake Winnipeg and their traditional territory encompasses land within Treaty 1 along with land north and west of the Winnipeg River, falling within four Treaty areas (Sagkeeng First Nation 2015): Treaty 1 (1871), Treaty 2 (1871), Treaty 3 (1873) and Treaty 5 (1875). The land and waterways have historically been an important part of the economic well-being and transportation system for the Sagkeeng First Nation. In early spring and late fall, fishing was preferred near Catfish Creek and at Point au Mitasse on Lake Winnipeg (Sagkeeng First Nation 2000). Travel in the fall was typically to the Lac du Bonnet area, where the Pinawa Channel meets the Winnipeg River, to harvest wild rice (Sagkeeng First Nation 2000). Family units had preferred hunting areas which included areas close to Fort Alexander and spanned north to Black River First Nation and over 200 km southeast to Dalles and Big Island First Nations in Ontario (Sagkeeng First Nation 2000). Previous studies have documented that Sagkeeng First Nation participates in traditional activities of harvesting wild rice, subsistence fishing (sturgeon), gathering plants and medicines and berry picking (AECL 2001). Sagkeeng First Nation currently uses the Winnipeg River as its source for water supply to the community (J.R. Cousin Consultants Ltd. n.d.).

Brokenhead Ojibway Nation's resource harvesters currently use traditional areas north of the Manigotagan River and as far south as the Rural Municipality of Brokenhead (Brokenhead Ojibway Nation 2015). This traditional use area spans Treaties 1, 3 and 5 (TRCM 2013). Brokenhead Ojibway Nation resource harvesting activities occur within wildlife management areas, parks and reserve boundaries. Resource harvesting sites within this area include locations along the Winnipeg and Brokenhead Rivers (Brokenhead Ojibway Nation 2015). Current resource harvesting activities include, but are not limited to, moose hunting and trapping for muskrat and beaver (Brokenhead Ojibway Nation 2015).

The Black River First Nation's traditional lands are primarily located south of the Manigotagan River, west of the Manitoba-Ontario border, and north of the Winnipeg River in Treaties 3 and 5 (Handkamer 2016; TRCM 2013). Resource use activities include hunting, fish, trapping, wild rice harvesting and plant collection both far afield and near the community (Black River First Nation 2015). Members of Black River First Nation have historically used the Black and Winnipeg rivers most frequently for travel (Handkamer 2016). The Black River served as an access route for resource harvesting in the east, specifically wild rice harvesting and hunting near Nopiming Provincial Park (Handkamer 2016).

Hollow Water First Nation's traditional lands encompass an area south of the Bloodvein River, west of the Manitoba-Ontario border, and north of the Manigotagan River in Treaties 3 and 5 (TRCM 2013). Historically, Hollow Water First Nation's primary food source and economy was based on wild rice harvesting on the Wanipigow and Rice rivers along with Clangula Lake and bays on Lake Winnipeg (Thompson and Bushie 2015). The woodlands were used for hunting and trapping in the winter, fishing along the shores of Lake Winnipeg was popular in the spring, and wild rice was harvested on the shallow rivers and lakes in the fall (Reder 2013). Hollow Water First Nation community members currently maintain the historical tradition of gathering on Black Island to harvest blueberries. Economic activities for the community currently include fishing, hunting, trapping and wild rice harvesting. Fishing is considered the most important of these activities as a majority of community residents are directly employed in the Lake Winnipeg fishery (Manitoba Eco-Network 2010).

Wabaseemoong Independent Nations' traditional land use area is located in Treaty 3 and adjacent to the Manitoba/Ontario border, north of the Town of Kenora (WIN n.d.). The Wabaseemoong Independent Nations have historically used and currently utilize the English and Winnipeg River systems for traditional land and resource use activities (Energy East Project 2016). Water routes from these two systems have provided resource use access to hundreds of kilometres in all directions (WIN n.d.). Previous discussions with Wabaseemoong Independent Nations, have confirmed interest in the area where traditional land and resource use activities regularly occur (AECL 2001).

The Red River Métis is widely dispersed throughout the province and highly mobile in regard to geographic extent of traditional resource use (Barkwell 2016). In September 2012, based on presently available historical research, the Manitoba Government implemented a harvesting agreement with the Manitoba Métis Federation that recognizes that the Red River Métis possess collectively-held Métis Harvesting Rights, within the meaning of Section 35 of the *Constitution Act, 1982,* throughout a territory of approximately 750,000 km^2 in size (R v. Powley 2003; Provincial Court of Manitoba 2008; Government of Manitoba et al. 2012). Recognized Red River Métis Natural Resource Harvesting Areas 36 and Game Hunting Area 26, presented in Figure 6.8.2-1, are situated in the vicinity of the WL site (Manitoba Sustainable Development n.d.). Red River Métis resource harvesters may harvest throughout these areas on "all unoccupied Crown lands in Manitoba and occupied provincial Crown lands, including provincial parks, wherever First Nation Members are allowed to harvest; and on any privately owned lands in Manitoba on which that Red River Métis Harvester has been given permission by the owner or occupant, or Indian Reserve lands with permission of Band Council" (MMF 2013).

The Red River Métis traditional land and resource use in the region generally consists of hunting, trapping and fishing, as well as harvesting of plants. Plant harvesting has been undertaken for food, crafts and medicines and has included birch, cedar, dandelion, milkweed, berries, wood products, roots, nuts and mushrooms. These activities were typically undertaken in the summer months and are known to occur in areas southwest of the Project. During the public and Indigenous engagement process, the Manitoba Métis Federation noted that its citizens' place of residence did not always correlate with their resource use areas, as the population is mobile and land use tends to be associated with where an individual learned to harvest. As such, Manitoba Métis Federation citizens often travel to other locations across the province when undertaking harvesting activities, which reflects the location in which they learned (e.g., where their grandfather taught them).

With respect to hunting, the Red River Métis are known to have hunted and currently hunt deer across much of southern Manitoba, which has been documented south of the WL site and east to the Ontario border. Other game known to be harvested include grouse, partridge, ptarmigan, waterfowl and rabbit. The Red River Métis trapping activities, most of which are undertaken for commercial purposes, have focused on beaver, coyote, fisher, fox, lynx, marten, mink, muskrat, otter, rabbit, raccoon, squirrel, weasel, wolf and wolverine. Moose, white-tailed deer and elk are also important game species for the Red River Métis resource harvesters (Manitoba Hydro 2016).

1.4 Proponent

AECL, a federal Crown corporation, is responsible for its radioactive waste liabilities, including the waste at the WL site. AECL has contracted CNL to manage and operate its sites on its behalf, including completing the decommissioning of the WL site. As such, CNL is the proponent for the Project.

1.4.1 Corporate History

AECL has a core mandate to enable nuclear science and technology and manage Canada's radioactive waste and decommissioning responsibilities. It fulfils this mandate through a contractual arrangement with CNL for the management and operation of AECL's sites, facilities and assets and the performance of AECL's waste and decommissioning responsibilities, under a Government-owned, Contractor-operated model.

CNL is Canada's leading nuclear science and technology organization and a world leader in developing innovative applications from nuclear technology. Services offered through CNL include research and development, design and engineering to specialized technology, waste management and site decommissioning. CNL is committed to ensuring that Canadians receive energy, health and environmental benefits from nuclear science and technology with confidence that nuclear safety and security are assured. CNL focuses on completing its work activities safely, and meeting the commitments expected of it by its regulators, customers, stakeholders, Indigenous peoples, and the public.

1.4.2 Management Structure

CNL is led by an Executive Team and a Board of Directors. The President and Chief Executive Officer, along with Vice Presidents, are responsible for all aspects of the business. An organizational chart outlining CNL's internal structure relevant to the Project is provided in Figure 1.4-1. A full listing of CNL's Board of Directors and Executive Team can be found online at www.cnl.ca. The following are key roles related to the execution of the Project.

- The CNL President and Chief Executive Officer has overall responsibility for CNL's management of legacy waste at the WL site.
- The Vice President Environmental Remediation Management has overall responsibility for the development of the Project including design, regulatory approvals, and execution. This also includes ensuring the safe conduct of licensed activities associated with the facilities and radioisotope laboratories at the WL site.
- The WL General Manager is accountable to the Vice President Environmental Remediation Management and is responsible for leading and managing the Project and the associated operational activities of the WL site and facilities safely, responsibly and effectively. The WL General Manager is the General Manager of the WL Closure Project and the holder of the WL site Licence (Licence No. NRTEDL-W5-8.00/2024).
- The Head of Decommissioning and Waste Management has overall responsibility for ensuring decommissioning and waste management activities are planned and performed according to the controls and requirements of the WL Decommissioning Quality Assurance Plan. Implementation and maintenance of the WL Decommissioning Quality Assurance Plan is the responsibility of the WL Site Head.

The Director of Reactor Decommissioning has overall responsibility for the safe, cost-effective delivery of projects related to the Project, whilst ensuring program, regulatory and compliance requirements are met. The Director of Reactor Decommissioning is responsible for executing the decommissioning activities at the WL site.

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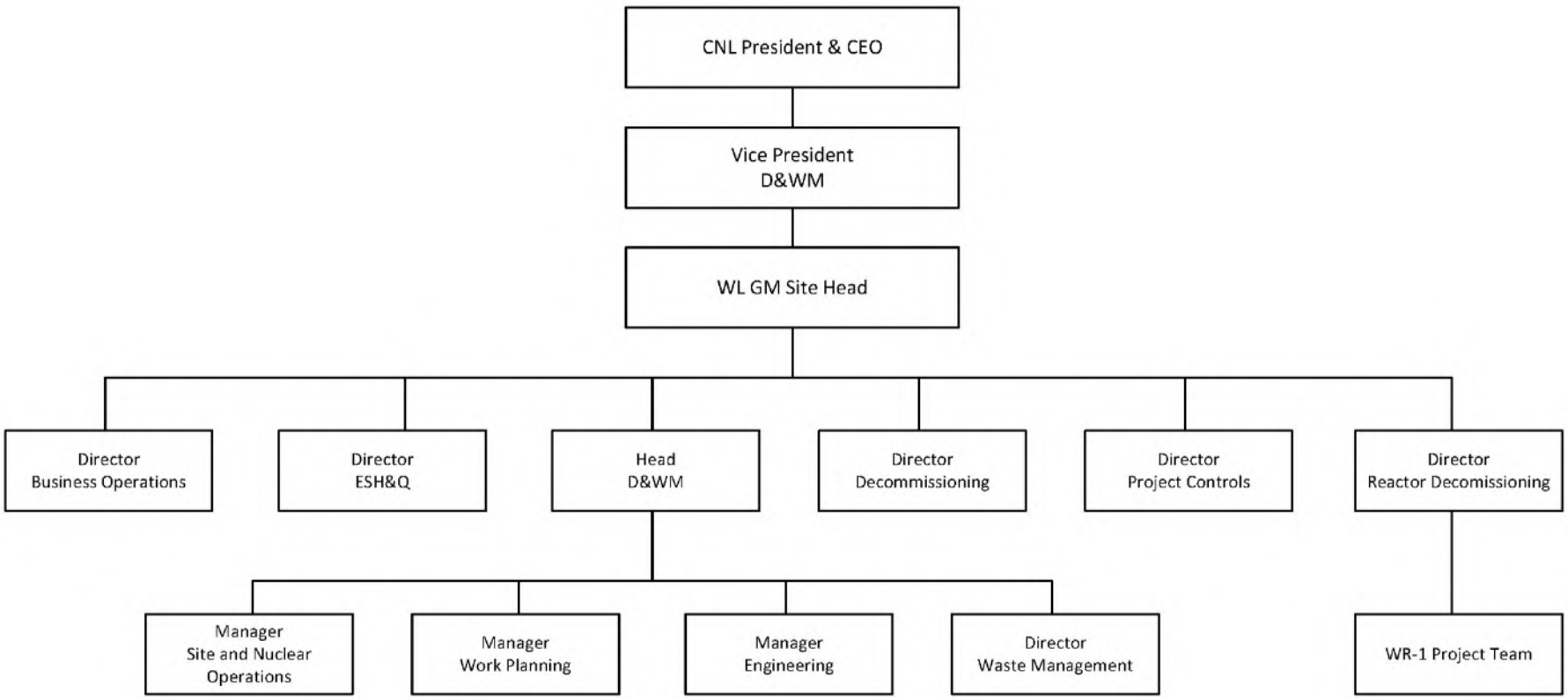

NOTE(S)

REFERENCE(S)

CNL. 2017. ENVIRONMENTAL POLICY. 900-509200-POL-001. REVISION 0. JUNE 2017.

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CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

CONSULTANT
WSP GOLDER

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TITLE
ORGANIZATIONAL CHART FOR CANADIAN NUCLEAR LABORATORIES AND MANAGEMENT OF THE PROJECT

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1.4.3 Key Contact Information

The primary contact for the purposes of the EIS for the Project is:

Mr. Pat Quinn
Director, Corporate Communications
Canadian Nuclear Laboratories
Chalk River Laboratories
Chalk River, Ontario K0J 1J0
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Email: pat.quinn@cnl.ca

1.5 Environment Policy

For CNL, business and environmental performance go hand in hand. It is important that CNL leads by example in terms of environmental performance. For this reason, CNL has an *Environment Policy* (CNL 2020a) that considers the protection of the environment as an integral component of their decision-making in all phases of its business activities, including product development, project planning, project implementation, operations and decommissioning. The Environmental Policy outlines the strategic environmental objectives for CNL sites, including the WL site. CNL also focuses its environmental efforts on limiting nuclear legacy obligations for future generations. The *Environment Policy* (CNL 2020a) applies to all aspects of CNL's activities and is outlined below:

- to practice responsible environmental management;
- to be committed to pollution prevention;
- to set environmental objectives and targets to support continual improvement of CNL's environmental performance;
- to set sustainability objectives and targets for energy efficiency, clean energy utilization, waste management and conservation of resources to support continual improvement of CNL performance;
- to comply with environmental laws, requirements and recognized standards and guidelines applicable to CNL's activities;
- to review the impacts of CNL activities, facilities, projects, services and products on the environment;
- to seek to develop and improve technologies to advance environmental protection and clean air solutions; and
- to promote public and employee awareness of this policy and CNL's environmental performance.

1.5.1 Health, Safety, Security, Environment and Quality Programs

To demonstrate compliance with the *Environment Policy* (CNL 2020a) and other regulatory commitments related to health, safety and security, CNL has developed a number of programs outlining corporate expectations:

- Occupational Safety and Health Program;
- Radiation Protection Program;
- Environmental Protection Program;
- Waste Management Program;
- Emergency Preparedness Program;
- Human Performance;
- Nuclear Criticality Safety Program;
- Fire Protection Program;
- Security Program;
- Nuclear Materials and Safeguards Management Program;
- Quality Assurance Program; and

- Whiteshell Laboratories Environmental Assessment Follow-up Program.

The Environmental Protection Program, which is most relevant for this EIS, is described briefly below.

1.5.2 Environmental Protection Program

Activities at the WL site have been International Organization for Standardization (ISO) 14001 certified since 2010; during this time, there has been a steady evolution of CNL's Environmental Protection Program (CNL 2021). A considerable level of effort and vigilance is required to establish, maintain and improve the Environmental Protection Program over time.

CNL's Environmental Protection Program establishes requirements, processes and structure to comply with applicable legal environmental requirements and other requirements CNL has adopted as a matter of policy. The details of CNL's Environmental Protection Program are captured in CNL's document entitled *Environmental Protection* (CNL 2021). CNL's Environmental Protection Program implements CNL's *Environment Policy* (CNL 2020a) described in Section 1.5 (Environment Policy) and provides compliance with legal and other environmental obligations applicable at CNL operated sites in Canada. A comprehensive list of the documentation associated with the Environmental Protection Program is provided in CNL's *Environmental Protection Governing Document Index* (CNL 2020b). Some of the key requirements of the Environmental Protection Program are as follows:

- Identify and evaluate the effects of the environmental aspects associated with CNL's activities.
- Identify and provide access to applicable legal and other environmental requirements and obligations.
- Monitor and measure to verify environmental performance and compliance.
- Manage cultural resources.
- Manage land and habitat.
- Maintain appropriate level of environmental training and awareness.
- Establish and maintain emergency preparedness and response procedures.
- Implement "Green Initiatives" to improve waste management, energy and vehicle usage.

1.6 Regulatory Framework

1.6.1 Federal Review Process

On August 28, 2019, the *Impact Assessment Act* (IAA) came into force, repealing the CEAA 2012. The IAA contains transitional provisions for environmental assessments of designated projects commenced under CEAA 2012 and for which the CNSC is the Responsible Authority. The CNSC has informed CNL that the environmental assessment for the ISD of WR-1 at WL will continue under CEAA 2012. As per the transition provision described in subsection 182 of the IAA, "Any environmental assessment of a designated project by the Canadian Nuclear Safety Commission or the National Energy Board commenced under the 2012 Act, in respect of which a decision statement has not been issued under section 54 of the 2012 Act before the day on which this Act comes into force, is continued under the 2012 Act as if that Act had not been repealed." As outlined in subsection 182, given that this environmental assessment process was commenced under CEAA 2012 and a decision statement has not yet been issued, it will continue to be completed under its current process.

The federal environmental assessment requirements are detailed within CEAA 2012. Designated projects are defined under the Regulations Designating Physical Activities for CEAA 2012 and identify the CNSC as the Responsible Authority for projects that are regulated under the NSCA. As such, the CNSC is responsible for the conduct of the environmental assessment and ensuring that the requirements of CEAA 2012 are met. Following submission of the 2016 Project Description document titled *Environmental Assessment (and/or Environmental Effects Review), In situ Decommissioning of WR-1 Reactor at the Whiteshell Laboratories Site* (CNL 2016), the CNSC issued a *Record of Decision in the Matter of Canadian Nuclear Laboratories* (CNSC 2017) and determined that the Project requires a federal environmental assessment pursuant to CEAA 2012.

As noted in the above sections, CNL holds an existing decommissioning licence for the WL site (Licence No. NRTEDL-W5-8.00/2024). Other permits, licences and authorizations that may be required for the Project are listed below.

- Petroleum storage tank permit(s) from Environment and Climate Change Canada may be required, depending on the size of fuel tanks installed on the site.
- Hazardous waste generator registration will be maintained through Manitoba Sustainable Development (now Manitoba Environment, Climate and Parks) and in compliance with Manitoba's *Dangerous Goods Handling and Transportation Act* (C.C.S.M. c.D12).

The Project is located on federal lands and is regulated by the CNSC. Provincial permits, licences and other authorizations required for the management of hazardous non-radiological wastes will be adhered to. For example, the WL site is registered with the Manitoba Government as a Waste Generator and is required to abide by *The Dangerous Goods Handling and Transportation Act*, Continuing Consolidation of the Statutes of Manitoba 1987, c.D12 and the regulations under the Act. This includes the management of hazardous non-radiological waste under the Hazardous Waste Regulation (195/2015).

Under Section 15 of CEAA 2012, the CNSC is the Responsible Authority for the Project. As documented in the Record of Decision (CNSC 2017), CNSC staff have notified all relevant federal authorities, as well as all relevant provincial authorities in Manitoba with respect to the Project. All notified federal authorities indicated that they possess specialist knowledge with respect to the Project and expertise that could be drawn upon during the environmental assessment process. Federal authorities participating in the environmental assessment process include Environment and Climate Change Canada, Health Canada and Natural Resources Canada. The Manitoba Métis Federation, Sagkeeng First Nation, Black River First Nation, and Hollow Water First Nation joined the CNSC Federal and Provincial Review Team. In addition, the province of Manitoba is participating as a member of the review team during the environmental assessment process for the Project.

1.6.2 Relevant Standards, Codes and Guidelines

It is critical that the environmental assessment be conducted in accordance with relevant standards and codes, while also taking into consideration appropriate guidelines. The environmental assessment has been completed in a manner consistent with direction in the following documents.

Canadian Environmental Assessment Act, 2012

- *Canadian Environmental Assessment Act, 2012*. S.C. 2012, c. 19, s. 52
- CNSC *Generic Guidelines for the Preparation of an Environmental Impact Statement pursuant to the Canadian Environmental Assessment Act, 2012* (Generic EIS Guidelines; CNSC 2016).

- Operational Policy Statement: Assessing Cumulative Environmental Effects under the *Canadian Environmental Assessment Act, 2012* (The Agency 2015a).
- Operational Policy Statement: Addressing the "Purpose of" and "Alternative Means" under the *Canadian Environmental Assessment Act, 2012* (The Agency 2015b).
- Operational Policy Statement: Determining Whether a Designated Project is Likely to Cause Significant Adverse Environmental Effects under the *Canadian Environmental Assessment Act, 2012* (The Agency 2015c).
- Reference Guide: Considering Aboriginal Traditional Knowledge in Environmental Assessments Conducted Under the *Canadian Environmental Assessment Act, 2012* (The Agency 2015d).
- Technical Guidance for Assessing Physical and Cultural Heritage or any Structure, Site or Thing that is of Historical, Archeological, Paleontological or Architectural Significance under the *Canadian Environmental Assessment Act, 2012* (The Agency 2015e).
- Assessing Cumulative Environmental Effects under the *Canadian Environmental Assessment Act, 2012. Interim Technical Guidance* (The Agency 2018).
- Determining Whether a Designated Project is Likely to Cause Significant Adverse Environmental Effects under the *Canadian Environmental Assessment Act, 2012. Interim Technical Guidance* (The Agency 2018).

Canadian Nuclear Safety Acts and Regulations

- *Nuclear Safety and Control Act*. S.C. 1997, c. 9.
- CNSC *REGDOC-2.9.1, Environmental Principles, Assessments and Protection Measures* (CNSC 2020).
- CNSC *REGDOC-3.2.1, Public Information and Disclosure* (CNSC 2018a).
- CNSC *REGDOC-3.2.2, Indigenous Engagement* (CNSC 2019).
- CNSC *REGDOC-2.4.1, Deterministic Safety Analysis* (CNSC 2014).
- CNSC *REGDOC-2.11.1, Waste Management, Volume III: Assessing the Long-Term Safety of Radioactive Waste Management* (CNSC 2018b).
- CNSC *REGDOC-2.11.2, Decommissioning* (CNSC 2021).

Canadian Standards Association (CSA)

- *CSA N286-12: Management System Requirements for Nuclear Facilities* (CSA Group 2012a).
- *CSA N288.1-14 Guidelines for Calculating Derived Release Limits for Radioactive Material in Airborne and Liquid Effluents for Normal Operation of Nuclear Facilities* (CSA Group 2014a).
- *CSA N288.4-10 Environmental Monitoring Programs at Class 1 Nuclear Facilities and Uranium Mines and Mills* (CSA Group 2010).
- *CSA N288.5-11 Effluent Monitoring Programs at Class 1 Nuclear Facilities and Uranium Mines and Mills* (CSA Group 2011).
- *CSA N288.6-12 Environmental Risk Assessment at Class 1 Nuclear Facilities and Uranium mines and Mills*. (CSA Group 2012b).

- *CSA N288.7-15 Groundwater Protection Programs at Class 1 Nuclear Facilities and Uranium Mines and Mills* (CSA Group 2015).
- *CSA N292.3-14 Management of Low- and Intermediate-Level Radioactive Waste* (CSA Group 2014b).

Discipline-specific standards, codes and guidelines used in the assessment of effects are identified as appropriate within each discipline section (Sections 6.2 Atmospheric Environment to 6.9 Socio-economic Environment).

To demonstrate compliance with the Generic EIS Guidelines (CNSC 2016) and REGDOC-2.9.1 (CNSC 2020) and to facilitate access to information within the EIS document, a concordance table (or cross-referencing table) has been prepared (Appendix 1.0-1) that lists the requirements detailed in the Generic EIS Guidelines and REGDOC-2.9.1, and the location for the corresponding information provided within the EIS.

1.7 Documentation Framework

1.7.1 Licensing Documentation Interrelations

CNL is implementing the Project on a high priority basis and has engaged its own project resources and those of engineering and environmental consulting firms. Several related activities, including analyses and report preparation, are being performed in parallel and involve close interaction between and among these resources.

Four documents, in particular, are closely related and contain a degree of overlap in their supporting analyses and content: the EIS, the Decommissioning Safety Assessment Report (DSAR), the Safety Case Report, and the Detailed Decommissioning Plan (DDP). In addition, technical support documents and supplemental supporting documents present information on the existing environment, engagement activities and description of Project components, as well as assessments of the potential effects related to the Project. Much of the information in this EIS has been extracted from the technical support documents and supplemental supporting documents.

An overview of the four key documents is provided below and the interrelations between these reports, technical support documents and supplemental supporting documents are described in Appendix 1.0-2 and illustrated in Figure 1.7.1-1.

- **Environmental Impact Statement –** The purpose of the EIS is to document the assessment and determination of the potential effects of the Project on the environment, including the atmospheric, geological, hydrogeological, surface water, aquatic and terrestrial environments, as well as studying the effects on land and resource use and socio-economic environment. The EIS identifies environmental design features and mitigation to address potential effects. The information and analysis conducted and submitted in the EIS represents the basis against which the environmental, social and human health effects of the Project are evaluated by the regulatory authorities. The EIS for the Project is prepared in parallel with the DSAR, Safety Case Report and DDP and relies on the information available within various technical supporting documents and supplemental supporting documents. The EIS covers the entire lifecycle of the Project from closure to beyond the end of institutional control.
- **Decommissioning Safety Assessment Report –** The DSAR provides the rationale for the ISD strategy, evaluates and provides evidence that the overall performance of the decommissioned WR-1 Building is safe, and identifies institutional controls that will be needed in the long-term to demonstrate protection of human health and the environment. The DSAR assesses safety for both the closure and post-closure periods of the Project lifecycle, including the period beyond institutional control. The DSAR analyzes the normal evolution

of the facility through its lifecycle, as well as disruptive events, such as accidents and extreme weather conditions.

- **Safety Case Report –** The Safety Case Report demonstrates that ISD, post-closure activities and long-term disposal of WR-1 can be safety undertaken. This document provides the safety case (i.e., the argument and provision of evidence to demonstrate that the risk of a contaminant release has been reduced to a level that is as low as reasonably achievable [ALARA]) for the ISD approach and mapping of design and safety documents to the regulatory requirements to demonstrate that the suite of project documents meet all elements of the safety case. This document describes the risks, in terms of hazards presented by the ISD of WR-1, including potential faults and accidents, and those reasonably achievable measures that need to be implemented to prevent or minimize harm to the workers, public and environment. The Safety Case Report is supported by the EIS and DSAR.
- **Detailed Decommissioning Plan –** The DDP describes plans for the decommissioning of WR-1. It is a document that describes the work to be done, lays out the high-level work breakdown structure and provides a high-level hazard assessment. The DDP describes the WR-1 Building, the operational status, and the proposed final end-state for the site. Other key topics such as hazards, regulatory and environmental assessment considerations, waste management plans, program management and quality assurance are also covered in general terms in the DDP.

TECHNICAL SUPPORTING DOCUMENTS / SUPPLEMENTAL SUPPORTING DOCUMENTS

- Hydrogeological Study Report
- Geosynthesis Report
- Reactor Characterization Report
- Building Condition Assessment Report
- Climate Change Assessment
- Environmental Risk Assessment
- Environmental Assessment Follow-up Program
- Groundwater Flow and Solute Transport Modelling Report
- Indigenous Engagement Report
- Stakeholder Engagement Report
- Grout Formulation Report

TERTIARY SUPPORTING DOCUMENTS

DETAILED DECOMMISSIONING PLAN

The DDP describes plans for the decommissioning of the WR-1 Building. It is a bounding scope document that describes the work to be done, lays out the high-level work breakdown structure and provides a high-level hazard assessment.

DECOMMISSIONING SAFETY ASSESSMENT REPORT

The DSAR provides the rationale for the in situ disposal strategy, evaluates and provides evidence that the in situ disposal strategy is safe, and identifies long-term institutional controls to demonstrate protection of human health and the environment.

ENVIRONMENTAL IMPACT STATEMENT

The information presented and the analysis carried out in the EIS are the basis against which the environmental, social and human health effects of the project are evaluated by the regulatory authorities.

SAFETY CASE REPORT

The Safety Case demonstrates that in situ disposal, post-closure activities, and long-term disposal of the WR-1 Building can be safely undertaken.

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1.7.2 Structure of the Environmental Impact Statement

The EIS has been prepared following the CNSC Generic EIS Guidelines (CNSC 2016). The EIS is organized into the sections described below and shown in Figure 1.7.2-1.

- **Executive Summary –** contains a description of all key components of the Project and related activities, a summary of all engagement activities, an overview of the results of the environmental assessment and a summary of the conclusions about the residual environmental effects of the Project after considering mitigation and the significance of those effects.
- **Section 1.0 Introduction –** includes the Project context and an overview of the Project and its location, provides an introduction to CNL, outlines the regulatory framework the Project will follow and outlines the organization of the document.
- **Section 2.0 Purpose of the Project and Alternative Means for Carrying out the Project –** identifies the objectives of the Project, the problems or opportunities that the Project is intended to satisfy and the rationale for proceeding with the development. This section also considers the effects of alternative means of carrying out the Project, identifies the economically and technically feasible alternatives and includes environmental and social considerations that were evaluated as means of implementing the Project.
- **Section 3.0 Project Description –** provides a description of all phases of the Project in sufficient detail to allow CNL to predict potential adverse environmental, economic, social and health effects. A timeline for all phases of the Project is provided, as well as a discussion of components and activities, including infrastructure that will be developed as part of the Project.
- **Section 4.0 Indigenous Engagement –** summarizes CNL's engagement activities with Indigenous peoples, including documentation of meetings, discussion topics and outcomes and relevant agreements that were developed.
- **Section 5.0 Public Engagement –** summarizes CNL's engagement activities with the public and regulators, including documentation of meetings, discussion topics and outcomes and relevant agreements that were developed.
- **Section 6.0 Environmental Effects –** outlines the environmental assessment approach, selection of valued components (VCs) and discipline-specific definition of assessment boundaries; describes the Project setting; and presents the results of the environmental assessment (i.e., the predicted residual effects) and determination of significance of environmental, economic, social, heritage and health effects of the Project in each of the following sections:
  - Section 6.1 Environmental Assessment Approach;
  - Section 6.2 Atmospheric Environment;
  - Section 6.3 Geological and Hydrogeological Environment;
  - Section 6.4 Surface Water Environment;
  - Section 6.5 Aquatic Environment;
  - Section 6.6 Terrestrial Environment;
  - Section 6.7 Human and Ecological Health;

- Section 6.8 Land and Resource Use; and
- Section 6.9 Socio-economic Environment.

- **Section 7.0 Malfunctions and Accidents –** presents a description of potential credible malfunctions and accidents that could be associated with the Project, the conditions under which they could occur, and proposed mitigations and contingency plans.
- **Section 8.0 Summary of Cumulative Effects –** contains a summary of residual cumulative environmental, economic, social and health effects predicted to occur as a result of the Project.
- **Section 9.0 Summary of Significance of Residual Effects –** contains an overview of how significance was determined, a summary of the evaluation of significance for the residual environmental, economic, social and health effects predicted to occur as a result of the Project, and a conclusion about whether the residual effect of the Project on each VC was determined to be significant.
- **Section 10.0 Assessment of Effects of the Environment on the Project –** contains the assessment of effects of the environment on the Project including the likelihood and severity of the changes or effects and mitigation planned to avoid or limit the changes or effects. The assessment also includes consideration of effects from climate change.
- **Section 11.0 Summary of Monitoring and Follow-up Programs –** presents the reporting structure and timelines for the various management plans, continuing or follow-up monitoring plans and commitments made for the Project.
- **Section 12.0 Conclusions –** includes a synthesis of the effects assessment, including a summary of residual environmental effects predicted as result of the Project, the determination of significance for the residual effects, the proposed monitoring, and an overall conclusion for the EIS.
- **Section 13.0 References –** includes the references cited throughout the EIS (not illustrated in Figure 1.7.2-1).
- **Section 14.0 Glossary, Abbreviations and Units –** includes a glossary of terms used and list of the abbreviations and units cited throughout the EIS (not illustrated in Figure 1.7.2-1).

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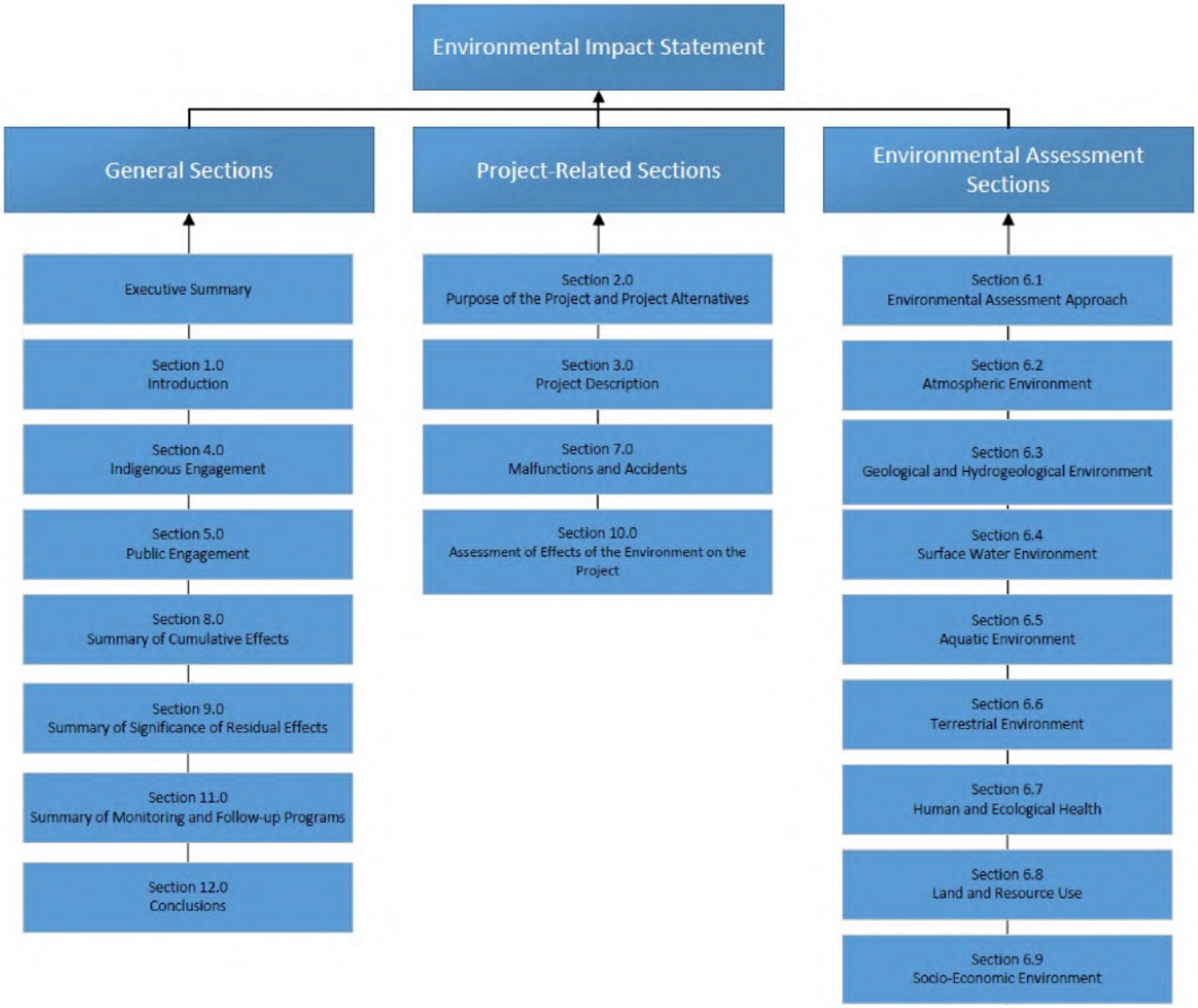

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CONSULTANT
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PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
ENVIRONMENTAL IMPACT STATEMENT STRUCTURE

PROJECT NO.	CONTROL	REV.	FIGURE
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2.0 PURPOSE OF THE PROJECT AND ALTERNATIVES TO THE PROJECT

2.1 Introduction

The Whiteshell Reactor 1 (WR-1) was permanently shut down in 1985. The first stage of decommissioning of WR-1 included the removal of easily mobilized radioactive material (e.g., fuel and fluids) and decontamination of the main floor (600 level) and first sublevel (500 level) space. All irradiated fuel was removed from the facility and transferred to dry storage at the Concrete Canister Storage Facility adjacent to the Whiteshell Laboratories (WL) Waste Management Area (WMA). Bulk organic coolant was also removed from the reactor cooling circuits and transferred to the WL WMA for incineration. Reactor control systems were isolated and all building service systems were maintained in an operating mode. This initial decommissioning work prepared WR-1 for a storage with surveillance period and substantially decreased potential hazards from the facility. Many of the remaining systems for WR-1 are permanently shut down, although they remain largely intact. All of the required service systems remain operational to maintain WR-1 in a storage with surveillance state.

Canadian Nuclear Laboratories (CNL) is proposing an in situ disposal (ISD) approach to the In Situ Decommission of WR-1 at the Whiteshell Laboratories Site (the Project). The intent of this section is to provide an overview of CNL's overall waste disposal strategy, describe the purpose of the Project as it relates to the overall strategy, provide a list of design principles that the preferred alternative must meet, and present alternative means of carrying out the proposed Project.

2.2 CNL's Integrated Waste Strategy

In Canada, nuclear waste producers and owners are responsible for the funding, organization, management and operation of disposal facilities required for their wastes. CNL has developed an Integrated Waste Strategy that concisely details pathways for all CNL waste streams from generation to final disposition. The Integrated Waste Strategy is based on CNL's waste inventory and forecast data. The strategy is founded on the fundamental principles of waste avoidance, minimization and re-use. It enables the assessment of the quantities and types of waste that CNL manages (e.g., from clean waste to radiological waste). The ISD of the WR-1 meets one of the CNL Integrated Waste Strategy objectives by providing a disposal route for the WR-1 components and systems.

2.3 Purpose of the Project

The Government of Canada, through Atomic Energy of Canada Limited (AECL), is responsible for Canada's radioactive waste liabilities. AECL's objective is to reduce risks and costs for Canada in a safe manner, consistent with international best practices (IAEA 2004, 2006a). AECL has contracted CNL to decommission the WL site and reduce Canada's waste liabilities. This work will ensure the long-term safety and security of the public and the environment.

The WR-1 Building is one of the nuclear liabilities at the WL site. The WR-1 Building is approaching 60 years old. Although the building has been well-maintained, it is approaching the end of its useful life.

The purpose of the Project is to safely decommission the reactor in a timely manner that reduces the need for further human intervention. Potential decommissioning strategies were identified through internal CNL discussions and feedback received from the public and Indigenous engagement activities.

CNL evaluated several decommissioning strategies, focusing on the following four main objectives:

1) Ensure protection to the environment (i.e., human and ecological) by:
    a) limiting the need for interim storage if possible;
    b) reducing deferment periods where appropriate;
    c) limiting releases of radiological and hazardous substances from the facility;
    d) meeting applicable regulations;
    e) continuing to meet the obligations committed to in the Comprehensive Study Report (CSR; AECL 2001); and
    f) demonstrating the long-term safety of the selected decommissioning strategy, including implementation of a long-term monitoring and surveillance program.
2) Apply international best practices to safely decommission WR-1.
3) Apply CNL and international safety design principles to minimize radiation exposure to the public and workers (e.g., meeting the As Low As Reasonably Achievable [ALARA] principle).
4) Avoid or minimize industrial hazards during decommissioning activities.

2.4 Project Design Principles

The principles presented in Sections 2.4.1 and 2.4.2 are essential elements in the design of the decommissioning strategy. The alternatives described in Section 2.5.4 were evaluated in the context of these design principles.

2.4.1 CNL Design Principles

The safety principles to be applied to the design and implementation of the decommissioning strategy include:

- defence-in-depth principle;
- ALARA principle; and
- nuclear safety culture.

Defence-in-Depth Principle

The key aspect of defence-in-depth is using multiple layers of protection against abnormal events. When defence-in-depth is applied it provides protection against a wide range of events (e.g., anticipated operational occurrences, accidents, equipment failure, human errors, forest fires, and floods). Defence-in-depth consists of two components: 1) equipment and administrative features that provide protection, and 2) integrated safety management programs that control operations. Section 7.0 and Section 10.0 provide an analysis of potential accidents and malfunctions identified for the Project and effects of the environment on the Project, respectively.

The application of the defence-in-depth concept to abnormal events requires that no single human or equipment failure would result in an unacceptable hazard to the workers in the facility, the public or the environment. This strategy is centred on several barriers of protection with ascending levels of importance: accommodation, mitigation and prevention. The level of application corresponds to the level of risk posed by the postulated event.

To effectively control a hazard, the same basic approach has been taken based on the following sequence of hazard control principles:

- eliminating the hazard;
- reducing/replacing the hazard;
- isolating the hazard;
- controlling the hazard;
- using personnel protective equipment & clothing (PPE&C);
- adhering to policies and procedures; and
- maintaining appropriate documentation.

Of these seven principles, the most effective and preferred method of hazard control is to eliminate the hazard. When a hazard cannot be eliminated, then the remaining principles are implemented to provide an acceptable level of defence-in-depth. The defence-in-depth strategy is used to limit the effects of potential mechanical and human failure and unexpected occurrences. For human errors, prevention is achieved by a combination of process design and administrative controls (e.g., training and procedures), as well as by establishment of a strong safety culture.

As Low As Reasonably Achievable Principle

The ALARA principle requires that the exposures to persons shall be as low as reasonably achievable, social and economic factors being taken into account. CNL's ALARA program (CNL 2018a) will be followed and the essential elements include:

- demonstrated management commitment to the ALARA principle;
- implementation of ALARA through design, organization and management, selection and training of personnel, oversight of the Radiation Protection Program, resources and documentation;
- establishment of nuclear safety culture;
- planning and control of all work;
- application of task-specific dose and dose-rate radiological control hold points; and
- regular operational reviews.

In addition to CNL's ALARA program (CNL 2018a), the Canadian Nuclear Safety Commission (CNSC) regulatory guide to the ALARA principle (CNSC 2004) is taken into consideration in the design of a decommissioning plan. This document outlines approaches to achieving ALARA through the management control over work practices, qualification and training for personnel, control of occupational and public exposure to radiation, and planning for unusual situations.

The ALARA principle will be achieved by cost-effectively implementing zoning and access control measures, maintaining adequate shielding for structures and waste packages with high radiation fields, providing process equipment segregation, establishment of radiation alarms, continuous monitoring and through operator training and approved procedures. Further reduction in operating staff doses is achieved by limiting releases through periodic inspection and preventive maintenance of equipment. It is important to note that CNL plans to meet regulatory limits for radiation doses to workers at all times.

Nuclear Safety Culture

CNL has adopted the Institute of Nuclear Power Operations' nuclear safety culture definition (INPO 2004)[1]. The following principles and traits are well recognized to contribute to a healthy nuclear safety culture:

- **Personal accountability** – All individuals take personal responsibility for safety.
- **Questioning attitude** – Individuals avoid complacency and continuously challenge existing conditions and activities in order to identify discrepancies that might result in error or inappropriate action.
- **Effective safety communication** – Communications maintain a focus on safety.
- **Leadership safety values and actions** – Leaders demonstrate a commitment to safety in their decisions and behaviors.
- **Decision-making** – Decisions that support or affect nuclear safety are systematic, rigorous and thorough.
- **Respectful work environment** – Trust and respect permeate the organization.
- **Continuous learning –** Opportunities to learn about ways to ensure safety are sought out and implemented.
- **Problem identification and resolution –** Issues potentially affecting safety are promptly identified, fully evaluated and promptly and adequately addressed (corrections are commensurate with the potential consequences).
- **Environment for raising concerns** – A safety-conscious work environment is maintained where personnel feel free to raise safety concerns without fear of retaliation, intimidation, harassment or discrimination.
- **Work processes** – The process of planning and controlling work activities is implemented so that safety is maintained.

The CNSC has issued REGDOC-2.1.2, *Safety Culture* (CNSC 2018a), which provides a definition of safety culture and highlights general safety culture requirements that apply to all licensees. CNL abides by this document that describes the expected and suggested criteria for licensees to self-assess, establish corrective action plans and report on safety culture.

[1] "Nuclear safety culture" is defined as the core values and behaviors resulting from a collective commitment by leaders and individuals to emphasize safety over competing goals to ensure protection of people and the environment.

2.4.2 Design Principles from External Sources

In addition to CNL's design principles, the design and implementation of the decommissioning approach will use Canadian and international best practices and safety fundamentals, including those from the International Atomic Energy Agency (IAEA) and the CNSC.

International Atomic Energy Agency

The IAEA's *Fundamental Safety Principles* (IAEA 2006a) outline and describe 10 safety principles in terms of radiation protection in design:

1) responsibility for safety;
2) role of government;
3) leadership and management for safety;
4) justification of facilities and activities;
5) optimization of protection;
6) limitation of risks to individuals;
7) protection of present and future generations;
8) prevention of accidents;
9) emergency preparedness and response; and
10) protective actions to reduce existing or unregulated radiation risks.

The IAEA has also published *SSG-29: Near Surface Disposal Facilities for Radioactive Waste* (IAEA 2014b). This document gives detailed design guidance on the following:

- containment;
- isolation;
- multiple safety functions;
- passive safety; and
- surveillance and control of passive safety features.

It is noted that as the Whiteshell Reactor Disposal Facility (WRDF) will contain intermediate level waste, SSG-29 is not applicable to the Project; however, where relevant, guidance given in SSG-29 has been taken into account.

Regulating nuclear safety in Canada is the responsibility of the CNSC. The IAEA is a valuable resource to provide guidance for decisions concerning safety related to CNL's plans to decommission WR-1. Current IAEA guidance states that in situ decommissioning should not be the preferred decommissioning strategy for nuclear power reactors, except possibly under exceptional circumstances (IAEA 2014a). As explained in Section 6.3 of the Whiteshell Laboratories Detailed Decommissioning Plan (DDP; CNL 2021), Canada's regulatory framework for decommissioning, according to CNSC REGDOC-2.11.2 (CNSC 2021), includes ISD as a viable decommissioning

strategy option under specific circumstances or legacy sites. The Project meets all the requirements for a legacy site, as defined in REGDOC-2.11.2:

- WR-1 was a research and a demonstration facility constructed at a time in history when decommissioning was not part of the design;
- All reactor fuel has been removed from the WR-1 site;
- Use of ISD will protect the workers, the public and the environment; and
- WR-1 site will remain under Institutional Controls for a period defined in the safety case.

All four technically feasible alternative means of carrying out the decommissioning of WR-1 assessed in Section 2.5.4 align with IAEA's General Safety Requirements Part 6, *Decommissioning of Facilities* (IAEA 2014a), which lists 15 requirements (which are outlined below) that should be met when selecting a specific decommissioning approach for a facility.

1) **Optimization of protection and safety in decommissioning** – **Exposure during decommissioning shall be considered to be a planned exposure situation and the relevant requirements of the Basic Safety Standards shall be applied accordingly during decommissioning.**

   National regulations on the protection of the environment shall be complied with during decommissioning, and beyond if a facility is released from regulatory control with restrictions on its future use.

   All decommissioning work at CNL is carried out under the oversight of the CNL Radiation Protection Program, as per the CNSC-issued site decommissioning licence, which provides the framework and constraints for planned exposures during decommissioning work at WL.

   Furthermore, the Project is subject to federal legislation including the *Nuclear Safety and Control Act* and *Canadian Environmental Assessment Act, 2012* (CEAA 2012). The Project is further subject to oversight and approval from the CNSC, which licenses all activities performed by CNL related to decommissioning and waste management. The Decommissioning Licence NRTEDL-W5-8.00/2024 dictates requirements for CNL to comply with and outline what activities CNL is permitted to perform. Regular inspections by the CNSC ensure compliance with the Decommissioning Licence, and all applicable relevant federal legislation. These conditions remain in place until the CNSC deems them no longer necessary for the safety of workers, the public and the environment.

2) **Graded approach in decommissioning** – **A graded approach shall be applied in all aspects of decommissioning in determining the scope and level of detail for any particular facility, consistent with the magnitude of the possible radiation risks arising from the decommissioning.**

   The conduct and regulatory oversight of decommissioning actions shall be applied in a manner that is commensurate with the hazards and risks associated with the decommissioning of the facility.

   All decommissioning activities carried out by CNL are subject to CNSC oversight under the Decommissioning Licence NRTEDL-W5-8.00/2024. The Decommissioning Licence outlines the activities that CNL is permitted to perform and conditions that must be met while performing it. The Decommissioning Licence further identifies all the relevant CNL policies, programs and procedures that decommissioning activities must be

performed in accordance with. The CNSC provides compliance oversight to ensure CNL is following the specified policies, program and procedures. One such requirement is the adherence to the CSA N286 quality assurance standard for nuclear power plants, which has specific provisions for application of graded approaches to performing work, commensurate with the risk level involved. This graded approach has been implemented in many of the policies, programs and procedures identified in the WL site licence, which have been deemed as satisfactory by the CNSC. The graded approach is reflected in procedures for environmental review, radiation and contamination monitoring, occupational health and safety measures, quality assurance and waste management and minimization, among others. The ALARA principle (As Low As Reasonably Achievable) permeates CNL's safety culture, and the "Reasonably" portion of that is where the graded approach is applied.

The graded approach is also apparent in CNSC oversight of CNL operations. The Decommissioning Licence also outlines which activities CNL may perform without notifying the CNSC, where the CNSC must be notified, or where the CNSC must approve prior to execution. These distinctions are based on the commensurate risk of the activities.

3) **Assessment of safety for decommissioning – Safety shall be assessed for all facilities for which decommissioning is planned and for all facilities undergoing decommissioning.**

The final decommissioning plan shall be supported by a safety assessment addressing the planned decommissioning actions and incidents, including accidents that may occur or situations that may arise during decommissioning.

As part of the ongoing environmental assessment, under CEAA 2012, CNL has prepared this Environmental Impact Statement (EIS), which summarizes the assessed effects of the Project on the environment. This is supported through a detailed *Decommissioning Safety Assessment Report for the WR-1 In Situ Decommissioning of Whiteshell Reactor 1 Project* (DSAR; Golder 2021a), compliant with CNSC's REGDOC 2.11.1, *Waste Management, Volume III: Assessing the Long-Term Safety of Radioactive Waste Management* (CNSC 2018b). Detailed calculations and modelling that support the assessment in the DSAR are provided in an Environmental Risk Assessment (ERA) report (EcoMetrix 2021), and a Groundwater Flow and Solute Transport Modelling report (Golder 2021b). The DSAR also provides an assessment of accident and malfunction scenarios during decommissioning, and their effect on the environment. All of these documents provide supporting information for the Detailed Decommissioning Plan (DDP) that is prepared in compliance with CSA N294 and submitted for CNSC acceptance as a component of the licence application.

This EIS, the DSAR and the supporting documents focus on the preferred Alternative #3 – ISD. Alternative #1 – Deferred Dismantling and Removal and Alternative #2 – Immediate Dismantling and Removal were shown to be safe in the CSR (AECL 2001). Alternative #4 – Partial Dismantling and Removal with ISD of the Remainder is a combination of Alternatives #2 and #3, both of which have been shown to be safe; therefore, Alternative #4 is deemed safe.

4) **<u>Responsibilities of the government for decommissioning</u> – The government shall establish and maintain a governmental, legal and regulatory framework within which all aspects of decommissioning, including management of the resulting radioactive waste, can be planned and carried out safely. This framework shall include a clear allocation of responsibilities, provision of independent regulatory functions, and requirements in respect of financial assurance for decommissioning.**

The responsibilities of the government shall include:

- *Establishing a national policy for the management of radioactive waste, including radioactive waste generated during decommissioning;*
- *Establishing and maintaining the legal, technical and financial responsibilities for organizations involved in decommissioning, including responsibilities for granting the authorization to conduct decommissioning and for the management of the resulting radioactive waste;*
- *Ensuring that the necessary scientific and technical expertise is available both for the licensee and for the support of regulatory review and other independent national review functions;*
- *Establishing a mechanism to ensure that adequate financial resources are available when necessary for safe decommissioning and for the management of the resulting radioactive waste.*

The Government of Canada provides the legislative framework supporting the CNSC, including defining its mandate and authority as Canada's independent nuclear regulator. The CNSC is responsible for the oversight of all civilian nuclear activities in Canada.

Whiteshell Laboratories is the property of AECL, which is a Schedule III, Part 1 Crown Corporation under the *Financial Administration Act, 1985* and an agent of Her Majesty in Right of Canada. As owner, AECL retains responsibility for the site, financial obligations for decommissioning, and long-term management of the site post-closure. These liabilities have been officially recognized by the Minister of Natural Resources in a letter dated July 31, 2015 (Rickford 2015) and satisfy *CNSC Regulatory Document-3.3.1 Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities* (CNSC 2021a). AECL has chosen a Government-Owned, Contractor-Operated approach to completing the decommissioning of WL. The tendering process reviewed the proposed approaches to the decommissioning of WL against:

- compliance with AECL mandate, policies and procedures as agent of the Federal Government of Canada;
- adherence to CNSC requirements for the vendor to be the site licence holder and be approved by the CNSC to perform decommissioning work;
- expertise of each vendor in safely performing nuclear decommissioning work; and
- financial commitments of AECL to execute work safely.

5) **<u>Responsibilities of the regulatory body for decommissioning</u> – The regulatory body shall regulate all aspects of decommissioning throughout all stages of the facility's lifetime, from initial planning for decommissioning during the siting and design of the facility, to the completion of decommissioning actions and the termination of authorization for decommissioning. The regulatory body shall establish the safety requirements for decommissioning, including requirements for management of the resulting radioactive waste, and shall adopt associated regulations and guides. The regulatory body shall also take actions to ensure that the regulatory requirements are met.**

The CNSC is the authority having jurisdiction for all nuclear decommissioning work in Canada. The CNSC has a rigorous licencing approach that ensures nuclear safety in all licensed nuclear decommissioning work. The Decommissioning Licence (Licence No. NRTEDL-W5-8.00/2024) currently issued to CNL, and all future licences and licence revisions granted to CNL for decommissioning the WL site, do and will include specific requirements, standards and guidance for maintaining safe decommissioning operations. These requirements are developed with input from regulatory and industry experience and take into consideration international guidance and best practices. As a member state of the IAEA, Canada (and therefore the CNSC) are committed to pursuing the highest standards in nuclear safety through international collaboration and sharing operational experience.

6) **<u>Responsibilities of the licensee for decommissioning</u> – The licensee shall plan for decommissioning and shall conduct the decommissioning actions in compliance with the authorization for decommissioning and with requirements derived from the national legal and regulatory framework. The licensee shall be responsible for all aspects of safety, radiation protection and protection of the environment during decommissioning.**

The responsibilities of the licensee shall include:

- *Selecting a decommissioning strategy as the basis for preparing and maintaining the decommissioning plans throughout the lifetime of the facility.*
- *Preparing and submitting an initial decommissioning plan and its updates for review by the regulatory body.*
- *Establishing and implementing an integrated management system. If the licensee changes during the lifetime of the facility, procedures shall be put in place to ensure the transfer of responsibilities for decommissioning to the new licensee.*
- *Fostering a safety culture in order to encourage a questioning and learning attitude towards safety, and to discourage complacency.*
- *Estimating the cost of decommissioning and providing financial assurances and resources to cover the costs associated with safe decommissioning, including the management of the resulting radioactive waste.*
- *Notifying the regulatory body prior to the permanent shutdown of the facility.*
- *Submitting a final decommissioning plan and supporting documents for review and approval by the regulatory body, in accordance with national regulations, in order to obtain an authorization to conduct decommissioning.*

- *Managing the decommissioning project and conducting decommissioning or ensuring oversight of the actions conducted by contractors.*
- *Managing the remaining operational waste from the facility and all waste from decommissioning.*
- *Ensuring that the facility is maintained in a safe configuration during the period of transition following permanent shutdown and until the approval of the final decommissioning plan.*
- *Performing safety assessments and environmental impact assessments in support of decommissioning actions.*
- *Preparing and implementing appropriate safety procedures, including emergency plans.*
- *Ensuring that properly trained, qualified and competent staff are available for the decommissioning project.*
- *Performing radiological surveys in support of decommissioning.*
- *Verifying that end state criteria have been met by performing a final survey.*
- *Keeping and retaining records and submitting reports as required by the regulatory body.*

CNL performs many of these responsibilities on a daily basis as part of its core business operations. CNL carries out all work at WL in accordance with the Decommissioning Licence (Licence No. NRTEDL-W5-8.00/2024) from the CNSC. The requirements for obtaining and maintaining a licence align with the objectives of the bullet list above. All aspects of the decommissioning work, are subject to CNSC oversight and acceptance prior to any work being performed, including:

- preliminary and detailed planning;
- integrated management systems;
- development of company safety culture;
- cost estimating and financial guarantees;
- safe work execution and oversight;
- waste management, facility maintenance and safety;
- safety assessments supporting decommissioning planning;
- emergency planning, training and qualification of staff; and
- record retention.

The preparation of a DDP by CNL summarizes the pertinent information noted above for CNSC review and acceptance. The CNSC performs regular compliance inspections to verify CNL complies with the requirements of the Decommissioning Licence and the work summarized in the DDP. CNL also develops work plans with additional detail on how work scope of the DDP will be carried. These work plans are provided to the CNSC for information, as a means to assess the plans' compliance with the goals outlined in the DDP. Upon completion of the work, end-state reports are prepared to summarize the work performed against the planned activities, noting discrepancies or changes, for CNSC acceptance.

7) **Integrated management system for decommissioning – The Licensee shall ensure that its integrated management system covers all aspects of decommissioning.**

The prime responsibility for safety shall remain with the licensee.

CNL is the licensee for the overall WL Closure Project, including the decommissioning of WR-1. Under the terms of the Decommissioning Licence, CNL has demonstrated its commitment to safety through both policy and through daily work activities including safe work processes such as work permits, Event Free Tools, and fostering a strong safety culture that permeates the organization.

8) **Selecting a decommissioning strategy – The licensee *shall select a decommissioning strategy* that will form the basis for the planning for decommissioning. The strategy shall be consistent with the national policy on the management of radioactive waste.**

There may be situations in which immediate dismantling is not a practicable strategy when all relevant factors are considered. The selection of a decommissioning strategy shall be justified by the licensee. The licensee shall demonstrate that, under the strategy selected, the facility will be maintained in a safe configuration at all times and will reach the specified decommissioning end state, and that no undue burdens will be imposed on future generations.

CNL has selected ISD as the decommissioning strategy for WR-1. In the absence of a well-defined national waste strategy, CNL continues to pursue a risk-based approach to radioactive waste management that complies with all CNSC regulations, applicable legislation, and where appropriate aligns with international guidance and best practices. The justification for the selection of this strategy is presented in this section. The EIS, supported by the DSAR (Golder 2021a), the ERA (EcoMetrix 2021) and other technical documents, demonstrates that the effects of this decommissioning strategy do not place an undue burden on future generations of people and the environment. All other alternative means for decommissioning WR-1 would have to be justified if they were selected as the preferred decommissioning strategy.

9) **Financing of decommissioning – Responsibilities in respect of financial provisions for decommissioning shall be set out in national legislation. These provisions shall include establishing a mechanism to provide adequate financial resources and to ensure that they are available when necessary, for ensuring safe decommissioning.**

The requirements for financial guarantees are laid out in CSA N294, *Decommissioning of Facilities Containing Nuclear Substances* (CSA Group 2019). Adherence to this standard by CNL is required from national legislation to CNSC regulatory requirements and licence conditions.

10) **Planning for decommissioning – The licensee shall prepare a decommissioning plan and shall maintain it throughout the lifetime of the facility, in accordance with the requirements of the**

regulatory body, in order to show that decommissioning can be accomplished safely to meet the defined end state.

CNL has prepared an Overview DDP for the wider WL site closure project. The Overview DDP provides the overall plan for decommissioning of the WL site, including WR-1, and has been periodically revised to include adjustments to the plan. This Overview DDP is part of a larger body work that supports the CNL application for a decommissioning licence for the WL site. It is supported by additional technical information, including but not limited to the Comprehensive Study Report, EIS, DSAR, and CNL policies, programs and procedures. Furthermore, CNL has also prepared a DDP specifically for WR-1 that will be maintained throughout the Project lifetime and is also subject to CNSC review and approval prior to being implemented.

11) **Final decommissioning plan – Prior to the conduct of decommissioning actions, a final decommissioning plan shall be prepared and submitted to the regulatory body for approval.**

The final decommissioning plan and supporting documents shall cover the selected decommissioning strategy; the schedule, type and sequence of decommissioning actions; the waste management strategy applied, including clearance, the proposed end state and how the licensee will demonstrate that the end state has been achieved; the storage and disposal of the waste from decommissioning; the timeframe for decommissioning; and financing for the completion of decommissioning. If the final decommissioning plan includes new technologies and concepts for decommissioning, the licensee shall demonstrate that such methods are safe and effective. Interested parties shall be provided with an opportunity to examine the final decommissioning plan can provide comments prior to its approval.

A DDP has been prepared to address the requirements of a final decommissioning plan including each of the items listed above. Development of the DDP is done in accordance with the WL Closure Project Quality Assurance Manual (CNL 2018b) and CSA N294, the WL site licence and the WL Licence Conditions Handbook (CNSC 2020a), and guidance from recent project experience and regulatory input.

12) **Conduct of decommissioning actions – The licensee shall implement the final decommissioning plan, including management of radioactive waste, in compliance with national regulations.**

Decommissioning techniques shall be selected such that protection and safety is optimized, protection of the environment is ensured, the generation of waste is minimized and any potential negative impact on the storage and disposal of waste is minimized.

All operations at CNL, decommissioning or otherwise, are subject to approval by the CNSC. Approval is granted via a site licence that summarizes the policies, programs and key procedures that govern the work processes at WL. All work is performed in accordance with the policies, programs and key procedures identified, including Radiation and Environmental Protection, Occupational Health and Safety, Waste Management, Security Program and Quality Assurance. Any changes to these policies, programs or key procedures are submitted, if required, to the CNSC for review and/or acceptance prior to being implemented to perform work.

CNL has been performing decommissioning work at WL under a CNSC-issued Decommissioning Licence since 2002. Since 2002, the CNSC has verified that CNL is performing its work in a safe and compliant manner. All work necessary to decommission WR-1 will comply with these accepted practices to ensure protection of workers, the public and the environment, safe and optimized waste management and minimization.

13) **Emergency response arrangements for decommissioning – Emergency response arrangements for decommissioning, commensurate with the hazards, shall be established and maintained, and events significant to safety shall be reported to the regulatory body in a timely manner.**

Establishment of appropriate emergency response measures is required per the WL Decommissioning Licence and the Licence Conditions Handbook (Condition 10.1). CNL meets this requirement through the implementation of the WL's Site Emergency Response Plan, as per the CNSC-issued site Decommissioning Licence.

14) **Radioactive waste management in decommissioning – Radioactive waste shall be managed for all waste streams in decommissioning.**

Radioactive waste that remains at the facility and radioactive waste that is generated during decommissioning shall be disposed of properly. If disposal capacity is not available, radioactive waste shall be stored safely in accordance with the relevant requirements.

The safe and effective management of radioactive wastes is mandated through the CNSC Decommissioning Licence under which all activities at WL are performed. Section 11 of the Decommissioning Licence mandates that CNL maintain a waste management program for WL.

CNL maintains a waste management program for WL that controls the management of all radioactive wastes generated at WL, as per the CNSC-issued Decommissioning Licence.

15) **Completion of decommissioning actions and termination of the authorization for decommissioning – On the completion of decommissioning actions, the licensee shall demonstrate that the end state criteria as specified in the final decommissioning plan and any additional regulatory requirements have been met. The regulatory body shall verify compliance with the end state criteria and shall decide on termination of the authorization for decommissioning.**

Upon completion of decommissioning of WR-1, CNL will prepare an End-State Report, which will document the work performed and the end-state achieved. Further, CNL will implement an Environmental Assessment Follow Up Program (EAFP) to provide evidence that the system is performing as designed after the end-state has been achieved. The End-State Report is mandated by the WL Quality Assurance Plan (CNL 2018b) and CSA N294. The EAFP is a mandated component of the environmental assessment process under CEAA 2012. Ongoing environmental monitoring is also a critical aspect of the WL Decommissioning Licence. CNL has previously prepared end-state reports for other work completed on the WL site, to the satisfaction of the CNSC, and will ensure the WR-1 End-State Report meets the same expectations. CNL has also been performing routine EAFP monitoring of all decommissioning work, to the satisfaction of the CNSC, to demonstrate their compliance with the criteria of the CSR.

CNL will not adjust or cease monitoring of the WL site without the approval of the CNSC, and any decision to terminate, amend or transfer the Decommissioning Licence for the WL site will be made by the CNSC.

Canadian Nuclear Safety Commission

The CNSC has published REGDOC-2.11.1, *Waste Management Volume III, Assessing the Long Term Safety of Radioactive Waste Management* (CNSC 2018b), which describes the CNSC's licensing philosophy and licensing requirements related to radioactive waste management.

The purpose of REGDOC-2.11.1 Volume III, is to assist applicants for new licences and licence renewals in assessing the long-term safety of radioactive waste management, including:

- long-term care and maintenance considerations;
- setting post-decommissioning objectives;
- establishing assessment criteria;
- assessment strategies and level of detail;
- selecting timeframes and defining assessment scenarios;
- identifying receptors and critical groups; and
- interpretation of assessment results.

REGDOC-2.11.1 Volume III describes the philosophy that underlies the CNSC's approach to regulating the management of radioactive waste and the principles that are taken into account when making regulatory decisions about waste management. CNL considered the CNSC's guidance documents in the design and safety case (i.e., the argument and provision of evidence to demonstrate that that associated hazards and risks have been assessed, appropriate limits and conditions have been defined, and that adequate safety measures have been identified and put into place) for development of the Project.

2.5 Alternative Means of Carrying out the Project

2.5.1 Evaluation Approach

CEAA 2012 requires that federal environmental assessments evaluate alternative means of carrying out the Project that are technically and economically feasible and the environmental effects of any such alternative means. The Canadian Environmental Assessment Agency identifies in its *Operational Policy Statement: Addressing "Purpose of" and "Alternative Means" under the Canadian Environmental Assessment Act, 2012* the overall approach for considering the "alternative means" of carrying out a project (The Agency 2015). "Alternative means" is defined as the "various technical and economically feasible ways under consideration by the proponent that would allow a designated project to be carried out." The environmental effects of each alternative are considered in the assessment, as well as the technical feasibility, the economic feasibility and public and worker health and safety.

The purpose of this section is to present the alternative means of carrying out the Project. The consideration of alternatives is presented in the following three steps:

- identification of technical and economically feasible alternative means;
- identification of effects on valued components (VCs); and
- application of defined assessment criteria (described in Section 2.5.2) and the completion of a comparative evaluation to identify the preferred or most favourable option.

The decommissioning strategy for WR-1 draws upon the experiences and lessons learned from the decommissioning of similar reactors. CNL has conducted extensive research on reactor decommissioning strategies and past projects as part of the planning work for WR-1. CNL has relied on industry experts and has augmented its own team with staff that have been involved in previous reactor decommissioning work. CNL contracted Savannah River National Laboratory to perform a literature review of reactor encasement projects in order to assess techniques and performance results. This is documented in the report titled *Cementitious Materials Applications for Reactor Decommissioning* (SRNL 2016) and includes 12 reactors that have been encased in the USA, Russia, Georgia and Puerto Rico. CNL completed an additional report of 16 nuclear, hazardous, mining and industrial sites that have selected ISD as the strategy for permanent disposal (CNL 2019).

Staff from Savannah River National Laboratory visited both WR-1 and the Nuclear Power Demonstration reactor site in Ontario for the purpose of assessing these reactors and advising the CNL team. Technical considerations included size, condition, remaining radioactive inventory, site hydrogeology, site geology, construction type, integrity and durability of barriers, waste disposal options, site location relative to waste management facilities, site end state and other facility characteristics.

CNL also relied on extensive reactor dismantling experience from the companies that make up the Canadian National Energy Alliance. These companies (initially SNC Lavalin, Energy Solutions, Fluor and CH2M Hill; now SNC Lavalin, Fluor and Jacobs) have vast experience worldwide in nuclear decommissioning. CNL also relied on experience, lessons learned and strategies employed by the United States Department of Energy Office of Environmental Management (US DOE EM) and other international sources. While not a complete list, lessons learned and strategic consideration for ISD that informed the alternatives analysis are readily documented in the following publications:

- IAEA TecDoc 1124 – *Onsite Disposal as a Decommissioning Strategy* (IAEA 1999).
- *Innovations Report from Savannah River National Laboratory* (SRNL 2013).
- *Use of Cementitious Materials for SRS Reactor In-Situ Decommissioning* (Langton et al. 2010).
- IAEA Nuclear Energy Series No. NW-G-2.1 *Policies and Strategies for the Decommissioning of Nuclear and Radiological Facilities* (IAEA 2011a).
- IAEA Technical Report Series No. 446 *Decommissioning of Research Reactors: Evolution, State of the Art, Open Issues* (IAEA 2006b).
- *US DOE EM Strategy and Experience for In Situ Decommissioning*, Office of Engineering and Technology, EM-20, September 2009 (US DOE 2009).
- *In Situ Decommissioning Concepts and Approaches for Excess Nuclear Facilities Decommissioning End State – 13367*, Waste Management 2013 Conference (Serrato et al. 2013).
- *In Situ Decommissioning Lessons Learned 14042*, Waste Management 2014 Conference (Negin et al. 2014).
- *Entombment: A Viable Decommissioning Strategy for Research Reactors?* International Nuclear Safety Journal, Volume 3, Issue 4, 2014 (Laraia 2014).

The information gathered from these sources contributed to the alternatives assessment, particularly with regard to technical feasibility, economic feasibility and environmental effects during closure and post-closure.

WR-1 was defueled during previous decommissioning activities, reducing radioactivity. As a result, most remaining activity is associated with activated metals and contaminated systems and components. The vast majority of the remaining radioactivity is in the reactor core, which includes the calandria (i.e., the reactor vessel) and the fuel channels. This radioactivity must be considered when selecting a technically and economically suitable decommissioning strategy. Another key aspect of WR-1 that must be considered when assessing decommissioning strategies is that the reactor components are primarily located in the five storeys below-grade.

The alternative means evaluated in the EIS are:

- Alternative #1 – Deferred Dismantling and Removal;
- Alternative #2 – Immediate Dismantling and Removal;
- Alternative #3 – ISD;
- Alternative #4 – Partial Dismantling and Removal with ISD of the Remainder;
- Alternative #5 – ISD Using Alternative Backfill Materials; and
- Alternative #6 – Rolling Stewardship.

These alternatives were evaluated in the context of the design principles described in Section 2.4. The full dismantling and removal of the WR-1 Complex is assessed in the CSR and covered under CNL's existing decommissioning licence for the WL site (Licence No. NRTEDL-W5-8.00/2024). As such, the decommissioning alternatives discussed below are specific to the decommissioning of WR-1 Building, which is the central portion of the WR-1 Complex and contains WR-1.

Each alternative was evaluated first for its technical feasibility (e.g., whether the approach has been used elsewhere and can be easily adapted to this application). For those alternatives deemed technically feasible, a comparison of economic feasibility (i.e., cost), safety and environmental effects was completed. The alternatives assessment considered safety (e.g., effects on workers and the public), as well as biophysical (i.e., groundwater, aquatic environment, terrestrial environment and atmospheric environment) and social (i.e., socio-economic and land and resource use) effects.

Public and Indigenous engagement was an important aspect of the decision-making process. A summary of the alternative means being considered was made available to the public at open houses and meetings with Indigenous peoples. The input received is documented in Section 4.0 Indigenous Engagement and Section 5.0 Public Engagement. As a result of these engagement activities, the assessment criteria for evaluating safety and environmental effects were expanded and additional details were added through the development of the EIS.

2.5.2 Selection of Assessment Criteria

Selection of the assessment criteria was based on the requirements of REGDOC-2.9.1, *Environmental Principles, Assessments and Protection Measures* (CNSC 2020b). Alternatives were screened for technical feasibility. Feasible alternatives were then assessed for economic feasibility and their effects on safety (worker, public and Indigenous safety) and the environment.

The effects were also evaluated against the criteria for each phase of the Project to demonstrate the changing nature of the possible effects of each alternative over time. The Project phases are:

- closure phase – period for decommissioning activities that spans three years (2022 to 2027)
- post-closure phase – comprises two discrete periods:
  - institutional control – Institutional control is estimated to last a minimum of 100 years (i.e., 2027 to 2127) during which long-term monitoring and maintenance activities will continue, to demonstrate compliance with the safety case assumptions. Although institutional control is estimated to last a minimum of 100 years, it is recognized that it will continue until the CNSC agrees institutional controls are no longer needed; and
  - post-institutional control – period beyond the year 2127 that continues indefinitely and during which institutional control is assumed to eventually collapse and knowledge of the facility is lost. There is much uncertainty around when such period may actually begin, if at all. For the purpose of the assessment, it is assumed to occur 100 years after closure of the facility (i.e., at the end of institutional control).

Project phases are discussed in further detail in Section 6.1.4.2 Temporal Boundaries.

The discussion and evaluation of alternatives and assessment criteria were also presented at numerous public and Indigenous engagement events and feedback was solicited. The general feedback indicated the criteria for assessment of safety and environmental effects were not detailed enough. Specific changes as a result of this feedback included the separation of the Safety category into distinct categories for Worker Safety and Public Safety, reducing the perceived importance of transportation risk in the criterion, and defining different criteria for each time phase of the project (closure, institutional control, post-institutional control). Furthermore, the analysis was revised to clarify that this assessment is not intended to try to determine a ‘best’ alternative, which is highly subjective. It instead considers only alternatives that can all safely achieve the Project goals, and identifies the alternative that makes the most sense given the current circumstances and as per the regulatory guidance [The Agency 2015].

Criteria used to assess each of the alternatives were grouped into four categories: technical feasibility, economic feasibility, safety and environment effects. The criteria are summarized in Table 2.5.2-1, with further rationale provided in the following sections.

Table 2.5.2-1: Criteria for Assessing Alternative Means of Carrying out the Project

Category	Project Phase		Criteria
Technical Feasibility	Closure		***Is the alternative an approach and/or technology that has been successfully deployed elsewhere?*** ***Does the alternative require any tools, equipment or technologies that cannot be easily adapted to the current application (e.g., climate, location, waste type)?***
	Post-closure	Institutional Control	***Does the alternative rely on development of new facilities or technologies that do not yet exist (environmental monitoring or waste processing technologies, storage or disposal facilities)?***
		Post-institutional Control	***Does the alternative require physical human intervention/support beyond the institutional control period?***
Economic Feasibility	Closure		***Are the costs of activities for each alternative supportable within the current funding framework?*** ■ Ongoing storage and surveillance ■ Decommissioning of the WR-1 Building ■ Transportation of waste off site
	Post-closure	Institutional Control	***Are the costs during the institutional control period well defined and sustainable for a reasonable period of assumed institutional control?*** ■ Post-closure environmental monitoring ■ Construction and maintenance of additional interim or final storage facilities
	Post-closure	Post-institutional Control	***Does the alternative require an economic commitment beyond the duration of a reasonable assumed institutional control period?*** ***Are the long-term costs well defined?***
Safety	Closure and Post-closure		**What are the effects on Worker Safety?** ■ Radiological hazards during decommissioning ■ Non-radiological hazards during decommissioning ■ Industrial safety during decommissioning ■ Waste handling and transport hazards ***What are the effects on Public and Indigenous Safety?*** ■ Exposure risks to public near the WL site during closure ■ Transportation hazards
Environmental Effects	Closure and Post-closure		***What is the significance of potential effects on***: ■ Groundwater ■ Aquatic environment ■ Terrestrial environment ■ Atmospheric environment ■ Socio-economic environment

The technical feasibility criteria were not given a specific weight, but were given a "go, no-go" decision. All feasible alternatives were then assessed for economics and effects on worker, public and Indigenous safety, as well as environmental effects. Safety and environmental effects were weighted as follows:

- 30% worker safety;
- 30% public and Indigenous safety;
- 30% biophysical (groundwater, aquatic, terrestrial and atmospheric) environment; and
- 10% socio-economic environment.

Worker safety, public and Indigenous safety, and biophysical environment were given equal weight (30%) because it is recognized that they are inter-related (i.e., one can affect the other), and the assessment does not value the safety of one group of people over another. Socio-economic factors were given a lower weight as physical health and safety are a higher priority than socio-economic health, although, both are important in the decision-making process. While CNL did receive and consider alternative weighting from Sagkeeng First Nation (Sagkeeng), it did not result in changes to CNL's weighting, as CNL believes its weighting to be reasonable and balanced. Additional discussion can be found below.

In their Alternative Means Assessment, Sagkeeng, described in further detail at Section 2.8, provided criteria and tests that are meaningful to their community and represented their community values and interests, as represented by the Chief and Council. CNL re-evaluated its own work based on the information in Sagkeeng's alternative means assessment and deliberated whether changes should be made to their alternative means assessment.

CNL also acknowledges that the weighting of each criterion is a somewhat subjective exercise. Not surprisingly, study results reflected Sagkeeng's priority values and associated criteria and weighting for assessing alternatives. Different perspectives and understandings will value different criteria more or less in their decision making. CNL believes the categories, weighting, and scoring it applied to each criterion is fair and balanced. It assumes that impacts to the public and Indigenous peoples, and the environment in which they live and practice their rights, make up 60% of the evaluation. Impacts on the health and safety of workers who live in the local community are 30%, and impacts to the socio-economic interests of the area are given 10%. CNL feels this adequately places the most emphasis on the safety and health of all people, and the environment.

The alternatives were qualitatively ranked. The total score was calculated by adding up the weighted criteria score in each criteria (i.e., worker safety, public and Indigenous safety, biophysical environment, and socio-economic environment). The weighted criteria scores were determined by adding up the scores in each time period (i.e., closure phase + institutional control period + post-institutional control period), and multiplying the sum by the criteria weighting (a percentage) for that criteria score.

$$Total\ score = (CS_{WS})W_{WS} + (CS_{PS})W_{PS} + (CS_{BE})W_{BE} + (CS_{SE})W_{SE}$$

$$CS_{XX} = R_{XX,C} + R_{XX,IC} + R_{XX,PIC}$$

CS_{XX} = Criteria score
W_{XX} = Criteria weighting
$R_{XX,YY}$ = Ranking score
WS = Worker Safety
PS = Public and Indigenous Safety
BE = Biophysical Environment
SE = Socio-Economic Environment

C = Closure Phase
IC = Institutional control period
PIC = Post-institutional control period

Results are summarized in Section 2.6. If an alternative had a high chance of successfully addressing a particular criterion, it was rated most favourable. If an alternative had a moderate likelihood of addressing a criterion, it was rated as favourable, and if an alternative was assessed as having a low likelihood of success with a particular criterion, it was rated as least favourable. More than one alternative could be given the same ranking. The results, which are summarized in Table 2.7-1, were illustrated based on the relative preference of each feasible alternative as depicted below.

2.5.2.1 Technical Feasibility

The following criteria were developed for the technical feasibility category:

- **Closure Phase**
  - **Is the alternative an approach and/or technology that has been successfully deployed elsewhere?** This criterion looks for previous examples to demonstrate that the work to complete the closure phase of the Project can be completed safely with existing technologies. Feasible alternatives will have a demonstrated previous implementation and well-defined process for completion.
  - **Does the alternative require any tools, equipment or technologies that have not previously been implemented elsewhere?** This criterion looks to establish if the approach requires any specialized equipment or tools that, while used in previous applications of the alternative, pose a challenge to implementation, such as climate, safety standards or other factors that affect the ability to implement them. Feasible alternatives will have limited need for undeveloped or underdeveloped technologies, and will show how the technologies have been similarly adapted for the current application.
- **Post-closure Phase – Institutional Control**
  - **Does the alternative rely on development of new facilities or technologies that do not yet exist (environmental monitoring or waste processing technologies, storage or disposal facilities)?** This criterion looks to determine the technical needs of the alternative during the institutional control period. It seeks to identify the needs for monitoring equipment and technologies, and the needs for new facilities to support monitoring and storage of wastes. Feasible alternatives will have a well-defined scope of work and utilize existing or readily adapted technologies to implement them. They will also not rely on future development of undefined advanced technologies.

- **Post-closure Phase – Post-institutional Control**
  - **Does the alternative require physical human intervention/support beyond the institutional control period?** This criterion looks to identify whether the alternative requires human intervention for a period of time beyond that considered a reasonable timeframe to rely on institutional controls. Feasible alternatives will not rely on a perpetual, or undefined long-term, human presence to safely implement the approach.

2.5.2.2 Economic Feasibility

The following criteria were developed for the economic feasibility category:

- **Closure Phase**
  - **Are the costs of the alternative supportable within the current funding framework (ongoing storage and surveillance, decommissioning of the WR-1 Building, transportation of waste off site)?** This criterion looks to identify if the costs associated with the closure phase of each alternative are well defined and within the current funding framework.
- **Post-closure Phase – Institutional Control**
  - **Are the costs during the institutional control period well defined and sustainable for a reasonable period of assumed institutional control (post-closure environmental monitoring, construction and maintenance of additional interim or final storage facilities)?** This criterion looks to identify the economic needs to support each alternative during the institutional control period. Feasible options will have well-defined costs for the associated activities and defined periods over which they will occur. Feasible options must also be within the current funding framework.
- **Post-closure Phase – Post-institutional Control**
  - **Does the alternative require an economic commitment beyond the duration of a reasonable institutional control period?** This criterion looks to identify the long-term economic commitment required for each alternative. Feasible alternatives will have a well-defined limit on financial or economic commitments required to implement the Project.

2.5.2.3 Safety

The safety of the workers, Indigenous peoples and the public is of upmost importance. The evaluation of the potential hazards is separated into time phases to address the evolving nature of hazards. The following criteria were developed for the safety category:

- **Closure Phase**
  - **Worker safety** – The defense-in-depth principle and ALARA principle were considered when alternatives were evaluated for worker safety. For the criteria considered, it is often not possible to completely eliminate the hazard, but all alternatives include appropriate mitigation to reduce the hazard and protect workers.
    - **Radiological hazards during decommissioning** – All alternatives would involve some level of radiation exposure to workers during decommissioning; however, appropriate mitigation

(e.g., temporary shielding and ventilation, PPE&C) could be put in place for all alternatives so that worker dose limits would not be not exceeded. The amount of mitigation required would vary among the alternatives due to different types of exposure and radiation levels among the alternatives. Alternatives that minimize the need for mitigation the most were considered most favourable, while alternatives that require more mitigation were considered proportionately less favourable.

- **Non-radiological hazards during decommissioning** – The WR-1 Building also contains non-radiological hazards such as lead, polychlorinated biphenyls (PCBs) and asbestos-containing materials such as pipe insulation. Appropriate mitigation (e.g., PPE&C and ventilation) could be put in place for all alternatives to ensure the protection of worker health. The degree to which mitigation would be needed determined the level of favourability of each alternative. Alternatives requiring the least amount of mitigation were considered most favourable and alternatives requiring the greatest amount of mitigation were considered proportionately less favourable.
- **Industrial safety during decommissioning** – Decommissioning of the WR-1 Building would introduce standard worker industrial safety hazards (e.g., working at heights, confined spaces, congested workspaces and hoisting/rigging). These hazards would be more prevalent in some alternatives. Alternatives with the lowest exposure to these worker safety issues, compared to the other alternatives, were considered most favourable. Alternatives with the highest potential exposure to these worker safety issues, compared to the other alternatives, were considered proportionately less favourable.
- **Waste handling** – The transport of waste off site would require additional handling by workers. Appropriate mitigation (e.g., temporary shielding and ventilation, PPE&C) could be put in place for all alternatives to ensure that worker dose limits would not be exceeded during waste handling and packaging for transport. However, as an appropriate facility does not yet exist for waste disposal, interim storage of wastes would be necessary and double handling of the waste would be required for final disposal at an unspecified future date. Alternatives that would not require the double-handling of wastes were considered most favourable. Alternatives that would require double-handling of wastes and interim storage were considered proportionately less favourable.

- **Public safety**
  - **Exposure risk to public at WL site during closure** – The potential radiological risk to the public at the WL site would vary depending on the nature of the decommissioning work being performed. Alternatives with the most invasive activities (e.g., cutting, vibrating, heating) would have a higher risk of emissions, while less invasive techniques (e.g., less cutting, vibrating, heating) would have a lower risk. An alternative was considered most favourable if lower emissions were expected during the closure phase. An alternative was considered proportionately less favourable if higher emissions were expected during the closure phase.
  - **Transport of hazardous waste** – While transport of waste is routine and safe, transporting WR-1 wastes off site would introduce the additional risk of vehicle accidents. For low-level wastes, the effects of an incident would not be significant from a radiological perspective; however, intermediate level wastes would present a higher risk to the public during transport and would require more safety measures. Alternatives with the lowest volume of wastes shipped off site for disposal were considered

most favourable. Alternatives with the highest volume of wastes shipped off site for disposal were considered proportionately less favourable.

- **Post-closure Phase – Institutional Control**
  - **Worker safety –** All alternatives must be able to meet regulatory limits for exposures to workers and the public, plus the occupational health and safety standards during the institutional control period. An alternative was considered most favourable if the risks (radiological, non-radiological, industrial waste handling and transport) to workers were well defined and smaller compared to the risks of the closure phase (showing an overall risk reduction). An alternative was considered proportionately less favourable if the risks were not well defined, or if there was not an overall reduction in risk to workers.

    Public safety – Alternatives that would reduce the potential for public exposure (emissions, intrusion, transport on public roadways) were considered most favourable. Alternatives that would require repackaging, relocation or other ongoing emissions management were considered proportionately less favourable.
- **Post-closure Phase – Post-institutional Control**
  - **Public safety –** In the post-institutional control period, it was assumed that that there would be no workers present. All people would be considered the public. The primary risk to the public would be from emissions of radiological and non-radiological contaminants over time. All alternatives must be able to demonstrate long-term safety, at or below regulatory limits established by the CNSC. An alternative was considered most favourable if radiological and non-radiological materials were appropriately contained, thereby reducing the risk to the public during the post-closure phase to orders of magnitude below acceptable levels. An alternative was considered proportionately less favourable if the final method was not defined, or if it just met CNSC standard for exposure to the public (1 millisievert per year [mSv/a]).

2.5.2.4 Environmental Effects

The evaluation of environmental effects is based on a qualitative comparison of biophysical and socio-economic effects on VCs. Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, government agencies, Indigenous peoples or the public (The Agency 2018). The selection of appropriate VCs allows the assessment to be focused on those aspects that are of greatest importance to society.

The list of VCs selected for the evaluation is described in Section 6.1 Environmental Assessment Approach. CNL considered a number of factors when selecting the VCs including:

- presence, abundance and distribution within, or relevance to, the area associated with WR-1;
- potential for interaction with WR-1 and potential vulnerability to the effects of WR-1;
- species conservation status or concern (e.g., rarity, sensitivity and uniqueness);
- ecological and socio-economic value to communities, government agencies and the public;
- traditional, cultural and heritage importance to Indigenous peoples;
- legally recognized and afforded specific protection by law, policy, or regulation; and
- experience with similar projects.

To facilitate comparison of potential environmental effects on VCs between the alternatives, effects were described by discipline. For example, VCs for the terrestrial biodiversity discipline include numerous wildlife and vegetation species. For the alternatives assessment, environmental effects were evaluated for the terrestrial biodiversity discipline as a whole.

The following criteria were developed for the environmental effects category:

- **Closure Phase:**
  - **Groundwater, Aquatic, Terrestrial and Atmospheric Environment –** All alternatives would involve some level of emissions to the environment during decommissioning. The type (radiological/non-radiological), magnitude and emission route would vary among alternatives. In general, more invasive decommissioning activities (e.g., cutting, drilling, heating, vibrating) would result in larger potential emissions. Generally, these emissions could be effectively mitigated so that there are no significant effects on the environment. Alternatives that are expected to produce the lowest emission levels were considered most favourable, while alternatives expected to produce higher emission levels were considered proportionately less favourable.
  - **Socio-economic Environment –** During the closure phase, each alternative could have various socio-economic benefits or drawbacks, both directly and indirectly, including the financial benefit, experience and development of the employees and companies participating in the work, and the demands or investments in local infrastructure to support work. Alternatives were considered more favourable if they would provide benefits to the local region and province of Manitoba in the form of employment and investment in local infrastructure. Alternatives were considered proportionately less favourable if the benefits would be more readily realized outside of the local region and province of Manitoba, or if the work created additional demands on local infrastructure.
- **Post-closure Phase – Institutional Control:**
  - **Groundwater, Aquatic, Terrestrial and Atmospheric Environment** – The potential effects on aquatic, terrestrial and atmospheric environment would vary among the different alternatives. In all cases, emissions would be monitored and regulated to an approved standard. An alternative was considered more favourable if the expected releases during the institutional control period could be effectively managed and would not have any significant effect on the environment. An alternative was considered proportionately less favourable if the expected releases during the institutional control period could not be effectively mitigated.
  - **Socio-Economic Environment –** The potential socio-economic effects during the institutional control period include effects on continued employment, land use/availability, the availability of the land for alternate uses or economic development, any changes in the municipal funding arrangement, and ongoing effects or demands on local infrastructure. Alternatives that would provide local employment, encourage economic development and use of the site, and would not impose ongoing demands on local infrastructure were considered more favourable. Alternatives that would have restrictions on future use of the land, deter or limit economic development and require ongoing demands on local infrastructure were considered proportionately less favourable.

- **Post-closure Phase - Post-Institutional Control:**
  - **Groundwater, Aquatic, Terrestrial and Atmospheric Environment** – The potential effects on the environment during the post-institutional control period assumed that institutional control would have been lost. All alternatives must meet regulatory standards for releases to the environment under normal conditions. Alternatives that would be purpose built to provide protection without the need for human intervention were considered more favourable. Alternatives that would require ongoing human intervention in order to remain effective were considered proportionately less favourable.
  - **Socio-Economic Environment –** Socio-economic effects were not evaluated for the post-institutional control period. This phase assumes that all knowledge and control of the site has been lost, so the site could not influence the actual or perceived socio-economic benefits or drawbacks.

2.5.3 Selection of Alternative Means

Alternative means to decommission WR-1 were identified through internal CNL discussions and from public and Indigenous engagement activities.

CNL focused on first identifying the possible end-states for WR-1:

1) radioactive contamination is not present at WR-1 above unrestricted clearance levels; and

2) radioactive contamination is present at WR-1 above unrestricted clearance levels.

In order to achieve the first end-state (no contamination remaining at WR-1), the only possible decommissioning strategy is:

- complete dismantling of the reactor and removal of wastes to an off-site facility for interim storage or disposal.

The second end-state, where radioactive contamination will remain at the WR-1, can be achieved with any one of three decommissioning strategies.

- **Status quo –** The building and equipment remains in its current storage with surveillance state and is decommissioned following a deferment period.
- **On-site storage –** Radioactive waste is collected into storage containers, moved to the WMA and stored and monitored indefinitely.
- **On-site disposal –** Radioactive waste is placed into a safe final disposal configuration. Disposal can be provided for all or some of the WR-1 components.

On-site storage was eliminated from the assessment because it is contrary to the ALARA principle. It exposes workers and the public to the highest potential exposures during the decommissioning work and does not remove the wastes from the site. Interim storage would require substantial additional storage infrastructure to be constructed at the WL site, which would increase the scope, hazards and costs of the work, again without providing any reduction of on-site liabilities. Without a final disposal facility identified at this time, there is a risk that interim storage methods will require ongoing maintenance for an unidentified period of time.

Table 2.5.3-1 lists the alternative decommissioning strategies that CNL chose to include in this evaluation.

Table 2.5.3-1: Alternative Means Evaluated for the Project

Decommissioning Parameter	Alternatives Evaluated in the EIS
Decommissioning Strategy	■ Alternative #1 – Deferred Dismantling and Removal ■ Alternative #2 – Immediate Dismantling and Removal ■ Alternative #3 – ISD ■ Alternative #4 – Partial Dismantling and Removal with ISD of the Remainder ■ Alternative #5 – ISD Using Alternative Backfill Materials ■ Alternative #6 – Rolling Stewardship

EIS = Environmental Impact Statement.

Feedback on alternatives from the public and Indigenous peoples (see Sections 4.0 Indigenous Engagement and 5.0 Public Engagement) focused on full dismantling as originally assessed and approved in the CSR (Alternative #1), thereby preserving the status quo.

Other comments were related to being able to retrieve or remediate the disposed reactor at an unspecified future date should monitoring show that environmental effects are not acceptable. A specific suggestion was the use of sand instead of grout as a backfill material, with the expectation that the sand could be more easily removed in the event that retrieval or remediation efforts were undertaken; thus Alternative #5 was added to the assessment.

The concept of "Rolling Stewardship," where wastes are packaged and stored in an accessible location and monitored on site in perpetuity, was proposed both through the public and Indigenous (specifically by Turtle Lodge, located on Sagkeeng First Nation) review of the Project's Draft Environmental Impact Statement (Golder et al. 2017); thus Alternative #6 was added to the assessment.

Another suggestion was to create a geologic repository on the WL site. This option was not considered separately by CNL as it would be included in Alternative #4, which considers partial ISD with alternate disposal of the reactor core components in another facility.

2.5.4 Assessment of Alternatives

2.5.4.1 Alternative #1 – Deferred Dismantling and Removal

Alternative #1 is deferred decommissioning with complete dismantling and removal of the WR-1 Building. This alternative is currently approved under the existing decommissioning licence for the WL site as described in CNL's DDP for Building 100 (CNL 2015). This decommissioning strategy assumes an additional prolonged period of storage and surveillance (more than 30 years) prior to completing decommissioning activities.

The major tasks during the closure phase include monitoring and surveillance during the deferment period and then the complete removal of the reactor and the building as follows (CNL 2015):

- removal of non-contaminated asbestos-containing materials and disposal at an appropriate facility;
- removal of contaminated asbestos-containing materials and disposal as radioactive waste;
- removal, segmentation, packaging and transport of the reactor fuel channels;

- removal, segmentation as required, packaging and transport of reactor thermal shields, the reactor vessel and components;
- removal, segmentation, packaging and transport of reactor process systems and equipment;
- decontamination of the building to meet the release criteria;
- final radiological surveys to verify that release criteria are met;
- removal of the building structure to 3 m below ground level;
- backfilling of the site to return it to a state that blends with the surroundings; and
- transport the radioactive waste to a disposal facility.

As described in CNL's DDP for Building 100 (CNL 2015), the WR-1 Building would be decontaminated to allow the bulk of the construction material to be reused, rubblized and used to backfill the WR-1 void or transferred to an inactive landfill. Decontamination and size reduction of materials and equipment would be performed where practicable. Decontaminating techniques that would not produce liquid wastes were preferred to avoid discharge of contaminants to the environment. Decontamination could produce contaminated concrete rubble and other building components, which would be transferred to another facility for interim storage or directly to a final disposal facility. Following removal and decontamination, the facility would be subjected to a radiological survey to confirm that facility release criteria have been met. The remaining building components could be reused or recycled, transferred to an inactive landfill site, or remain in-ground and backfilled over. Once decommissioning is complete, the area would likely be designated for industrial land use, with no restrictions.

During the institutional control period, the wastes were assumed to be kept in interim storage before being transferred to an undefined final disposal facility. The institutional control period would include the institutional control period established for the final disposal facility.

The post-institutional control period occurs after institutional control ends for the disposal facility.

2.5.4.1.1 Technical

The goal of this alternative is to allow radioactive components remaining in the WR-1 Building to decay to safer levels to reduce radiation exposure of workers and the public during decommissioning. There are numerous examples of complete decommissioning projects of nuclear reactors in the United States, United Kingdom, Japan, France and Germany. Canada has not performed a reactor dismantling project yet, other than simple SLOWPOKE reactors. Lessons learned from previous decommissioning work would be used to prepare and execute this decommissioning plan, including the World Association of Nuclear Operators, Institute of Nuclear Power Operations and CNL. There are no foreseeable technical complications to applying those techniques and lessons learned to WR-1.

The complete removal of the facility would require the off-site disposal of wastes. It was assumed that an approved disposal facility would exist or be imminent at the time of decommissioning (i.e., in 30 years), and that it would have the capacity to accept the wastes to be generated from WR-1. Therefore, interim storage of wastes would not be required for deferred decommissioning, or only required for a short time. In the event that off-site disposal would not yet be available, additional interim storage capacity would be required. Interim storage facilities already exist, and expansion would not be technically challenging. The requirement for human support or intervention would end once the final disposal state is reached.

Delayed decommissioning means that the radioactive components within WR-1 would stay on site for a longer period of time. CNL would continue its surveillance and monitoring programs. These programs have been in place for over 20 years at the WL site and are effective at monitoring releases to the environment. Once decommissioning is complete, monitoring would be completed to confirm that the non-radiological and radiological clearance and release criteria meet the target end-state (industrial land-use). Long-term monitoring requirements during the institutional control period are expected to be relatively straightforward and include verifying that release criteria continue to be met.

The technical feasibility of this alternative hinges on the expectation that an off-site disposal facility would exist in the near future. The technical feasibility of the Project would diminish over time if delays to the construction of a final waste disposal facility occur. The technical feasibility of final disposal is not assessed here, as facility design has not been chosen. A key consideration would be whether the facility is dedicated to WR-1 wastes or accepts wastes from other customers. The assumption that a disposal facility would be available is reasonable as several different types of waste disposal facilities have been constructed successfully worldwide to date.

In summary, Alternative #1 (deferment) does meet the technical feasibility criteria as set out in Section 2.5.2.1. The technology for Alternative #1 is proven, and the monitoring programs currently in place at the WL site would continue until decommissioning is complete. Monitoring during the institutional control period could be developed that meets national and international requirements. The assumption that an off-site waste disposal facility would be available in the future is realistic, and thus the alternative is technically feasible and carried forward for further assessment.

2.5.4.1.2 Economic

Alternative #1 would require a prolonged deferment period (more than 30 years) and additional costs associated with ongoing storage with surveillance. As long as WR-1 and the WR-1 Building remain in their current state, the required costs include ongoing security, fire and radiation protection, environmental monitoring, regulatory compliance programs, and maintenance and repairs to necessary infrastructure. The projected annual cost to support these ongoing activities for the WL site is between $9 million (M) and $20 M during decommissioning and $4 M in the final year after all major decommissioning has been completed. Assuming that the overall cost of storage and surveillance remains at 2018 levels, the annual cost is $4 M. Deferring decommissioning a further 30 years results in an additional storage with surveillance cost of about $120 M (Table 2.5.4-1). This would be in addition to the cost of full dismantling and removal of WR-1 at the end of this deferment period. The cost associated with the deferred decommissioning is anticipated to be marginally lower because of the decreased levels of radioactivity for shorter-lived radionuclides such as cobalt-60, hydrogen-3 (tritium) and iron-55, as compared to immediate decommissioning. However, these savings would be largely offset by the costs of a lengthy storage and surveillance period and increased costs due to escalation.

The cost and risk associated with packaging and transporting waste from Whiteshell Laboratories to Chalk River Laboratories has been evaluated as part of the overall CNL integrated waste strategy. This assessment determined a cost estimate of $24 M (see Table 2.5.4-1) to package, transport and store wastes from decommissioning WR-1 using Alternative #1.

Monitoring requirements were based on the assumption that 10 years of monitoring would be completed following decommissioning to verify that non-radiological and radiological clearance and release criteria defined in the WL Closure Land-Use and End-State Plan would be in accordance with the target end-state.

Table 2.5.4-1: Alternative #1 Estimated Cost

Project Component	Activities	Cost ($ Million)
Storage and Surveillance	Includes ongoing security, fire and radiation protection, environmental monitoring and regulatory compliance programs	120
Decommissioning of WR-1 Building	Includes the complete dismantling and removal of the WR-1 Building	>120
Transportation and Storage of Waste	Waste handling, packaging and transportation of wastes to an off-site disposal facility	24
Monitoring Requirements	Includes environmental monitoring after decommissioning is complete	1
	Total	265

The costs of construction of a final disposal facility are not estimated or included in this comparison, as the costs could vary depending on the facility design chosen.

There are no post-institutional control activities on site associated with Alternative #1. Any post-institutional control activities associated with off-site disposal are not included in this evaluation.

The estimated costs of Alternative #1 are feasible within recent and current funding arrangements. As such, Alternative #1 is deemed economically feasible and carried forward for further assessment.

2.5.4.1.3 Safety

2.5.4.1.3.1 Worker Safety

For Alternative #1, the deferment period is considered to be part of the closure phase. The risks to workers during this phase are essentially the same as they are currently and are well understood. There is some uncertainty about the extent of building maintenance that would be required to maintain the current level of safety for workers as the facility continues to age during the deferment period. Over the course of the deferment period, the risks to workers from failing or damaged equipment, and the risks associated with correcting those failures, would generally increase until decontamination and demolition of the WR-1 Building begins. However, these risks are still considered very small and have been well managed to date.

After the deferment period, full dismantling and removal would require sectioning of the fuel channels and reactor vessel, which represent the areas of highest radioactivity. Proper sectioning and bundling of all below-grade materials for safe hoisting would also require substantial work within the WR-1 Building. As described previously, the goal of this alternative is to allow radioactive components remaining in the WR-1 Building to decay to safer levels to reduce radiation exposure of workers during decommissioning. Even though full dismantling and removal would require workers to be present below-grade for prolonged periods of time, dose controls requirements (e.g., shielding and distance) would be less onerous for deferred decommissioning as compared to immediate dismantling and removal (i.e., Alternative #2). However, even with the deferment period, there are aspects of the work that would still require effort to mitigate radiological exposures during removal of the reactor components.

Equally important are the non-radiological hazards present in WR-1, such as asbestos, which do not decay over the course of the deferment period. All asbestos would have to be remediated prior to removing piping and equipment. The extensive remediation efforts may be further hindered by the ongoing degradation of the asbestos during the deferment period. Lead paint, PCBs and mould are also potential hazards that must be addressed and

mitigated during demolition work. More extensive and intrusive decommissioning work would create more risk of exposures to and releases of these materials.

Other industrial hazards are also associated with the dismantling and removal of WR-1. Because much of the contaminated equipment and materials are located below-grade, removal would require considerable cutting to properly section and bundle materials for safe extraction. This would increase worker exposure to risks associated with cutting tools, working at heights, confined spaces and hoisting/rigging. Therefore, additional safety controls would be required to protect workers in these areas.

While the construction and operation of an off-site disposal facility is outside the scope of this project, the effects of that work were considered when assessing the alternatives. Off-site disposal would require workers to dismantle WR-1 at the WL site, package the wastes and transport them on public roads to a waste storage or disposal facility. It would also require workers to construct, operate and decommission additional capacity at a waste disposal facility in addition to decommissioning WR-1. This would involve many standard transportation and construction hazards and risks.

The deferment period has one additional limitation that could affect the level of risk to workers and the public: the loss of experienced personnel over the 30-year deferment. Few employees remain with extensive knowledge of the facility. Delaying decommissioning would very likely result in the loss of the ability to draw from that knowledge during decommissioning work. This could exacerbate existing hazards further.

The institutional control period for Alternative #1 has two components:

1) monitoring of the WL site to verify that end-state conditions have been met; and

2) monitoring the removed wastes in their off-site storage/disposal configuration.

On-site monitoring would continue for a period of time to verify that site end-state conditions have been met. This monitoring would be relatively low risk for workers and would involve collection of various water, soil, flora and fauna samples. This work is currently being performed at the WL site as part of ongoing operations, but is expected to decrease over time. The institutional control period is estimated to last 200 years for Alternative #1 (CNL 2015).

Off-site monitoring during the institutional control period is less defined. It is assumed that a disposal facility will exist, but the location and type of facility are yet to be determined. As such, it is assumed that any facility built would have a similar level of monitoring as Alternative #3 (ISD).

After the institutional control period, it is assumed that there would be no workers present at the site. As such, worker safety is not discussed for the post-institutional control period.

Overall, Alternative #1 would involve intensive decommissioning work and put workers at the highest risk of injury compared to all other alternatives during the closure phase. It would also require off-site construction work for additional storage or disposal capacity. The radiological hazard would be slightly reduced in Alternative #1 compared to Alternative #2 (no deferment), but all other non-radiological hazards would remain largely the same. The loss of experienced workers over the deferment period would further exacerbate these risks. The risks to workers during the institutional control period are well understood and are lower than during the closure phase. This alternative assumes that safe final disposal of the waste would occur before the end of the institutional control

period. The only assumption that can be made about monitoring at the disposal facility is that it would be done in accordance with safety standards of the time.

2.5.4.1.3.2 Public Safety

For Alternative #1, the deferment period is considered to be part of the closure phase. The risks to the public during this phase are essentially the same as they are currently and are well understood. After the deferment period, full dismantling would occur, requiring intrusive decommissioning activities. These activities have the potential to increase both radiological and non-radiological emissions to the air and water, though any such increases would be planned, mitigated and monitored so that emissions remain ALARA and within the safe limits established through the existing decommissioning licence for the WL site. Once the wastes are removed from the WL site, the risk to the public would be reduced from the already benign levels seen during the deferment period. As such, there is not expected to be any remaining risk to the public following the closure phase. Dismantling of WR-1 would require volumes of waste, including the reactor core components, to be transported from the WL site to an approved interim storage location. The materials would likely be transported by road, resulting in an additional risk of a transportation incident. Transporting hazardous materials (both radioactive and non-radioactive) is routine and the risks are well understood. The risks are transferred to the public along the transport route, as well as in the vicinity of the interim storage location. These risks are considered to be very low.

During the institutional control period, the wastes are assumed to be in a waste storage or disposal facility that is routinely maintained and monitored to prevent releases to the environment. This presents a low risk to the public in the vicinity of the new facility, unless additional handling or transportation of the waste were required at some point prior to final disposal. Again, those risks would be small due to the extensive experience in waste handling and transportation. Additional risks related to the construction of the new facility, including increased construction traffic and fugitive dust emissions, could be effectively managed.

In the post-institutional control period, it is assumed that a final disposal facility will exist for the wastes. The type of facility and its location would be socio-economic factors at the time of construction. With such uncertainty, it cannot be assumed that a future disposal facility would pose a lesser risk to the public than any such facilities that exist today or that are currently proposed. CNL assumes that the risks to the public from such a future disposal facility are at least equivalent to the risks associated with the proposed ISD method (Alternative #3).

2.5.4.1.4 Environmental

For Alternative #1, the deferment period is considered to be part of the closure phase. The risks to the environment during this phase are essentially the same as they are currently and are well understood. Dismantling and removal of WR-1 would require extensive and intrusive decommissioning activities (e.g., dismantling, cutting, hoisting). These more intrusive activities would likely result in increased air emissions from the following sources:

- increased use of vehicles and equipment that combust fuel and emit indicator compounds;
- more vehicles travelling on roads that emit fugitive dust; and
- additional release of radioactive compounds during cutting and dismantling of equipment for transport off site; however, the release of radioactive compounds would still be expected to be within applicable release limits (AECL 2001).

Increased air emissions, both radiological and non-radiological, present potential risks to the public, vegetation and wildlife. Effective mitigation could be implemented so that the release of radioactive compounds would be within applicable release limits (AECL 2001). These measures are described in detail in CNL's DDP for Building 100 (CNL 2015). In addition, deferred decommissioning would take place after a period of natural radioactive decay, thereby reducing the risk of radionuclides being released during decommissioning.

The increased vehicle use during decommissioning and the transporting of wastes off site would also result in increased greenhouse gas emissions. An air quality assessment was completed as part of the CSR for the entire WL site (AECL 2001). The CSR assessed the removal of WR-1 (Alternative #1). The assessment determined that appropriate mitigation could be implemented so that air emissions would not result in significant effects.

During the institutional control period, residual radiation may still be present, but it is expected to be at very low levels (below the clearance levels). There would be no risk to the environment at the WL site in the post-closure phase. Removal of WR-1 would eliminate the potential risk of radioactive contaminants entering and potentially affecting human health and the environment.

Alternative #1 has the WR-1 liability and associated risks transferred to another off-site facility for interim storage, and then to a final disposal facility. It is not yet known what environmental effects would be associated with these new facilities.

In the post-institutional control period, the potential effects on the groundwater, aquatic, terrestrial and atmospheric environment would be comparable to other long-term waste disposal options. CNL conservatively assumes that the risks to the environment from a future disposal facility would be at least equivalent to the risks associated with the proposed ISD method (Alternative #3).

From a socio-economic perspective, the extended deferment period and full dismantling approach provides the most man-hours of employment and direct economic benefit to the region of any of the alternatives. The direct economic benefit would be limited to the closure phase, as there would be little work performed at the WL site during the institutional control period since all wastes would have been transferred off site. That economic benefit from monitoring and surveillance work would be transferred to the host community of the interim waste storage facility and the future disposal facility. The complete removal of materials from the WL site would result in an increased level of traffic and wear on local, regional and national roads. The nature of the transportation may also necessitate additional infrastructure upgrades, repairs or temporary closures along the transport route.

In the institutional control period at the WL site, the removal of WR-1 would improve the availability of the site for future business ventures. In addition, complete removal may allow this portion of the site to be released with no restrictions on use, although this would need to be verified against site clean-up criteria. This could result in more diverse commercial or industrial opportunities for the site and additional traditional land use activities (e.g., hunting and berry picking, cultural practices). It is expected that the interim storage facility would be located on a site that has already been allocated for storage of nuclear materials and thus would not necessarily be negatively affected by the interim storage of WR-1 wastes. In addition, the Community Regeneration Partnership, which is intended to help the communities affected by decommissioning, is developing a socio-economic plan for the participating communities and rural municipalities, which could support future economic development and promote the viability of the regional economy. No additional work is expected to occur at the WL site in the institutional control period, and thus there is no expected effect on local infrastructure.

Beyond the institutional control period, it is assumed that prior knowledge of the site and its history would be lost. There should not be any socio-economic effects after the institutional control period.

2.5.4.2 Alternative #2 – Immediate Dismantling and Removal

Alternative #2 would involve the dismantling and removal of WR-1 and the associated building without a deferment period. Similar to Alternative #1, this alternative would involve the removal of all equipment and materials from the WR-1 Building, decontamination of building structure, and demolition and removal of the building structure to 3 m below-ground level. Following removal and decontamination, the site would be subjected to a radiological survey to confirm that the release criteria defined in the WL Closure Land-Use and End-State Plan have been met. The remaining building components could be reused or recycled, transferred to an inactive landfill site, or remain in situ and be backfilled over. Once decommissioning is complete, the area would likely be classified as industrial land use, with no restrictions.

2.5.4.2.1 Technical

The technical feasibility of Alternative #2 (immediate dismantling) is identical to that of Alternative #1. The only difference is the timing of the work. Alternative #2 has the dismantling work beginning immediately, without additional time for radiological hazards to decay. Alternative #2 would require additional procedural and engineered mitigation so that worker exposure to radiological hazards remains ALARA. During and after the latter half of the institutional control period, the radiological hazards would have decayed sufficiently to be considered equivalent to Alternative #1. In summary, Alternative #2 does meet the technical feasibility criteria as set out in Section 2.5.2.1. The technology for Alternative #2 is proven. The monitoring programs currently in place at the WL site would continue until decommissioning is complete. Monitoring during the institutional control period can be developed that meets national and international requirements. The higher radiological hazards for workers are well within a range that has been successfully mitigated in decommissioning projects. The assumption that a off-site waste disposal facility would be available in the future is realistic, and thus the alternative is technically feasible and carried forward for further assessment.

2.5.4.2.2 Economic

The economic feasibility of Alternative #2 is similar to that of Alternative #1. Because Alternative #2 is immediate, the costs associated with a deferment period (e.g., building maintenance and licence requirements) can be avoided. Alternative #2 has an increased radiological risk to workers, with an increased cost to mitigate those hazards. Preliminary estimates put the cost of the work required around $120 M (Table 2.5.4-2). This estimate is at the lower end of costs experienced for dismantling other reactors, which have ranged from $32 M to $1.1 billion.

CNL has prepared a detailed cost estimate of $24 M for the packaging, transportation and waste storage for the WL site. This is the basis for the waste costs associated with dismantling WR-1 (see Table 2.5.4-2).

Monitoring requirements are based on the assumption that 10 years of monitoring would be completed following decommissioning to verify that non-radiological and radiological clearance and release criteria continue to be met.

Table 2.5.4-2: Alternative #2 Estimated Project Cost

Project Component	Activities	Cost ($ Million)
Storage and Surveillance	Includes ongoing security, fire and radiation protection, environmental monitoring and regulatory compliance programs	0
Decommissioning of WR-1 Building	Includes the complete dismantling and removal of the WR-1 Building	120
Transportation and Storage of Waste	Waste handling, packaging and transportation of wastes to an off-site disposal facility.	24
Monitoring Requirements	Includes environmental monitoring after decommissioning is complete	1
	Total	145

As with Alternative #1, the costs of construction of a final disposal facility are not estimated or included in this comparison, as the costs could vary substantially depending on facility design chosen.

There are no on-site post-institutional control activities associated with Alternative #2. Any post-institutional control activities associated with off-site disposal are not included in this evaluation.

The estimated costs of Alternative #2 are feasible within recent and current funding arrangements. As such, Alternative #2 is deemed economically feasible and carried forward for further assessment.

2.5.4.2.3 Safety

2.5.4.2.3.1 Worker Safety

In the closure phase, just like Alternative #1, full dismantling and removal would require sectioning (e.g., cutting and dismantling) of the fuel channels and reactor vessel, which represent the areas of highest radioactivity. Proper sectioning and bundling of all below-grade materials for safe hoisting would also require substantial work within the WR-1 Building. Without the deferment period, the mitigation required to protect workers from radiological hazards would be more onerous than for Alternative #1.

Equally important are the non-radiological hazards present in WR-1, such as asbestos. In the case of non-radiological hazards, not having a deferment period is generally beneficial. The condition of non-radiological hazardous materials usually degrades over time, increasing the potential risk to workers. Immediately dismantling would probably reduce the worker risks from hazardous materials such as asbestos or PCBs.

Industrial hazards are associated with the dismantling and removal of WR-1. Because much of the contaminated equipment and materials are located below-grade, removal would require considerable cutting and dismantling to properly section and bundle materials for safe extraction. This would increase worker exposure to risks associated with powered cutting tools, working at heights, confined spaces and hoisting/rigging.

In contrast to Alternative #1, eliminating the deferment period would reduce the loss of key personnel with valuable operational and personal experience. Few employees would remain with extensive knowledge of the facility, and their expertise and experience would be valuable tools for further reducing risks to workers.

Just as with Alternative #1, the removal of WR-1 would require the off-site disposal of wastes, which would require additional handling by workers for waste packaging and transporting. It is assumed that an approved waste management facility will exist at the time of decommissioning and that it would have the capacity to accept the WR-1 wastes. While the construction and operation of such a facility is outside the scope of the Project, the effects of that work are considered when assessing the alternatives. Off-site disposal would require workers to dismantle, package and transport WR-1, and to construct, operate and decommission additional capacity at a waste disposal facility. Just as in Alternative #1, this would involve many standard transportation and construction hazards and risks.

The institutional control period for Alternative #2 is nearly identical to Alternative #1 (i.e., 200 years). The only difference for Alternative #2 may be a slightly higher radiological risk to workers monitoring the wastes at the off-site storage facility for the first 30 years. However, the increased risks are small and manageable.

In the same way as Alternative #1, after the institutional control period, it is assumed that there would be no workers present at the WL site. As such, worker safety is not discussed for the post-institutional control period.

Overall, Alternative #2, is nearly identical to Alternative #1. It would involve intensive decommissioning work and put workers at a risk of injury or exposure during the closure phase. It would also require additional off-site construction work to build additional storage or disposal capacity. The radiological hazard is slightly increased in Alternative #2, compared to Alternative #1, and all other non-radiological hazards remain largely the same. The elimination of the deferment period provides the benefit of access to experienced and knowledgeable staff that would not be available in the near future. The risks to workers during the institutional control period are well understood and are lower than the closure phase. Alternative #2 assumes that safe final disposal of the waste occurs before the end of an institutional control period, but CNL cannot define how that would be accomplished, other than to assume it would be done in accordance with safety standards of the time.

2.5.4.2.3.2 Public Safety

The activities expected for Alternative #2 have the potential to increase both radiological and non-radiological emissions to the air and water. These emissions can be planned, mitigated and monitored so that emissions remain ALARA, and within the safe limits established through the existing decommissioning licence for the WL site. Once the wastes are removed from the WL site, there is not expected to be any remaining risk to the public. Dismantling WR-1 would require that the volumes of waste, including the reactor core components, be transported to an approved interim storage facility for long-term management. The materials would likely be transported by road, resulting in an additional risk of a transportation incident. Transporting hazardous materials (both radioactive and non-radioactive) is routine and the risks are well understood. The risks are transferred to the public along the transport route, as well as in the vicinity of the interim storage location. These, risks would be considered to be very low.

During the institutional control period, the wastes are assumed to be in a waste storage or disposal facility that is maintained and monitored to prevent releases to the environment. This would present a low risk to the public in the vicinity of the new facility, unless additional handling or transportation of the waste were required at some point prior to final disposal. Again, those risks would be small due to the extensive experience in waste handling and transportation. Additional risks related to the construction of the new facility, including increased construction traffic and fugitive dust emissions, can be effectively managed.

In the post-institutional control period, it is assumed that a final disposal facility will exist for the wastes, though the location and type of facility are unknown. The type of facility and its location would be a product of the socio-economic factors at the time of construction. With such uncertainty, it cannot be assumed that a future disposal facility would pose a lesser risk to the public than any such facilities that exist today or that are currently proposed. CNL assumed that the risks to the public from such a future disposal facility would be at least equivalent to the risks associated with the proposed in situ disposal method (Alternative #3).

2.5.4.2.4 Environmental

For Alternative #2, the risks to the environment are essentially the same as for Alternative #1. The complete removal of WR-1 would require extensive and intrusive decommissioning activities (e.g., dismantling, cutting, hoisting). These intrusive activities are more likely to result in increased air emissions from the following sources:

- increased use of vehicles and equipment that combust fuel and emit indicator compounds;
- more vehicles travelling on roads that emit fugitive dust; and
- additional release of radioactive compounds during cutting and dismantling of equipment for transport off site; however, the release of radioactive compounds is still expected to be within applicable release limits (AECL 2001).

Increased air emissions, both radiological and non-radiological, could present potential risks to the public, vegetation and wildlife. Effective mitigation could be implemented so that the release of radioactive compounds would be within applicable release limits (AECL 2001). These measures are described in detail in CNL's DDP for Building 100 (CNL 2015). The increased vehicle use during decommissioning and the transport of wastes off site would also result in increased greenhouse gas emissions.

An air quality assessment was completed as part of the CSR for the entire WL site (AECL 2001). The CSR assessed the dismantling and removal of WR-1. The assessment determined that appropriate mitigation could be implemented so that air emissions would not result in significant effects.

During the institutional control period, residual radiation could still be present, but it is expected to be at very low levels (below the clearance levels as stipulated in the Nuclear Substances and Radiation Devices Regulations). There would be no risk to the environment at the WL site in the post-closure phase. Removal of WR-1 would eliminate the potential risk of radioactive contaminants entering and potentially affecting human health and the environment.

Alternative #2 has the WR-1 liability and associated risks transferred to another off-site facility for interim storage, and then to a final disposal facility. It is not yet known what environmental effects would be associated with these new facilities.

In the post-institutional control period, the potential effects on the groundwater, aquatic, terrestrial and atmospheric environment would be comparable to other long-term waste disposal options. CNL conservatively assumed that the risks to the environment from a future disposal facility would be at least equivalent to the risks associated with the proposed in situ disposal method (Alternative #3).

From a socio-economic perspective, during the closure phase, the full dismantling approach provides potentially substantial man-hours of employment and direct economic benefit to the region. The direct economic benefit would be limited to the closure phase, as there would be little work performed at the WL site during the institutional

control period since all wastes have been transferred off site. That economic benefit from monitoring and surveillance work would be transferred to the host community of the interim waste storage facility and the future disposal facility. The complete removal of materials from the site would result in an increased level of traffic and wear on local, regional and national roads. The nature of the transportation may also necessitate additional infrastructure upgrades, repairs or temporary closures along the transport route.

In the institutional control period at the WL site, the removal of WR-1 would improve the availability of the site for future business ventures. In addition, complete removal may allow this portion of the site to be released with no restrictions on use, although this would need to be verified against site clean-up criteria. This could result in more diverse commercial or industrial opportunities for the site and additional traditional land use activities (e.g., hunting and berry picking, cultural practices). It is expected that the interim storage facility would be located on a site that has already been allocated for storage of nuclear materials, and thus would not necessarily be negatively affected by the interim storage of WR-1 wastes. In addition, the Community Regeneration Partnership is developing a socio-economic plan for the participating communities and rural municipalities, which could support future economic development. No additional work is expected to occur at the WL site during the institutional control period, and thus there is no expected effect on local infrastructure.

Beyond the institutional control period, it is assumed that prior knowledge of the site and its history would be lost. No socio-economic effects are expected after the institutional control period has ended.

2.5.4.3 Alternative #3 – In Situ Disposal

Alternative #3 would involve ISD of WR-1, where below-grade WR-1 systems, components and structures would be permanently encased with grout. Most of the above-grade structures and all above-grade equipment would be demolished and removed. A small section of the primary heat transport system that is currently above-grade would be removed and placed below-grade with the remainder of the primary heat transport system. After grouting, a concrete cap and engineered cover would be constructed over the below-grade structure. After the closure phase, the remaining structure would be called the WRDF. Institutional control is expected to be maintained for at least 100 years. For the purpose of the assessment, the post-institutional control period is assumed to start 100 years after closure (i.e., once the institutional control period ends).

CNL considered Alternative #3 for WR-1 for three key reasons:

- It allows CNL to safely address the nuclear liability associated with the WR-1 Building.
- CNL does not have a suitable facility available in Canada to accept either the intermediate-level radioactive waste or the organic-contaminated low-level waste expected from dismantling the reactor.
- Alternative #3 is not costlier than the original proposed approach of complete dismantling and removal.

There is no timeline for when a suitable facility might be available in Canada. To ensure that CNL continues to meet its mandate to protect the public and the environment, CNL needed to assess an approach that did not depend on a proposed future disposal facility. The approach for Alternative #3 does not depend on such a facility, does not defer the waste disposal responsibility to future generations, and allows CNL to continue to protect the environment and the public.

2.5.4.3.1 Technical

The US Nuclear Regulatory Commission has recognized ISD as an acceptable decommissioning and disposal strategy since the 1970s (US DOE 2013). The CNSC and the Canadian Standards Association (CSA) also both recognize ISD as an acceptable approach for legacy nuclear facilities such as WR-1, which are remnants of the dawn of the nuclear industry in Canada, and for which decommissioning was not planned as part of the design (CNSC 2021b; CSA 2019).

In situ disposal has already been used for several prototype reactors around the world (Laraia 2014), including:

- **Heavy Water Components Test Reactor, Savannah River, South Carolina** – The Heavy Water Components Test Reactor was an underground reactor built in in 1958. It was 480 times larger than WR-1. ISD was completed in 2011.
- **Lucens Reactor, Lucens, Vaud, Switzerland** – Lucens was a 6 megawatt (MW) experimental reactor (similar physical size to WR-1) that was shut down after an accident in 1969. After 30 years of storage with surveillance, the reactor building was grouted. The site was released from regulatory oversight in 2003 and is now a museum.
- **Boiling Water Reactor Experiment-1 (BORAX-1), National Reactor Testing Station, eastern Idaho** – This test reactor was initially destroyed in 1954. The reactor was placed in a landfill in the mid-1950s. In 1997, an engineered long-term barrier, designed to last 320 years, was installed over the BORAX-1 landfill.
- **R-Reactor and P-Reactor, Savanah River, South Carolina** – The R-reactor was removed from service in 1964. The P-Reactor was shut down in 1990. ISD was completed for both reactors in 2011.
- **Uranium Fueled Graphite-Moderated Reactors, Krasnoyarsk Mining Chemical Plant, Krasnoyarsk, Russia** – Two below-grade reactors (AD and ADE-1) were taken out of service in 1992 and 2010, respectively. In 2009, ISD was selected to decommission the reactors. The decommissioning program is now ongoing.
- **IRT-M Reactor, Tblisi, Georgia** – The reactor was taken out of service in 1988. ISD was completed around the reactor core in collaboration with the IAEA (Project GEO/4/002) in the late 1990s.
- **Below-grade portion of several small reactor facilities at Idaho National Laboratory** – Five Reactors Complexes (Engineering Test Reactor, Materials Test Reactor, Power Burst Facility Reactor, Zero Power Physics Reactor and the Experimental Breeder Reactor II) were all decommissioned at the Idaho National Laboratory. All of the reactors have been removed and disposed of.

Decades of environmental monitoring against design specifications, showed that ISD is a safe, cost-effective decommissioning option (US DOE 2013).

Grout would be used for ISD because it can be pumped into void spaces easily. Filling the void spaces in the below-grade WR-1 Building would stabilize the structure. The introduction of grout would also impede infiltration of water and limit access to intruders (US DOE 2013). Various compounds could be added to the grout formulation to enhance the immobilization of contaminants (US DOE 2013) or to adapt them to local conditions. The properties required for the grout would be achieved using locally available materials that limits water infiltration, minimizing the migration of contaminants to underlying aquifers. In addition, the concrete cap and engineered cover would prevent a person that might inadvertently enter the area from being able to contact buried contamination (US DOE

2013). At the WL site, the concrete cap and engineered cover could also provide insulation from freeze-thaw cycles and reduce degradation of the grouted structure below.

The majority of radiological wastes from WR-1 would be filled as practical with grout and disposed of in situ at the WL site. Only limited quantities of radiological wastes would require packaging and transport to an interim storage facility pending final disposal. Much of the building waste is expected to be clear of contamination. This waste would be handled with standard commercial waste disposal and recycling processes, requiring no additional monitoring or controls.

The institutional control period for the WRDF would involve regular collection of samples and visual inspections of the site. A monitoring program is already in place for the WL site. The monitoring for the WRDF would be added to the existing EAFP. Institutional control is expected to be at least 100 years long. This monitoring would confirm that the WRDF is operating as expected, isolating the waste from the environment and the public.

The post-institutional control period is defined as the time when a major event (such as government collapse or global-scale natural disaster) causes all knowledge of the WRDF to be lost. For the purpose of the assessment, it is assumed to happen 100 years after closure (i.e., once the institutional control period ends).

The safety of the WRDF is provided by means of passive features (e.g., concrete cap and engineered cover) (IAEA 2011b). The performance of the multiple barriers assure that the WRDF remains safe. The monitoring program would verify long-term safety of the public and the environment.

In summary, Alternative #3 addresses all of the relevant technical feasibility criteria set out in Table 2.5.2-1. The technology for Alternative #3 has been implemented successfully in other jurisdictions. The technology can be easily adapted to suit the local conditions. Alternative #3 does not rely on the development of new technologies or facilities and does not rely on institutional controls for long-term safety. As such, Alternative #3 is deemed technically feasible and is carried forward for further assessment.

2.5.4.3.2 Economic

Alternative #3 does not require the dismantling of the WR-1, and therefore does not result in a large volume of waste material to be packaged and transported to an off-site disposal facility. Current estimates indicate costs associated with ISD activities would be about $35 M (Table 2.5.4-3). CNL assumed 100 years of institutional control during which active monitoring would be completed to verify that non-radiological and radiological clearance and release criteria continue to be met. For Alternative #3, it is anticipated that initial monitoring costs would be high and would decrease over time as monitoring becomes more focused.

Table 2.5.4-3: Alternative #3 Estimated Project Cost

Project Component	Activities	Cost ($ Million)
Storage and Surveillance	Includes ongoing security, fire and radiation protection, environmental monitoring and regulatory compliance programs	0
Decommissioning of WR-1 Building	Includes the ISD of the WR-1 and the associated building	35
Transportation of Waste	Waste handling, packaging and transportation of wastes to an off-site disposal facility	<1
Monitoring Requirements	Includes environmental and performance during institutional control (i.e., 100 years)	7
	Total	43

As with Alternative #1, the costs to dispose of the limited amounts of radioactive waste above-ground at a future disposal facility, or monitoring at that future facility, are not included in this comparison.

There are no on-site post-institutional control activities associated with Alternative #3. Any post-institutional control activities associated with off-site disposal are not included in this evaluation.

Alternative #3 does not cost more than Alternative #1, which has already been previously agreed to as economically feasible. Alternative #3 is therefore considered economically feasible and carried forward for further assessment.

2.5.4.3.3 Safety

2.5.4.3.3.1 Worker Safety

In the closure phase, Alternative #3 provides worker safety benefits. Although some demolition and dismantling are still required with the ISD alternative, the number and complexity of tasks is much less, reducing the safety risks to personnel (US DOE 2013). Due to the less frequent and less intrusive nature of the work, the exposure risk to all potential hazards, both radiological and non-radiological, is reduced with ISD.

The ISD would limit the potential radiation exposure to workers because it would reduce the handling and movement of material, and the grouting of the facility prevents migration of contaminants and radioactive emissions (US DOE 2013). Removal, size reduction and packaging of contaminated process equipment could be an intensive operation. Under the ISD alternative, much of this equipment and material would be left within the structure and grouted in place, thereby requiring minimal handling and subsequent exposure to personnel.

Alternative #3 could leverage the experience and knowledge of current senior staff to improve safety. Deferring the Project, such as for Alternative #1, could result in a loss of operational experience and knowledge that cannot be replaced.

Alternative #3 could introduce construction hazards and risks, such as handling raw materials, operating a batch concrete mixing plant, building and placing concrete forms, pouring grout, construction of the concrete cap and engineered cover and final site grading and landscaping. None of these hazards is unique to WR-1; they are standard for medium to large construction projects. The hazards and risks associated with that work would be well within acceptable limits and can be effectively mitigated.

The institutional control period for this alternative has two components:

- monitoring of the WRDF to verify end-state conditions and observed performance criteria are met; and
- monitoring the removed wastes in their off-site storage/disposal facility.

Monitoring of the WRDF would continue for at least 100 years to verify that the WRDF is performing as expected. This monitoring would be low risk for workers and would involve collection of various water, soil, flora and fauna samples, as well as visual inspection of the concrete cap and engineered cover for indications of premature failure.

Monitoring of wastes removed from the site to an off-site disposal facility during the institutional control period is less defined. It is assumed that a disposal facility would exist, but the location and type of facility are yet to be determined. As such it is assumed that any facility built would have a similar level of monitoring as the WRDF. This assumption is supported by the similarities in existing monitoring plans for the WL and Chalk River Laboratories sites and the various waste storage facilities they operate.

After the completion of the institutional control period, it is assumed that there would be no workers present at the WL site. As such, worker safety is not discussed for the post-institutional control period.

Overall, Alternative #3 (ISD) would present a reduced hazard to workers from radiological exposure and industrial hazards during the closure phase due to the less intrusive nature of the decommissioning work. It would still require off-site disposal of some wastes, though the quantity would be greatly reduced as compared to other alternatives. The risks to workers during the institutional control period are well understood and are lower than during the closure phase. There would be no risks to workers in the post-institutional control period.

Alternative #3 would require the transport and disposal of a small volume of waste off site, reducing the risk to handlers.

2.5.4.3.3.2 Public Safety

For Alternative #3, full dismantling would not occur, requiring fewer intrusive decommissioning activities. These activities have the potential for both radiological and non-radiological emissions to the air and water. Such releases would be planned, mitigated and monitored so that emissions remain ALARA, and within the safe limits established through the existing decommissioning licence for the WL site.

The demolition of the above-grade structure would require limited volumes of waste to be transported from WL to an approved interim storage facility. The materials would likely be transported by road, resulting in an additional risk of a transportation incident. The risks associated with transportation of hazardous materials are well understood, and hazardous materials (both radioactive and non-radioactive) are routinely transported. The risks would be transferred to the public living along the transport route, as well as in the vicinity of the interim storage facility. These risks would remain very low.

During the institutional control period, the WRDF would be routinely monitored to identify any releases to the environment. The risk of releases during the institutional control period would be low. The wastes removed from the site for interim storage or disposal would also be monitored. Such monitoring is expected to be equivalent to the WRDF and other waste management facilities currently in operation. The risk from WR-1 related wastes in this facility would be very low since WR-1 waste would likely make up only a very small portion of its inventory.

In the post-institutional control period, the long-term effects of the WRDF on the public are through potential contamination of groundwater, surface water, soils and air near the WRDF. Contamination may be leached from the grouted structure into the groundwater and transferred to surface water, air and soils near the WRDF. The majority of the contamination would remain or decay away within WRDF, and the risks from any emissions to the groundwater would be well below regulatory limits established by the CNSC. Such losses are expected from any type of waste management facility, constructed at any location.

In the post-institutional control period, it is assumed that a final disposal facility will exist for the off-site wastes, though the location and type of facility are unknown. The type of facility and its location would be socio-economic factors at the time of construction. With such uncertainty, it cannot be assumed that a future disposal facility would pose a lesser risk to the public than any such facilities that exist today or that are currently proposed. CNL assumed that the risks to the public from such a future disposal facility would be at least equivalent to the risks associated with future disposal of a fully dismantled WR-1 (Alternative #1 and Alternative #2).

2.5.4.3.4 Environmental

During the closure phase, as decommissioning work begins, ISD would require limited intrusive decommissioning activities (e.g., dismantling, cutting, hoisting) compared to the full removal option. These activities may result in increased air emissions from the following sources:

- increased use of vehicles and equipment that combust fuel and emit indicator compounds;
- more vehicles travelling on roads that emit fugitive dust;
- additional release of radioactive compounds during cutting and dismantling of equipment in preparation for grouting; however, the release of radioactive compounds is still expected to be within applicable release limits; and
- additional fugitive dust from storage and handling of raw materials for grout and from operation of the batch mixing plant or similar equipment.

Increased air emissions, both radiological and non-radiological, could present potential risks to the public, vegetation and wildlife. Effective mitigation can be implemented so that the release of radioactive compounds would be within applicable release limits. The applicable programs to mitigate these hazards are described in detail in CNL's DDP for Building 100 (CNL 2021). The increased vehicle use during decommissioning and the transport of wastes off site would also result in increased greenhouse gas emissions.

An air quality assessment was completed as part of the CSR for the entire WL site (AECL 2001). The CSR assessed the dismantling and removal of WR-1. The assessment determined that appropriate mitigation could be implemented to ensure that air emissions would not result in significant effects. Alternative #3 would require less demolition work but more construction and preparation work, resulting in a likely equivalent level of potential fugitive dust emissions.

During the institutional control period, routine monitoring would reduce the likelihood of any effects on the environment as a result of the WRDF. The WRDF would have a concrete cap and engineered cover that protects against burrowing animals and deep rooting plants. Any releases to the environment during the institutional control period would be monitored and mitigated as needed to ensure there are no significant effects on the environment. The same would be true for the wastes that were removed from the site and stored/disposed of elsewhere. Alternative #3 has the WR-1 liability remaining at the WL site.

In the post-institutional control period, the potential effects on the groundwater, aquatic, terrestrial and atmospheric environment would be comparable to other long-term waste disposal options. Over long periods of time, the facility would degrade and contamination could be released to the environment through the groundwater. The release of contaminants would pose very little risk to the environment because of the very slow rate at which contaminants migrate out of the WRDF. This is typical of most waste management systems, including any future radiological waste disposal facility expected to be built in Canada with existing technology.

For the wastes that were removed from the WL site, since the final disposal location and configuration is not yet known, a detailed qualitative assessment of potential effects could not be made. The type of facility and its location would be socio-economic factors. CNL conservatively assumed that the risk to the environment from such a future disposal facility would be at least equivalent to that from the proposed ISD (Alternative #3).

From a socio-economic perspective, during the closure phase, the duration of the increased staffing for the closure phase work would likely be shorter than for full dismantling (Alternatives #1 and #2) but would involve the purchase and installation of a substantial amount of raw materials, off-setting some of the cost of work not performed to remove the facility. The direct economic benefit would be highest in the closure phase, but would be substantially reduced during the institutional control period. The economic benefit of employment from monitoring and surveillance work over 100 years would be small compared to staffing levels prior to the closure phase. The installation of grout and the reduced volume of wastes removed from the WL site would result in a similar level of additional traffic and wear on local and regional roads, but would not likely affect infrastructure beyond the local region. The nature of the transportation may also necessitate additional infrastructure upgrades, repairs or temporary closures along the transport route.

In the institutional control period, unlike Alternatives #1 and #2, the presence of the WRDF would result in restrictions on WRDF land use for a period of at least 100 years. The WRDF could affect the availability of the site for future use. This may limit potential commercial and industrial opportunities for the WL site in the future and may limit future traditional land use activities (e.g., hunting and berry picking, cultural practices). As part of the WL Closure Land-Use and End-State Plan being developed, CNL would make efforts to effectively identify and implement a path forward for economic development in the local area. The Plan defines the post-closure end-states, the post-closure land-use classifications and allocation, and the physical release criteria that must be met at the site closure. While the role of the WL site may change, economic and community development are expected to continue. In addition, the Community Regeneration Partnership is developing a socio-economic plan for the participating communities and rural municipalities, which could support future economic development. The ongoing monitoring at the WL site during the institutional control period would likely be limited to the point where no substantial demands were imposed on local infrastructure, including roads.

It is expected that the interim storage or disposal facility for the removed wastes would be located on a site that has already been allocated for storage of nuclear materials. The facility would benefit economically from storing WR-1 wastes.

Beyond the institutional control period, it is assumed that prior knowledge of the site and its history would be lost. There would be no socio-economic effects beyond this point except those related to environmental effects.

2.5.4.4 Alternative #4 – Partial Dismantling and Removal with In Situ Disposal of the Remainder

Alternative #4 entails the dismantling and removal of select WR-1 systems and the ISD of any remaining WR-1 components. It is effectively a combination of the previous alternatives. A series of partial ISD scenarios were examined, including:

1) removal of fuel channels prior to ISD;

2) dismantling and removal of fuel channels and reactor vessel prior to ISD; and

3) dismantling and removal of fuel channels, reactor vessel and additional contaminated systems (e.g., primary heat transport system and/or moderator systems) prior to ISD.

The majority of the activity in WR-1 is located in the calandria and the fuel channels. All other components are considered low-level waste and have little effect on the safety of the WRDF. The change in overall safety case for the WRDF was also negligible when CNL considered removing just the fuel channels. Therefore, the partial dismantling evaluation focused on removing both the fuel channels and the calandria, and leaving all other systems in place for ISD.

Once removed, the reactor core components would be moved to an interim storage or disposal facility.

2.5.4.4.1 Technical

Alternative #4 is a combination of Alternative #2 and #3, both of which have been deemed technically feasible. No additional work is proposed as part of Alternative #4, and it is therefore deemed technically feasible and carried forward for further assessment.

2.5.4.4.2 Economic

Preliminary estimates indicate that Alternative #4 would cost between $10 M and $30 M to plan and execute the sectioning, removal and packaging of the fuel channels and calandria; however, these costs do not include the long-term storage of the core components once they are removed. An additional $35 M base cost for completion of the ISD is also required (Table 2.5.4-4). The packaging, transportation and storage of wastes are estimated at $10 M for fuel channel removal and $15 M for the calandria. The cost of this decommissioning alternative is still lower than the estimated cost for Alternative #2 (Table 2.5.4-2).

Monitoring requirements are conservatively based on the assumption that approximately 100 years of monitoring would be completed following decommissioning (i.e., during institutional control) to verify that non-radiological and radiological clearance and release criteria in accordance with the target end-state. For Alternative #4, it is anticipated that initial monitoring costs would be higher and would decrease over time as monitoring becomes more focused.

Table 2.5.4-4: Alternative #4 Estimated Project Cost

Project Component	Activities	Cost ($ Million)
Storage and Surveillance	Includes ongoing security, fire and radiation protection, environmental monitoring and regulatory compliance programs	0
Decommissioning of WR-1 Building	Includes the partial ISD of the WR-1 Building	45 to 65
Transportation and Storage of Waste	Waste handling, packaging and transportation of wastes to an off-site disposal facility	25
Monitoring Requirements	Includes environmental monitoring during institutional control (i.e., 100 years)	7
	Total	77 to 97

The cost estimates for Alternative #4 fall between the costs of Alternatives #2 and #3, which have both been deemed economically feasible. Therefore, Alternative #4 is deemed economically feasible and carried forward for further assessment.

2.5.4.4.3 Safety

2.5.4.4.3.1 Worker Safety

During the closure phase, this alternative is generally a combination of the various risks and hazards described for Alternatives #2 and #3. Alternative #4 has a similarly high radiological risk to workers, as the removal, handling and transport of the reactor core presents the largest radiological exposure risk of all the work that would be performed. While the expectation to the leave the remaining systems in place would have a lower risk of exposure to non-radiological hazardous materials and industrial hazards, as described in Alternative #3, the grouting of those systems would introduce the additional construction risks associated with ISD. These risks have been shown to be within acceptable limits and could be effectively managed and mitigated through standard safety practises.

In the institutional control period, Alternative #4 would require monitoring of two sites much like Alternative #3: the on-site WRDF and the off-site interim storage/disposal facility for the removed reactor core components. In this case, the more stringent monitoring program would likely be at the off-site facility simply due to the relative hazard of the reactor core to the remaining reactor systems.

In the post-institutional control period, it was assumed that both the WRDF and the removed reactor core components would be disposed of in a passive safe facility and workers would no longer be present.

2.5.4.4.3.2 Public Safety

In the same ways as worker safety above, Alternative #4 combines the risks to radiological exposure and construction hazards from Alternatives #2 and #3. Any work to remove the reactor core components presents a potential for radiological releases to the environment and potential exposure of the public. Similarly, the construction activities associated with ISD of the remaining systems presents a potential increase in fugitive dust and noise pollution, among other pollutants common from large construction projects (e.g., greenhouse gases). The reduction in intrusive decommissioning of the remaining reactor systems does not substantially reduce any risk to the public, as the primary risk reduction from ISD is in the industrial hazards workers are exposed to.

2.5.4.4.4 Environmental

Similar to all other alternatives, Alternative #4 would generate air emissions, both radiological and non-radiological, during decommissioning-related vehicle use and the release of radioactive compounds as equipment is removed or prepared for ISD. Alternative #4 would also require the operation of batch mixing plant (or similar equipment) for grout production and hauling of the cement and aggregate. These activities would generate air and greenhouse gas emissions; however, these emissions are anticipated to be minor and short term in duration and mitigation would be implemented to limit effects (e.g., use of enclosure for raw material handling).

In the institutional control and post-institutional control periods, there would be contaminants disposed of at both the WRDF and an off-site facility. In both cases, groundwater leaching through the disposal facility could migrate to surface water and adversely affect human and ecological health. The design of the ISD and off-site waste facility would be important to minimize groundwater leaching and to protect the environment. The level of risk during the institutional control period would be relatively small, as monitoring would be in place to identify any releases and mitigation would be implemented to reduce or prevent effects on the environment. In the post-institutional control period, the WRDF and future disposal facility for the reactor core components would not be actively monitored. The facilities would be designed to be passively safe to ensure long-term effects on the environment would not be significant. As with Alternative #2, removing the reactor core components from the WRDF would not eliminate the potential effects from them, but instead transfer the risk to a new location. Since it cannot be assumed what the future disposal facility for the reactor core components would be, it is assumed that it would provide at least a similar level of protection as the WRDF.

The socio-economic effects of Alternative #4 would be a combination of the effects of both Alternative #2 and #3. The direct economic benefit of employment during closure would likely be larger than in Alternative #3, but less than Alternative #2 simply due to the expected costs of the work performed.

In the institutional control period, the direct economic benefits and drawbacks of the monitoring work would be roughly the same as Alternative #3, though it is unclear if there would be any additional direct economic benefits as a result of the off-site storage or disposal of the reactor core components.

In the post-institutional control period, because there is assumed to be no knowledge of the facility, there would be no predicted socio-economic effects.

2.5.4.5 Alternative #5 – In Situ Disposal Using Alternative Backfill Materials

Alternative #5 is identical to Alternative #3 and #4 with only one key difference: the use of an easily removable material in place of grout as the backfill for the below-grade structure. A specific example is the use of sand instead of grout as a backfill material, with the expectation that the sand could be more easily removed in the event that retrieval or remediation efforts were undertaken.

2.5.4.5.1 Technical

During the closure phase, the use of sand or other materials is technically feasible as it is technology that is currently available and can be implemented for WR-1. During the institutional control period, the concept is also technically feasible as it would not differ from Alternative #3 in terms of what monitoring would be required. During the post-institutional control period, the concept is no longer feasible. The purpose of the alternate backfill is to make the wastes easily retrievable by humans that are monitoring the wastes. In a post-institutional control period,

the human component is no longer present and the retrievability is no longer valid. The concept was deemed not technically feasible as intentionally retrievable wastes with no human controls is not considered a passively safe condition, and not considered further.

2.5.4.6 Alternative #6 – Rolling Stewardship

Alternative #6 is the concept of "Rolling Stewardship," where wastes are packaged and stored in an accessible facility and monitored in perpetuity. It was proposed both through the public and Indigenous (specifically by Turtle Lodge, located on Sagkeeng First Nation) review of the Project's Draft Environmental Impact Statement (Golder et al. 2017). The concept is presented as an alternative to disposal or "abandonment" of wastes, rather than an alternative means to reach final disposal. The concept centres on the transfer of knowledge of, and responsibility for, the wastes from generation to generation through periodic ceremonies. In these ceremonies, wastes may be recharacterized, repackaged and passed symbolically to the next generation, over and over, until a "solution" to the radiation hazard is found. The concept is not explicit in what an acceptable solution would be.

2.5.4.6.1 Technical

During closure and the institutional control period, Alternative #6 is technically feasible, as CNL currently monitors all radiological wastes and maintains records to convey the knowledge of the wastes to the next responsible persons.

The entire concept is predicated on the assumption that some sort of organization would always exist to administer the stewardship. The criteria for technical feasibility requires that an alternative be safe and perform its intended function without human intervention. This alternative would require human intervention to maintain safety, therefore it is not considered technically feasible. The concept was, therefore, not considered further.

2.6 Comparison of Alternatives

As described in Section 2.5.2, the alternatives were qualitatively ranked according to the criteria listed in Table 2.5.2-1. Results are summarized in Table 2.7-1 and 2.7-2 illustrating the relative preference of each feasible alternative, as shown below.

2.6.1 Technical Feasibility

The alternatives assessment considered the relevant technical feasibility criteria set out in Section 2.5.2.1. The technologies for each proposed alternative are proven and have been successfully deployed at other sites. Monitoring requirements for Alternatives #3 and #4 would be more extensive than for Alternatives #1 and #2 but can be developed to meet national requirements. All alternatives require at least some wastes be transported for storage or disposal. Alternative #5 (using sand as an alternative backfill material) is not easily adaptable for use in WR-1 because of the issue of the material settling with time and being a poor barrier to water movement. Alternative #6 (rolling stewardship) did not meet the feasibility criteria for being passively safe, as it required an undefined long-term human intervention period to be safe.

Alternatives #1 to #4 were all considered technically feasible and carried forward for further assessment. Alternatives #5 and #6 were not considered technically feasible and were dropped from the assessment.

2.6.2 Economic Feasibility

Alternative #1 was approved as the strategy for decommissioning WR-1 as part of the original plan for decommissioning the WL site. The estimated costs have not changed substantially and were considered economically feasible. As such, an alternative that does not cost more than Alternative #1, and achieves the goal of decommissioning WR-1 is considered economically feasible. The costs of each alternative are summarized in Table 2.6.2-1.

Table 2.6.2-1: Summary of Estimated Project Cost for Alternatives

Project Component	Alternative #1 – Deferred Dismantling and Removal ($ Millions)	Alternative #2 – Immediate Dismantling and Removal (no deferment) ($ Millions)	Alternative #3 – ISD ($ Millions)	Alternative #4 – Partial Dismantling and Removal with ISD of the Remainder ($ Millions)
Storage and Surveillance after 2024	120	0	0	0
Decommissioning of WR-1 Building	>120	120	35	45 to 65
Transportation and storage of waste	24	24	<1	25
Monitoring Requirements	1	1	7	7
Total	**265**	**145**	**43**	**77 to 97**

All four alternatives were deemed economically feasible and carried forward for further assessment.

2.6.3 Safety

2.6.3.1 Worker Safety

2.6.3.1.1 Closure Phase

In the closure phase, Alternative #1 has a slightly lower radiological hazard due to decay during deferment, as compared to Alternatives #2, and #4. Alternative #3 however has the lowest radiological hazard as the most hazardous materials (reactor core) are left in place and not accessed for removal. Alternatives #1 and #2 have the highest risk of exposure to non-radiological hazardous materials (such as asbestos) due to the more intrusive nature of the decommissioning work, as compared to Alternatives #3 and #4. Alternatives #1 and #2 also have the highest risk of injury to workers from standard decommissioning hazards such as working at heights, confined spaces, cutting, hoisting and rigging hazards. Alternative #3 would involve the least amount of intrusive decommissioning and therefore offers the lowest risk of injury to workers from standard decommissioning hazards. Alternative #4 falls between Alternatives #2 and #3.

All alternatives have construction risks associated with physical work such as demolition of structures, excavation of soil around the building, fabricating and installing the grout (Alternative #3 and Alternative #4), construction of temporary storage facilities or future disposal facility.

Alternatives #2, #3 and #4 all utilize existing staff with many years of operational knowledge of the facility to enhance planning and safety measures. Alternative #1 cannot reasonably rely on that expertise being available due to the deferment period.

All four alternatives can be safely executed with appropriate mitigation in place.

Overall, for worker safety during the closure phase, Alternative #1 is ranked as least favourable, Alternatives #2 and #4 are favourable, and Alternative #3 is most favourable, based largely on the lower risk of exposure to radiological and non-radiological hazardous materials and standard decommissioning hazards.

2.6.3.1.2 Institutional Control Period

In the institutional control period, Alternatives #1 and #2 are the same and Alternative #4 is the combined effect of both Alternatives #2 and #3. Comparing Alternatives #2 and #3 shows that the risks to worker safety are largely the same for both alternatives. Both require ongoing regulatory control, which is not affected by geographical location, with no expected safety issues for workers. Both alternatives require that sampling and visual inspections be done, and decades of experience at the WL site have shown that this work can be carried out safely. In the case of Alternative #2, monitoring requirements are likely to be less comprehensive for the interim storage of the wastes because they would be above-ground, requiring less below-grade sampling. Once the wastes are moved from storage to disposal, the monitoring requirements become at least equivalent to Alternative #3.

Since Alternative #4 would require both on- and off-site monitoring, the effect on worker safety in the institutional control period is effectively doubled.

Overall, in the institutional control period, Alternatives #1, #2 and #3 are largely equivalent and rated as most favourable. Alternative #4 is rated as favourable.

2.6.3.1.3 Post-institutional Control Period

In the post-institutional control period, it was assumed that there would be no ongoing monitoring and control and no workers present at the site. As such, the effects on workers in this period were not evaluated.

2.6.3.2 Public Safety

2.6.3.2.1 Closure Phase

During the closure phase, the primary risk to the public is exposure to airborne and waterborne emissions of both radiological and non-radiological contaminants. The likelihood and magnitude of emissions are driven by the level of intrusive decommissioning work. Alternatives #1 and #2 are largely the same risk, except for a slight increase in radiological risk associated with Alternative #2. Alternative #3 would require the least intrusive decommissioning work and presents the lowest risk of emissions to air and water. Alternative #4 falls between Alternatives #2 and #3.

All four alternatives can be executed safely, which has been demonstrated by recent decommissioning and demolition experience at the WL site.

Overall, Alternative #3 was rated as most favourable, Alternative #4 as favourable, and Alternatives #1 and #2 as least favourable.

2.6.3.2.2 Institutional Control Period

In the institutional control period, the primary risk to the public is exposure to airborne and waterborne emissions of radiological or non-radiological contaminants. In Alternatives #3 and #4, the contaminants are sealed below-grade and emissions are routinely monitored. The same is true for Alternatives #1 and #2, though the wastes are sealed in appropriate storage containers instead of below-ground. In all cases, the routine monitoring verifies that the waste disposal facilities are operating properly. For Alternatives #1, #2 and the off-site portion of Alternative #4, there is access to the wastes to sample for emissions more easily than if the wastes were sealed below-ground. However, access or the need to relocate the stored wastes creates additional opportunities for emission of contaminants. In all cases, WL has demonstrated experience in effectively and safely monitoring wastes stored both above- and below-grade at the WL site, and all four alternatives can be executed safely.

Overall, all four alternatives were rated as favourable.

2.6.3.2.3 Post-institutional Control Period

In the post-institutional control period, the primary risk to the public is exposure to radiological or non-radiological contaminants emitted from the final waste disposal facility. All four alternatives were assumed to have an acceptable decommissioning strategy for the WR-1 waste. It was assumed that each decommissioning strategy was defined before the end of institutional control.

Alternatives #1, #2 and #4 rely on the assumption that a future disposal facility would be constructed, and that it will provide a greater degree of safety to the public than Alternative #3. This assumption is based on experience that safety standards and risk management improve with time. However, this assumption also must consider that any future disposal facility would also reflect the socio-economic conditions at the time of disposal. As such, there is no certainty that a future disposal facility would provide a substantially safer disposal method for WR-1 than ISD. It was assumed that each of the four alternatives would meet the applicable Canadian standards and regulations.

Alternative #3 would not rely on a future disposal facility. It has been shown that it would meet the safety standards currently in place.

Overall, because of the uncertainty around the future design of a final waste disposal facility, or the future changes to current safety standards, each alternative was assumed to provide at least an equivalent level of long-term safety for the public. Each alternative was rated as favourable.

2.6.4 Environmental Effects

2.6.4.1 Biophysical Environment

2.6.4.1.1 Closure Phase

In the closure phase, the primary risk to the environment is the emission of radiological or non-radiological contaminants from WR-1 to air and water. The primary cause of the emissions is from intrusive decommissioning work that disturbs such materials during removal.

Alternatives #1 and #2 would involve the most intrusive decommissioning work and the highest risk of emissions of contaminants into the air and water. Alternative #3 would require the least amount of intrusive decommissioning work and has the lowest risk of emissions. Alternative #4 falls between Alternatives #2 and #3.

Secondary risks are from increased greenhouse gas emissions, nuisance dust, noise pollution and habitat destruction. These are generally produced by the use of heavy equipment, trucks and loud machinery. Each alternative would require demolition of at least the above-grade structures of WR-1. This would use heavy machinery, portable power generators and trucks to transport equipment to site, and waste materials off site. There is potential for dust generation and noise pollution from the demolition work. Both of these can be mitigated through dust suppression techniques and timing of the work to minimize effects on locally nesting wildlife.

Alternative #1 and #2 would require transporting more radiologically contaminated waste, generating additional greenhouse gases and fugitive dust. Alternative #3 would require transporting of raw materials for grouting and the operation of a batch mixing facility or similar equipment. Both of these activities would also generate greenhouse gas emissions and fugitive dust. The use of dust suppression methods and active air monitoring would mitigate any effects from dust. It is likely that the greenhouse gas emissions would be higher for Alternative #3 as the transport of raw materials to the site likely outweighs the transport of waste off the site in Alternatives #1. Alternative #4 would require both the additional dismantling and shipping of waste, and also includes transporting raw materials for grouting, likely producing the highest greenhouse gas emissions.

In Alternatives #1, #2 and #4, additional interim waste storage capacity may be required. These facilities would likely be constructed on an existing nuclear licensed site in Canada, limiting the risk of habitat disturbances during construction.

In each alternative, the potential effects on the environment could be effectively mitigated through adherence to industry best practices and procedures. CNL has a demonstrated record of performing nuclear demolition and construction activities in adherence to environmental protection programs and limits as per the CNSC-issued site decommissioning licence. As such, all four alternatives can be considered safe for the environment with appropriate mitigation in place.

Overall, each alternative has the potential to affect the biophysical environment. The effects of Alternate #3 are limited to the WRDF, while the other alternatives also have potential effects at an undetermined new interim storage facility. As such, Alternative #3 was rated as most favourable, Alternatives #1 and #2 were rated as favourable, and Alternative #4 was rated as least favourable.

2.6.4.1.2 Institutional Control Period

In the institutional control period, the primary risk to the environment is exposure to airborne and waterborne emissions of either radiological or non-radiological contaminants. In Alternatives #3 and #4, the contaminants are sealed below-grade and emissions are routinely monitored. The same is true for Alternatives #1 and #2, though the wastes are sealed in appropriate storage containers instead of below-ground. In all cases, the routine monitoring for emissions quantifies any releases. For Alternatives #1 and #2, and the off-site portion of Alternative #4, there is easier access to the wastes to sample for emissions than if the wastes were sealed below-ground. However, access or the need to relocate the stored wastes creates additional opportunities for emission of contaminants. In all cases, WL has demonstrated experience in effectively and safely monitoring wastes stored both above- and below-grade at the WL site, and all four alternatives can be executed safely.

The only real difference between the alternatives during the institutional control period is effects of human presence at the disposal or storage site. The WRDF would require very little human presence. An interim storage facility may require more frequent inspection of both the waste and facility support systems. The increased human presence can contribute to an increase in overall risk from vehicle strikes, animal control or noise pollution.

In all cases, WL has demonstrated experience in monitoring and mitigating effects of CNL operations on the surrounding environment, and each alternative can be executed without significant adverse effects on the environment.

Overall, Alternative #3 was rated as most favourable, and all other remaining Alternatives were rated as favourable.

2.6.4.1.3 Post-Institutional Control Period

In the post-institutional control period, the primary risk to the environment is exposure to either radiological or non-radiological contaminants that are released into the environment. The waste from each alternative was assumed to be disposed of in an approved facility. It is possible that the future facilities would provide more effective containment of the wastes than the WRDF. However, CNL assumed that each alternative would have its waste in a disposal facility that meets the current Canadian standards and regulations.

As each alternative is expected to meet the safety standards of the time, they are all safe and were all rated as favourable.

2.6.4.2 Socio-economic Environment

2.6.4.2.1 Closure Phase

In the closure phase, the primary risk to socio-economic environment is in the available employment opportunities and their duration. All four alternatives require substantial financial resources for labour. Generally, the higher the cost, the more potential benefit to the local and regional economy. Alternatives #1 and #2 would have higher labour costs and more direct employment benefits due to the larger scope of work to be performed. Alternative #3 would utilize new materials purchased from local suppliers, providing a benefit both from direct employment and purchase of raw materials locally. In all cases, the work to be performed provides valuable experience to current employees, contractors and vendors who participate in the Project. That experience carries value to future employment opportunities.

Alternative #1 is expected to take the longest, and therefore would likely have the longest lasting employment benefit. Alternative #2 would follow as second longest, with Alternative #3 and #4 having the shortest direct employment benefit.

Another benefit from each alternative is related to supplementary work required off site such as construction of additional interim storage capacity, transportation of wastes and regulatory support for project activities. Alternatives #1, #2 and #4 all provide substantial related employment opportunities that are not as prominent in Alternative #3.

The WR-1 site would not be available for development during the closure phase, so there are no expected effects on the suitability of the site for redevelopment during this phase.

Overall, Alternatives #1 and #2 were rated as most favourable, Alternative #4 was rated as favourable, and Alternative #3 was rated as least favourable during the closure phase.

2.6.4.2.2 Institutional Control Period

In the institutional control period, the primary factors affecting the socio-economic environment are ongoing employment opportunities and suitability of the WRDF area for new economic development, and access to the lands for traditional uses.

In each alternative, there would be employment opportunities for ongoing monitoring and surveillance work, such as field staff performing inspections, laboratory staff analyzing samples and safety staff reporting to regulatory authorities. It cannot be assumed that the opportunity would be local to the WL site. Work could be performed by staff based in another part of the country (e.g., Chalk River Laboratories), so the benefits cannot be compared for regional benefit.

All or part of the WL site is expected to be made available in the future for new development, or for cultural or traditional uses. In each alternative decommissioning strategy, there is the potential for residual radiological contamination on the site that could affect the availability of the site for future uses. Radioactive contamination, even at the low levels expected at the WL site, would usually be considered a detriment to development or other future use. However, there are niche industries (e.g., power generation, medical isotope production) for which a previously affected site would be an opportunity to reduce their own potential effect on the environment by not developing unaffected land. Such industries are typically large employers with high paying employment opportunities. The potential benefit from a niche developer is difficult to compare to general market suitability of the site. Due to the uncertainty and for conservatism, it is assumed that such an industry would not want to develop the site because of the overall unavailability of the site for future use.

While all four alternatives are expected to enable a large portion of the WL site to become available for traditional uses by the Red River Métis and the First Nation, the perception of usability for traditional purposes may be negatively impacted by residual radioactivity or waste. While much of the site will be suitable for other uses, including traditional uses, Alternatives #3 and #4 will likely result in a small overall portion of the site remaining undesirable for traditional uses. Alternatives #1 and #2 are expected to have the most positive impact on the suitability of the site for traditional uses.

The wastes from Alternatives #1, #2 and #4 were assumed to be transferred to an existing nuclear site, so no adverse effects on the socio-economic environment near the interim storage or disposal facility would be expected. Alternative #3 leaves the most radioactivity at the WL site, followed by Alternatives #4 and #1/#2.

CNL would make efforts to effectively identify and implement a path forward for economic development, no matter how WR-1 is decommissioned. In addition, the Community Regeneration Partnership is developing a socio-economic plan, which is expected to support future economic development and community development.

Overall, Alternatives #1 and #2 were rated as most favourable, Alternative #4 was rated as favourable, and Alternative #3 was rated as least favourable.

2.6.4.2.3 Post-institutional Control Period

In the post-institutional control period, there was assumed to be no remaining knowledge of the facility. The socio-economic effects of the alternatives are only related to the potential environmental effects from each alternative. Since it was assumed that each alternative would provide a safe long-term disposal option, each alternative was deemed equivalent and should not have any socio-economic effects.

Each of the four alternatives were rated as favourable.

2.7 Conclusion

Tables 2.7-1 and 2.7-2 present a summary of the evaluation for each alternative. Table 2.7-1 summarizes the feasibility screening of the six presented alternatives and which criteria they passed and failed. Table 2.7-2 summarizes the evaluation for each feasible alternative and the Total Score for each.

Table 2.7-1: Summary of the Evaluation of Alternatives – Feasibility Screening

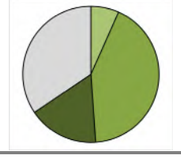
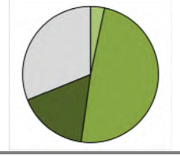
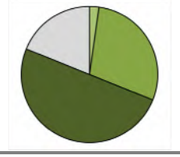
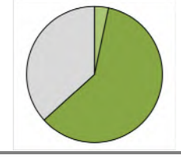
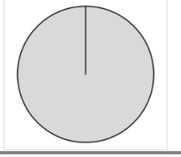
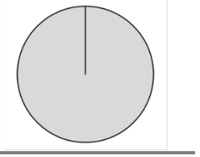
Criteria	Alternative #1 – Deferred Dismantling and Removal		Alternative #2 – Immediate Dismantling and Removal		Alternative #3 – ISD		Alternative #4 – Partial Dismantling and Removal with ISD of the Remainder		Alternative #5 – ISD with Alternate Backfill		Alternative #6 – Rolling Stewardship	
Technical Feasibility												
Closure Phase	⭕		⭕		⭕		⭕		⭕		⭕	
Post-closure Phase - Institutional Control	⭕		⭕		⭕		⭕		⭕		⭕	
Post-closure Phase - Post-institutional Control	⭕		⭕		⭕		⭕		🚫	Not effective barrier to intrusion/subsidence	🚫	Cannot be relied upon long term
Economic Feasibility												
Closure Phase	⭕		⭕		⭕		⭕		Not assessed		Not assessed	
Post-closure Phase - Institutional Control	⭕		⭕		⭕		⭕		Not assessed		Not assessed	
Post-closure Phase - Post-institutional Control	⭕		⭕		⭕		⭕		Not assessed		Not assessed	

Notes:

⭕ Feasible

🚫 Not Feasible

Table 2.7-2: Summary of the Evaluation of Alternatives – Assessment of Alternatives

Criteria	Alternative #1 – Deferred Dismantling and Removal	Alternative #2 – Immediate Dismantling and Removal	Alternative #3 – ISD	Alternative #4 – Partial Dismantling and Removal with ISD of the Remainder	Alternative #5 – ISD with Alternate Backfill	Alternative #6 – Rolling Stewardship
Safety						
Worker Safety (30%)						
Closure Phase	Most hazard to workers	Most radiological hazard	Least hazard to workers	Most radiological hazard	Not assessed	Not assessed
Post-closure Phase - Institutional Control	Monitoring at single site	Monitoring at single site	Monitoring at single site	Doubled worker exposure risk	Not assessed	Not assessed
Post-closure Phase - Post-institutional Control	No workers present	No workers present	No workers present	No workers present	Not assessed	Not assessed
Public Safety (30%)						
Closure Phase	Most risk of emissions	Most risk of emissions	Least risk of emissions	Intermediate	Not assessed	Not assessed
Post-closure Phase - Institutional Control	Same risk for all	Same risk for all	Same risk for all	Same risk for all	Not assessed	Not assessed
Post-closure Phase - Post-institutional Control	Assume same disposal criteria	Assume same disposal criteria	Assume same disposal criteria	Assume same disposal criteria	Not assessed	Not assessed
Environmental						
Biophysical (30%)						
Closure Phase	Intermediate	Intermediate risk of effects	Least risk of effects	Most risk of effects	Not assessed	Not assessed
Post-closure Phase - Institutional Control	Most human presence	Most human presence	Least human presence	Most human presence	Not assessed	Not assessed
Post-closure Phase - Post-institutional Control	Assume same disposal criteria	Assume same disposal criteria	Assume same disposal criteria	Assume same disposal criteria	Not assessed	Not assessed
Social (10%)						
Closure Phase	Most economic benefit	Most economic benefit	Least economic benefit	Intermediate	Not assessed	Not assessed
Post-closure Phase - Institutional Control	Least barriers to development/use	Least barriers to development/use	Most barriers to development/use	Intermediate	Not assessed	Not assessed
Post-closure Phase - Post-institutional Control	Assumed no knowledge/effect	Assumed no knowledge/effect	Assumed no knowledge/effect	Assumed no knowledge/effect	Not assessed	Not assessed
Total	 5.9 / 9	 6.2 / 9	 7.3 / 9	 5.7 / 9	 0 / 9	 0 / 9

Notes:

(3) Most favourable ← (2) → (1) Least Favourable

In consideration of all factors including Indigenous engagement, the assessment of the alternative decommissioning strategies for WR-1 shows that each alternative evaluated can be executed safely. The recommended alternative for the decommissioning of WR-1, based on the alternative means analysis, is Alternative #3 (ISD). The selection of ISD was based on the safety, environmental, technical and economic factors. ISD is a safe option, reducing the risk to workers compared to dismantling and providing long-term safety to the public and the environment. The ISD approach also has the least reliance on undefined future disposal options or technologies.

Based on an understanding of the hazards associated with WR-1, CNL believes that the WRDF can be built to meet CNSC regulations, considering the recommendations from the IAEA related to radiological waste disposal. CNL also believes that the safety case has been made that this dedicated facility can be used to permanently dispose of the waste, rather than temporarily store it.

CNL recognizes that each Indigenous Nation would prefer to see other alternatives exercised. All engaged First Nations and the Manitoba Métis Federation have expressed a varying level of concern over the Alternative #3 (ISD) or have expressed a preference for Alternative #2 (Immediate Dismantling and Removal). Sagkeeng provided the most extensive feedback of all Indigenous Nations. CNL has strongly considered Sagkeeng's views, opinions and interests and have ongoing engagements and commitments that reflect their input on Alternative Means; especially in the area of trauma informed engagement and risk-informed communications to address psychosocial effects. CNL is of the view that all parties have had an adequate and fair opportunity to present their interests on the Alternatives and that conducting additional Alternative Means Assessments will not yield any additional insights that haven't already been made.

CNL will continue to listen, and consider all feedback on the Project, and work with Sagkeeng through the technical working group table to address any interests and concerns that remain outstanding through dialogue and further engagement. CNL has invested and is committed to ongoing engagement with the First Nations and the Manitoba Métis Federation to discuss all ongoing issues and concerns.

2.8 Sagkeeng's Alternative Means Assessment – Approach and Findings

This sub-section provides a summary of Sagkeeng's independent Alternative Means Assessment Report and explains how CNL considered and utilized the report. For a complete detailed description of Sagkeeng's assessment, refer to Sagkeeng's Alternative Means Assessment Report, included as a supporting document to CNL's WR-1 EIS (Sagkeeng Anicinabe and Firelight Research Inc. 2020). For details on CNL's engagement with Sagkeeng refer to Section 4 in CNL's Indigenous Engagement Report (CNL 2022) and Section 4.0 in the EIS.

CNL values engagement with Sagkeeng and strived to address Sagkeeng's concerns related to the Project. Sagkeeng's Alternative Means Assessment Report and subsequent engagements on the topic have helped CNL understand Sagkeeng's concerns about the Project. We recognize that not all of Sagkeeng's concerns are within scope of the decommissioning Project of WR-1 but our commitments to Sagkeeng demonstrate our resolve to build a strong working relationship that extends beyond the environmental assessment process for the decommissioning Project of WR-1.

2.8.1 Background Information

Since 2018 January, Sagkeeng has raised concerns that their community values and distinct perspective on criteria, weights and scoring were not included in CNL's Alternative Means Assessment. In response to Sagkeeng's concerns, CNL funded and participated in a 3-day workshop on 2019, February with Sagkeeng Chief and Council, Elders, other community members and Sagkeeng's technical consultants to discuss CNL's alternative means and to consider Sagkeeng's viewpoint on the alternatives, considering their community values. The staff of the CNSC and employees of AECL participated as observers in the workshop. During the first day, CNL presented the CNL Alternative Means Assessment results to Sagkeeng and engaged in dialogue on their questions and concerns. Sagkeeng terminated the workshop before lunch on the second day. In their remarks, Chief Henderson and Elder Dave Courchene stated Sagkeeng needed to take some steps back in the process and use ceremony to help guide the community on the Project and educate CNL about the critical role of spirit and ceremony in Sagkeeng decision-making. Sagkeeng invited CNL, CNSC and AECL to participate in a ceremony at Turtle Lodge International Centre for Indigenous Education and Wellness in 2019, March as part of the next steps taken by Sagkeeng on considering the proposed Project and the other technically and economically feasible options.

During CNL's March 2020 meeting with Chief and Council, Sagkeeng again raised their concerns that CNL's alternative means did not adequately consider Sagkeeng's views. To further provide Sagkeeng an opportunity to meaningfully express their concerns and preferred alternatives, CNL provided funding to support a Sagkeeng-driven alternative means assessment that incorporated Sagkeeng's distinct perspectives and values.

2.8.2 Introduction

Sagkeeng's alternative means assessment was prepared by Sagkeeng Chief and Council with support from, and facilitation by, Firelight Group, with technical support from Tony Brown, an environmental consulting engineer. This included a two-day workshop with CNL in February 2019. Sagkeeng's Chief and Council also worked with CNL and Firelight to better understand CNL's four alternatives for decommissioning the WR-1 Reactor. The purpose of the workshop was to:

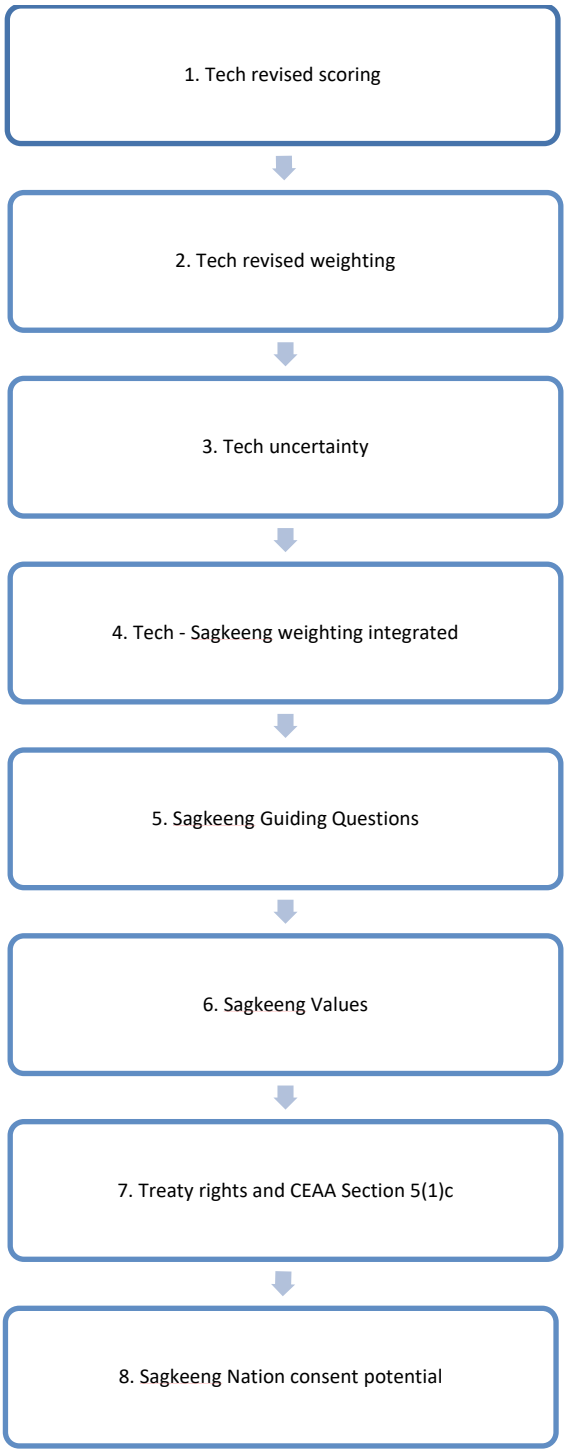
- Identify and prioritize Sagkeeng's values;
- Identify guiding questions and principles that could help protect those values, concerning the WR-1 decommissioning;
- Develop a series of tests/tools to assess the different alternatives and criteria; and
- Assess preference/acceptability of the four alternatives using the tests and report on them.

2.8.3 Description of Sagkeeng's Alternative Means Assessment Report Results

Sagkeeng delivered their Alternative Means Assessment Report to CNL on October 19, 2020, followed by a presentation to CNL, CNSC, and AECL on November 19, 2020. This section summarizes the Sagkeeng process and results, as understood by CNL.

Mr. Brown and Sagkeeng's Chief and Council, with the support of the Firelight Group, developed eight different tests to see which of CNL's four technically and economically feasible alternative ways to decommission the WR-1 Reactor was preferable from an independent technical perspective that used CNL's methodology as a starting point (Tests 1 to 3) and from the perspective of Sagkeeng Chief and Council in Tests 4 through 8 (Figure 2.8.3-1, reproduced from Sagkeeng Anicinabe and Firelight Research Inc. 2020b. Presentation of Results of Sagkeeng Anicinabe Alternatives Assessment for WR-1 Reactor Decommissioning, November 19, 2020, here for information).

Figure 2.8.3-1: The Eight Tests of Sagkeeng's Alternative Means Assessment



Sagkeeng requested Mr. Brown independently conduct a technical review of CNL's decommissioning alternatives for the WR-1 Reactor that was based on his professional opinion and experience of previous alternatives assessment processes. Mr. Brown took the CNL alternative means assessment and modified the scoring and weighting of criteria based on Sagkeeng values. In test three, Mr. Brown added additional criteria and further redistributed the weighting. These are described in the Sagkeeng Alternative Means Report as "Tests 1 to 3" (Sagkeeng Anicinabe and Firelight Research Inc. 2020).

Sagkeeng Chief and Council also developed five tests (i.e., Tests 4-8) that reflect Sagkeeng's understandings and values regarding the alternative means to decommission the WR-1 Reactor. These Tests and their results are summarized below.

2.8.3.1 Test 1 - Revised Scoring with CNL Weighting

In Test 1, Mr. Brown identified three areas in the CNL alternative means assessment that resulted in changes to scoring methodology: design methodology, mitigation, and ranking instead of scoring. Regarding design methodology, Mr. Brown questioned the assignment of scores based on the assumption that the retrofit of a 50-year-old facility would perform as effectively as a new, built for purpose facility. Mr. Brown suggested that this assumption does not account for the superior performance of a purpose-built facility. Regarding mitigation, CNL's alternative means assessment is based on potential impacts, prior to the implementation of standard mitigating measures. Mr. Brown indicated that this approach downgrades alternatives that pose theoretical risks, even when they can be effectively mitigated. Finally, ranking relative to the other alternatives, rather than assessing each alternative's performance against the criteria, was identified as a concern. In Mr. Brown's opinion, the CNL approach tended to overemphasize minor differences that skewed the selection process.

Mr. Brown revised CNL's scoring to address these concerns, without changing CNL's criteria weighting. The results of this test indicated Alternatives 1 and 2 (each involving the complete dismantling and full removal of radioactive wastes from WR-1 to an external facility) are preferred over Alternatives 3 and 4. CNL's preferred Alternative 3, In-Situ Disposal (ISD) rates last among the four alternatives (Figure 2.8.3.1-1 as reproduced from the report).

Figure 2.8.3.1-1: Mr. Brown's Revised Scoring with CNL's Weighting (as reported in Sagkeeng Anicinabe and Firelight Research Inc. 2020)

Indicates a higher score was assigned
Indicates a lower score should be assigned

	CNL Scoring					Independent Scoring (with rationale for any changes)							
	Weight	Alternative				Weight	Alternative						
Criteria		#1	#2	#3	#4		#1		#2		#3		#4	
Worker Safety														
Closure Phase		1	2	3	2		2.5	Risks Mitigated	2.5	Risks Mitigated	3		2.5	Risks Mitigated
Institutional Control Phase	30%	3	3	3	2	30%	3		3		3	Reversal Risks	2.5	99% of Rad Removed
Post-Inst. Control Phase		2	2	2	2		2		2		2		2	
Sum		6	7	8	6		7.5		7.5		8		7	
Weigted Sum		1.8	2.1	2.4	1.8		2.3		2.3		2.4		2.1	
Public Safety														
Closure Phase		1	1	3	2		2.5	Risks Mitigated	2.5	Risks Mitigated	3		2.5	Risks Mitigated
Institutional Control Phase	30%	2	2	2	2	30%	3	No Risks	3	No Risks	2.5	Minor Risks	3	99% of Rad Removed
Post-Inst. Control Phase		2	2	2	2		3	No Risks	3	No Risks	2.5	Minor Risks	3	99% of Rad Removed
Sum		5	5	7	6		8.5		8.5		8		8.5	
Weigted Sum		1.5	1.5	2.1	1.8		2.6		2.6		2.4		2.6	
Biophysical														
Closure Phase		2	2	3	1		2.5	Risks Mitigated	2.5	Risks Mitigated	3		2.5	Risks Mitigated
Institutional Control Phase	30%	2	2	3	2	30%	3	No Risks	3	No Risks	3	Minor Risks	3	99% of Rad Removed
Post-Inst. Control Phase		2	2	2	2		3	No Risks	3	No Risks	2		3	99% of Rad Removed
Sum		6	6	8	5		8.5		8.5		8		8.5	
Weigted Sum		1.8	1.8	2.4	1.5		2.6		2.6		2.4		2.6	
Social														
Closure Phase		3	3	1	2		3		3		1		2	
Institutional Control Phase	10%	3	3	1	2	10%	3		3		1		2	
Post-Inst. Control Phase		2	2	2	2		2		2		2		2	
Sum		8	8	4	6		8		8		4		6	
Weigted Sum		0.8	0.8	0.4	0.6		0.8		0.8		0.4		0.6	
Cumulative Weighted Sum	**100%**	**5.9**	**6.2**	**7.3**	**5.7**	**100%**	**8.2**		**8.2**		**7.6**		**7.8**	

Alternatives #1 and #2 are now preferred.
Alternative #3 has the lowest score.

2.8.3.2 Test 2 - Revised Weighting and Revised Scoring

The assessment of alternatives performed by CNL applied different weights to the various criteria that were considered. During their review of CNL's alternatives assessment, Sagkeeng expressed concern that the weights used in the assessment were established by CNL without consulting Sagkeeng on their appropriateness. Specifically, Mr. Brown believed that CNL's assessment placed excessive emphasis on the potential need for mitigation of occupational risks, even though precedent (and CNL's own assessment) indicates that all technically and economically feasible alternatives can be implemented safely. He suggested that this resulted in insufficient emphasis on the assessment of the primary purpose of the remediation Project, which is to protect people and the environment from impacts associated with a hazardous site. CNL weighted worker safety, public safety and environmental safety as equal in their assessment, accounting for 90% of the total.

In Test 2, Mr. Brown revised CNL weighting with the emphasis moving from worker safety to protection of the public and the environment (Table 2.8.3.2-1). While Mr. Brown agreed the protection of worker safety should be a mandatory requirement of any project, he questioned the relative emphasis on the need for mitigation of Worker Safety since CNL has indicated that all alternatives can be implemented safely (i.e., they will comply with the requirements of appropriate occupational authorities, including the CNSC). Further, Mr. Brown noted the following unique attributes for worker risks: 1) they have a short duration; 2) they can be fully mitigated; 3) they are highly regulated; and 4) workers are fully informed, trained, and compensated, as appropriate.

Table 2.8.3.2-1: Mr. Brown's Revised Weighting (as reported in Sagkeeng Anicinabe and Firelight Research Inc. 2020)

Criteria	CNL's Weighting	Mr. Brown's Weighting in Test 2
Worker Safety	30%	20%
Public Safety	30%	35%
Biophysical	30%	35%
Social	10%	10%

The revised weighting was added to Mr. Brown's prior revisions to the scoring of the alternatives. The result of the revised scoring and weighting showed Alternatives 1 and 2 still preferred and Alternative 3 still the least preferred (Figure 2.8.3.2-1).

Figure 2.8.3.2-1: Mr. Brown's Revised Scoring and Revised Weighting (Sagkeeng Anicinabe and Firelight Research Inc. 2020)

Indicates a higher weighting was assigned
Indicates a lower weighting was assigned

	Independent Scoring & CNL Weighting					Independent Scoring & Revised Weighting				
		Alternative					Alternative			
Criteria	Weight	#1	#2	#3	#4	Weight	#1	#2	#3	#4
Worker Safety										
Closure Phase		2.5	2.5	3	2.5		2.5	2.5	3	2.5
Institutional Control Phase	30%	3	3	3	2.5	20%	3	3	3	2.5
Post-Inst. Control Phase		2	2	2	2		2	2	2	2
Sum		7.5	7.5	8	7		7.5	7.5	8	7
Weigted Sum		2.3	2.3	2.4	2.1		1.5	1.5	1.6	1.4
Public Safety										
Closure Phase		2.5	2.5	3	2.5		2.5	2.5	3	2.5
Institutional Control Phase	30%	3	3	2.5	3	35%	3	3	2.5	3
Post-Inst. Control Phase		3	3	2.5	3		3	3	2.5	3
Sum		8.5	8.5	8	8.5		8.5	8.5	8	8.5
Weigted Sum		2.6	2.6	2.4	2.6		3.0	3.0	2.8	3.0
Biophysical										
Closure Phase		2.5	2.5	3	2.5		2.5	2.5	3	2.5
Institutional Control Phase	30%	3	3	3	3	35%	3	3	3	3
Post-Inst. Control Phase		3	3	2	3		3	3	2	3
Sum		8.5	8.5	8	8.5		8.5	8.5	8	8.5
Weigted Sum		2.6	2.6	2.4	2.6		3.0	3.0	2.8	3.0
Social										
Closure Phase		3	3	1	2		3	3	1	2
Institutional Control Phase	10%	3	3	1	2	10%	3	3	1	2
Post-Inst. Control Phase		2	2	2	2		2	2	2	2
Sum		8	8	4	6		8	8	4	6
Weigted Sum		0.8	0.8	0.4	0.6		0.8	0.8	0.4	0.6
Cumulative Weighted Sum	100%	**8.2**	**8.2**	**7.6**	**7.8**	100%	**8.3**	**8.3**	**7.6**	**8.0**

Emphasis shifted from Worker Safety to Public Safety and Biophysical. No change to Social at this time.

Alternatives #1 and #2 are still preferred. The performance of Alternative #3 decreases relative to other alternatives.

2.8.3.3 Test 3 - Revised Scoring, Revised Weighting and Technical Uncertainties

Mr. Brown identified his concern that excluding technical uncertainties overlooked important technical differences between the alternatives. In Test 3, two new weighted factors representing technical uncertainties were added; the reversibility of proposed alternatives and confidence in the predicted results of each alternative. He described reversibility as intending to address situations where a selected alternative fails to perform as intended and follow-up mitigations are necessary. For example, in the case of in situ decommissioning using cementitious grout (i.e., Alternatives 3 and 4), the removal of radioactive wastes in the future (if required) would be particularly challenging and could result in elevated occupational risks. Confidence in the predicted results considers the fact that there is a greater degree of certainty regarding the long-term performance of some alternatives.

As shown in Table 2.8.3.3-1, Mr. Brown added a new criterion to address these considerations and the weights of the other criteria were redistributed. Based on scoring using the revised methodology, Alternatives 1 and 2, deferred decommissioning with complete dismantling, and removal and immediate decommissioning with complete dismantling and removal, were preferred and the performance of Alternative 3, complete in-situ decommissioning, decreased relative to the other alternatives (Figure 2.8.3.3-1).

Table 2.8.3.3-1: Mr. Brown's Revised Weighting with Additional Criteria (as reported in Sagkeeng Anicinabe and Firelight Research Inc. 2020)

Criteria	CNL's Weighting	Mr. Brown's Weighting from Test 2	Mr. Brown's Revised Weighting with Additional Criteria (Test 3)
Worker Safety	30%	20%	15%
Public Safety	30%	35%	30%
Biophysical	30%	35%	30%
Social	10%	10%	10%
Reversibility	-	-	15%
Confidence in predicted result	-	-	

Figure 2.8.3.3-1: Mr. Brown's Revised Scoring, Revised Weighting and Technical Uncertainties (as reported in Sagkeeng Anicinabe and Firelight Research Inc. 2020)

Indicates a higher weighting was assigned
Indicates a lower weighting was assigned

	Independent Scoring & Revised Weighting					Independent Scoring, Revised Weighting & Technical Uncertainty				
	Weight	Alternative				Weight	Alternative			
Criteria		#1	#2	#3	#4		#1	#2	#3	#4
Worker Safety										
Closure Phase		2.5	2.5	3	2.5		2.5	2.5	3	2.5
Institutional Control Phase	20%	3	3	3	2.5	15%	3	3	3	2.5
Post-Inst. Control Phase		2	2	2	2		2	2	2	2
Sum		7.5	7.5	8	7		7.5	7.5	8	7
Weigted Sum		1.5	1.5	1.6	1.4		1.1	1.1	1.2	1.1
Public Safety										
Closure Phase		2.5	2.5	3	2.5		2.5	2.5	3	2.5
Institutional Control Phase	35%	3	3	2.5	3	30%	3	3	2.5	3
Post-Inst. Control Phase		3	3	2.5	3		3	3	2.5	3
Sum		8.5	8.5	8	8.5		8.5	8.5	8	8.5
Weigted Sum		3.0	3.0	2.8	3.0		2.6	2.6	2.4	2.6
Biophysical										
Closure Phase		2.5	2.5	3	2.5		2.5	2.5	3	2.5
Institutional Control Phase	35%	3	3	3	3	30%	3	3	3	3
Post-Inst. Control Phase		3	3	2	3		3	3	2	3
Sum		8.5	8.5	8	8.5		8.5	8.5	8	8.5
Weigted Sum		3.0	3.0	2.8	3.0		2.6	2.6	2.4	2.6
Social										
Closure Phase		3	3	1	2		3	3	1	2
Institutional Control Phase	10%	3	3	1	2	10%	3	3	1	2
Post-Inst. Control Phase		2	2	2	2		2	2	2	2
Sum		8	8	4	6		8	8	4	6
Weigted Sum		0.8	0.8	0.4	0.6		0.8	0.8	0.4	0.6
*** **NEW Technical Uncertainty**										
Reversibility							3	3	1	2
Confidence in Predicted Results		Not part of CNL's scoring				15%	3	3	2	2.5
Sum							6	6	3	4.5
Weigted Sum							0.9	0.9	0.5	0.7
Cumulative Weighted Sum	**100%**	**8.3**	**8.3**	**7.6**	**8.0**	**100%**	**7.9**	**7.9**	**6.9**	**7.4**

Weightings revised to include new criterion

2.8.3.4 Test 4 - Technical with Sagkeeng Preferred Weighting

Test 4 incorporated Sagkeeng's preferred weighting, which was established by Sagkeeng's Chief and Council. The weighting placed less emphasis on worker safety (10% versus 30% by CNL). Sagkeeng agreed with Mr. Brown's estimation that worker safety issues are extremely well regulated and minimal in relation to the nuclear decommissioning sector. The Sagkeeng weighting placed more emphasis on social factors (30% versus 10% by CNL) (Table 2.8.3.4-1).

Sagkeeng noted that social considerations such as community health and well-being, mental health, and food security are in pre-existing conditions of high constraint/vulnerability among Sagkeeng members, and therefore, is a much higher priority criterion for Sagkeeng when considering the preferability of different alternative means to decommission the WR-1 Reactor.

Table 2.8.3.4-1: Technical with Sagkeeng Preferred Weighting *(reproduced from* Sagkeeng Anicinabe and Firelight Research Inc. 2020*)*

Criteria	CNL Weighting	Mr. Brown's Weighting from Test 2	Sagkeeng Weighting from Test 4
Worker Safety	30%	20%	10%
Public Safety	30%	35%	30%
Biophysical	30%	35%	30%
Social	10%	10%	30%

Table 2.8.3.4-2 below, shows the results when Sagkeeng's preferred criterion weighting was applied to two separate scenarios:

- Test 4.1 - Sagkeeng's preferred weighting with CNL's scoring; and
- Test 4.2 - Sagkeeng's preferred weighting with Mr. Brown's scoring.

The first row in Table 2.8.3.4-2 represents Mr. Brown's conversion of CNL's preferred scoring and weighting to quantitative data, and is here for comparative purposes only; it is not a Sagkeeng test.

Table 2.8.3.4-2: Sagkeeng Test #4.1 and 4.2 Results – Sagkeeng Weighting Preference Added

	Alternative 1 – Deferred Decommissioning w/ Complete Dismantle	Alternative 2 – Immediate Complete Dismantle	Alternative 3 – Complete ISD	Alternative 4 – Partial Dismantle and Removal/ Partial ISD
CNL Scoring (converted by Mr. Brown to quantitative)	5.9	6.2	7.3	5.7
4.1 CNL Scoring with Sagkeeng weighting	6.3	6.4	6.5	5.7
4.2 Mr. Brown's scoring with Sagkeeng weighting	8.4	8.4	6.9	7.7

When Sagkeeng's preferred criteria weighting is applied to the two different sets of technical scoring, the relative performance of Alternative 3 declines in both instances, but it is preferred based on CNL Scoring, and by CNL scoring with Sagkeeng weighting. While in Test 4.1 ISD remains the preferred alternative, its relative score in comparison with other alternatives is lower with only a 0.1 point difference between Alternative 3 (ISD) and Alternative 2 (full, immediate removal). When Mr. Brown's scoring is applied, Alternatives 1 and 2 (full removal) are preferred and the performance of Alternative 3 (full ISD) decreases relative to other alternatives, becoming the least preferred alternative means of decommissioning the WR-1 Reactor. The report suggests that when social considerations are prioritized, ISD becomes the least preferable alternative.

2.8.3.5 Test 5 - Sagkeeng Guiding Questions "Pass/Fail Test"

In test 5, Sagkeeng developed a set of 18 guiding questions identifying overarching key considerations applied by Sagkeeng Chief and Council in their reassessment of alternatives to the Project. Sagkeeng representatives then graded CNL's four alternative means on a "pass/fail/unknown" basis against the guiding questions. For a full list of questions, please review Sagkeeng's Alternative Means Assessment Report (Sagkeeng Anicinabe and Firelight Research Inc. 2020). Sagkeeng's questions focused on:

- **Technical feasibility:** Sagkeeng focused on whether technical performance was proven for each phase of the Project, and confidence that physical human intervention would not be required long-term at the WR-1 site.
- **Economic feasibility:** Sagkeeng focused on longer term costs (e.g., construction, future remediation or mitigations, monitoring costs) and whether there was confidence that those funds would be available in the future.
- **Worker safety:** Sagkeeng focused on whether the alternative could be conducted in a safe manner for workers and worker risks, now and if future intervention was required.

- **Public safety:** Sagkeeng focused on the acceptability of risks associated with the alternative, based on perspectives from local public and other Indigenous Nations.
- **Environmental effects:** Sagkeeng focused on whether radiation risks are As Low As Reasonably Achievable (ALARA), and the ability to identify effects over time.
- **Social and Culture:** Sagkeeng focused on whether the alternative lives up to Canada's commitments to Indigenous nations and people (e.g., UNDRIP, Truth and Reconciliation Commission *Calls to Action*), fear and stigma reduction, and increased access for Sagkeeng members to the Traditional Territory.

These questions were posed in relation to three time frames; closure phase, institutional control phase and post-institutional control phase, respectively.

Graded against Sagkeeng's guiding questions, Alternative 2, immediate decommissioning with complete dismantling and removal was most preferable, while Alternative 3, complete in-situ decommissioning, was the least preferred. Specifically, Sagkeeng's Chief and Council found that Alternative 3 rates poorly in relation to the following:

- The amount of risk left in situ on Sagkeeng Traditional Territory;
- The length of time that active controls will need to be in place on Sagkeeng Traditional Territory;
- Fear and stigma associated with the area, now and into the far future, by Sagkeeng members;
- Confidence that the technology used (concreting/grouting radioactive materials in place underground near the Winnipeg River) will be effective, especially long-term, and that malfunctions will be avoided;
- Confidence that should a malfunction occur, that the cleanup will be easy, safe and effective, and that monies will be available long-term to conduct that cleanup process; and
- Living up to Canada's prior commitments and permitted plan to remove all radioactive materials from the WR-1 facility.

Sagkeeng's Chief and Council also expressed the opinion that even with the bulk of radioactive waste removed from the WR-1 Reactor, fear and stigma would still be associated with the small amount of radioactive material remaining underground in Sagkeeng Traditional Territory and therefore Alternative 4 also rated poorly.

2.8.3.6 Test 6 - Assessment using 13 Sagkeeng Priority Value-Based Preferences as Criteria

Test 6 assessed each alternative against values that Sagkeeng considered to be central to decision-making on preferred futures. The key question at the heart of this test was "Which alternative or alternatives are preferable to Sagkeeng when considering what matters most to Sagkeeng members?" (Sagkeeng Anicinabe and Firelight Research Inc. 2020, pg. 28). Thirteen preferences were selected by Sagkeeng Chief and Council, which represented priority values and preference statements (in italics below), that included:

1. Protect and Heal the Water - *Sagkeeng prefers alternatives that can demonstrate that in the near to long-term, that waters, especially in Winnipeg River, will be protected and will be perceived to be safe by Sagkeeng members*;

2. Protect and Promote Sagkeeng Culture/Spirit - *Sagkeeng prefers alternatives that are respectful of the spiritual balance of people with the earth, and allow at least the potential for greater access to territory for cultural purposes in the future*;
3. Territorial Integrity - *Sagkeeng members prefer alternatives that reduce hazards and result in a net benefit toward restoration of territorial integrity*;
4. Food Security and Faith in Traditional Foods - *Sagkeeng prefers alternatives that will increase trust in traditional foods and water sources over time, increase the amount of potential territory to access country foods in, and reduce risk of wildlife contamination and health risks;*
5. Reduced Mental Stress, Fear, Stigma - *Sagkeeng's preference is for alternatives that will reduce mental stress, fear, and stigma, now and into the future, at and around the Whiteshell facility and at the wider Sagkeeng territory scale*;
6. Reduced Long-Term Risks in Sagkeeng Territory - *Sagkeeng prefers alternatives that reduce long-term risks in Sagkeeng territory and result in reduced long-term human population health risks, reduced long-term risks on the Winnipeg River waters and fish, and lowest amount of in situ risks at the Whiteshell Labs site;*
7. Address the Hazard Sooner and Reduced Future Management Requirements - *Sagkeeng prefers alternatives that address the hazard at WR-1 sooner, require less future management, and leave less risk on Sagkeeng lands for future generations*;
8. Flexibility to Adapt to Contingencies; *Sagkeeng prefers alternatives that either include the flexibility to alter management plans at the site in the future (even possibly future reversal and removal of radioactive materials) or remove the risks entirely from the site altogether*;
9. Impact Equity - *Sagkeeng prefers alternatives that do not put a disproportionate burden of impacts on Sagkeeng members, now and in the future*;
10. Higher Affected Public/Sagkeeng Acceptability **-** *Sagkeeng prefers alternatives that are acceptable to Sagkeeng Anicinabe members and land users*;
11. Protection and Promotion of Treaty Rights - *Sagkeeng prefers alternatives that have the least potential for adverse impacts or infringements on Treaty rights in as much of Sagkeeng territory as possible, and prefers also for alternatives that could have the most beneficial effects on members' ability to meaningfully practice their rights into the future*;
12. Adherence to Ancestral Laws and Norms - *Sagkeeng prefers alternatives that adhere to or are otherwise are not likely to conflict with these ancestral laws*; and
13. Sagkeeng Territory Free of Radioactive Waste - *Sagkeeng prefers alternatives that do not result in a permanent nuclear waste disposal facility in Sagkeeng territory*.

CNL's alternatives were assessed against each preference and scored on a range from 1 to 3 by Sagkeeng Chief and Council. A score of 3 represented a very good alternative when assessed against the preference statement, while a score of 1 represented a poor alternative. Detailed descriptions of how each alternative scored against each preference statement, and supporting rationales, are provided in Section 2.6 of Sagkeeng Anicinabe and Firelight Research Inc. (2020).

The results are summarized in the table below.

Table 2.8.3.6-1: Summary of Sagkeeng Test #6: Values-based Preference Statements

Sagkeeng Values-based Preference Statement	1 – Deferred Full Removal	2 – Immediate Full Removal	3 - ISD	4 – Partial ISD, partial removal
Total Score	29.5	39	15	25
Preference Ranking	2nd	1st	4th	3rd

In every instance in this test, Alternative 2, immediate decommissioning with complete dismantling and removal, scored highest, and Alternative 3, complete in-situ decommissioning, was scored lowest.

2.8.3.7 Test 7 - Assessment using Indigenous Rights and Interests Factors

This test was largely derived from the question “Which alternatives will have the least potential for adverse impact on the ability of Sagkeeng members to meaningfully practice their treaty rights, and the most potential for beneficial impacts on Sagkeeng rights? (Sagkeeng Anicinabe and Firelight Research Inc. 2020, pg. 46).”

These tests were an assessment based on each alternative’s potential beneficial or adverse implications in relation to Sagkeeng’s treaty rights which included but are not limited to the following:

- Test 7.1 treaty Rights: hunting, fishing, trapping, gathering, use and navigation of water, travelling and staying on the land; and
- Test 7.2 CEAA (2012) Section 5(1)(c) factors: health and socio-economic conditions, physical and cultural heritage, current use of lands and resources for cultural purposes, and structures or sites of historical, archaeological, paleontological, or architectural significance.

In the end, the results for Tests 7.1 and 7.2 were the same qualitative responses from Chief and Council and so are pooled together in Table 2.8.3.7-1 below.

Table 2.8.3.7-1: Summary Results of Sagkeeng Test #7

Criteria	Alternative 1 – Deferred Decommissioning w/ Complete Dismantle	Alternative 2 – Immediate Complete Dismantling	Alternative 3 – Complete In-Situ Decommissioning	Alternative 4 – Partial Dismantling and Removal/ Partial ISD
Preference Ranking	**2nd**	**1st**	**4th**	**3rd**
Key Differences	Lower score than Alternative 2 due to deferral of full removal and thus slower potential for improvement in conditions for Treaty rights.	Full removal of all nuclear materials would see both the least real and perceived risks at the site, thus most improved conditions for practice of Sagkeeng Treaty rights.	Minimal to no removal of perceived risk through keeping the waste on site, thus low likelihood of restored Sagkeeng confidence and Treaty rights practice.	Despite 99% of radioactive materials removed, perception of risk could still alienate Treaty rights.

When considered against Sagkeeng treaty rights and CEAA (2012) Section 5(1)(c) factors, Alternative 2, immediate decommissioning with complete dismantling and removal, was most preferable, while Alternative 3, complete in-situ decommissioning, was the least preferred. Sagkeeng have consistently indicated that early and full removal of nuclear materials from Sagkeeng territory is preferred in part because, in their view it brings higher potential for the meaningful recovery of treaty rights and use of lands and resources in and around Whiteshell Laboratories; this result is only achieved by Alternative 2. Alternative 1 scores second highest because it would achieve this eventually, but not as quickly as Alternative 2. ISD (Alternatives 3 and, to a lesser degree, 4) maintain nuclear materials at the WR-1 Reactor site in perpetuity and, the report suggests, this does not restore the necessary conditions for increased expression of treaty rights. Alternative 4 scores higher as it lowers the volume of radioactive materials, however Sagkeeng suggest that this is not likely to have a significant positive effect on the recovery of treaty rights in and around the Whiteshell area due to sustained perceived risk.

The study claims that the above results are consistent with recent studies related to the proposed WR-1 decommissioning, in which Sagkeeng members noted that ISD would result in reduced confidence in water quality in the Winnipeg River, which is inextricably linked to the future practice of Treaty rights such as fishing, harvesting wild rice, hunting, and collecting drinking water (e.g., Olson et al. 2019). Existing Sagkeeng use and occupancy data shows that numerous values and Treaty rights-based practices – including fishing sites for several species, fish spawning, berry and medicinal plant gathering locations, hunting and trapping values, sacred and ceremonial places, and campsites, among others – are already impacted or at risk in the immediate vicinity of Whiteshell, and Sagkeeng members have expressed that a decision to move forward with ISD would sustain this impact and risk in perpetuity (Olson et al. 2019). Sagkeeng members prefer Alternatives 1 and especially 2 because they would remove the hazard and improve the prospects of future access to the site for the practice of Treaty rights and reconnection to the land.

2.8.3.8 Test 8 - Sagkeeng Perspectives on the Overall Ability of Each Alternative to receive the Necessary Consent from Sagkeeng

Test 8 was based on the assumption that Sagkeeng is involved in all decisions that potentially affect them and that final decisions need to be supported by Sagkeeng free, prior and informed consent, as per Canada's commitments under the *United Nations Declaration on the Rights of Indigenous Peoples*. This test assessed each alternative against the likelihood that CNL would receive consent from Sagkeeng Anicinabe and members.

The following Table shows the results from Test 8 with Sagkeeng's supporting rationales.

Table 2.8.3.8-1: Summary Results of Sagkeeng Test #8

Criteria	Alternative 1 – Deferred Decommissioning w/ Complete Dismantle	Alternative 2 – Immediate Complete Dismantle	Alternative 3 – Complete ISD	Alternative 4 – Partial Dismantle and Removal/ Partial ISD
Sagkeeng Consent Likely?	Uncertain	Yes	No	No
Why?	Deferred complete removal addresses Sagkeeng's main concern, which is removal of all radioactive materials from their lands.	The rationale is the same as Alternative 1, however the benefits are achieved more quickly by immediate removal.	ISD leaves risk in the ground in perpetuity for future generations; Sagkeeng suggest that the land and waters cannot heal; the land will not become more accessible to Sagkeeng members and they will not be able to use the land; fear and stigma related to Whiteshell will continue into the future.	While partial dismantle and removal will heavily reduce the risk for future generations, partial ISD leaves some risk in the ground at the WR-1 site and Sagkeeng claim access is still impacted well into the future, and perceived risk remains high.

Alternative 2, immediate decommissioning with complete dismantling and removal, is acceptable under this scenario while Alternatives 3 and 4, complete in-situ decommissioning with partial dismantling and removal, and partial in-situ decommissioning, respectively were rejected by Sagkeeng Chief and Council. Alternative 1 is identified as "uncertain" for its ability to secure Sagkeeng consent due to the time Treaty rights would be subject to infringement as a result of radioactive materials being removed further in the future.

Sagkeeng's Alternatives Assessment states (pg. 51) "It is important to note that the results of this test are preliminary and do not imply blanket consent for any alternative. Any proposal would need to show evidence that it is planned and undertaken in such a way that will not harm Sagkeeng lands, waters, rights, and people. Any final Sagkeeng consent decisions will need to be through proper Sagkeeng Anicinabe protocols."

2.8.4 Sagkeeng's Alternative Mean Assessment Conclusion

Table 2.8.4-1 provides a summary of Sagkeeng's preferred and least preferred alternatives for all 8 tests conducted.

Table 2.8.4-1: Sagkeeng's Preferred and Least Preferred Alternatives (Sagkeeng Anicinabe and Firelight Research Inc. 2020).

Sagkeeng Test	Most Preferred	Least Preferred
1. Technical revised scoring	1 and 2	3
2. Technical revised scoring and revised weighting	1 and 2	3
3. Technical with revised scoring, revised weighting, and uncertainty integrated	1 and 2	3
4. Technical with Sagkeeng weighting	4.1 - 3 4.2 - 1 and 2	4.1 - 4 4.2 - 3
5. Sagkeeng guiding questions	2	3
6. Sagkeeng values-based preferences	2	3
7. Treaty rights	7.1 – 2 7.2 - 2	7.1 – 3 7.2 - 3
8. Likelihood of Sagkeeng consent	2	3 and 4

Based on the results of Sagkeeng's eight tests in their Alternative Means Assessment report, the most preferred option for decommissioning of the WR-1 Reactor is Alternative 2, immediate full removal of WR-1 Reactor. The second most preferred alternative is Alternative 1, deferred full removal. The least favourable decommissioning for WR-1, according to Sagkeeng's assessment, is Alternative 3, in-situ disposal. The report concludes that (pg. 54), "Sagkeeng's alternatives assessment convincingly demonstrates that ISD (Alternative 3) performs poorer against virtually all Sagkeeng values and preferences, especially against "full removal" Alternatives 2 and 1 (in that order of preference). This assessment also shows that ISD is less preferred relative to full removal options on both a technical (Sagkeeng Tests 1 through 3) and a non-technical (Sagkeeng Tests 4 through 8) basis."

Sagkeeng's Alternatives Assessment concludes with the following synopsis and recommendations (pg. 56):

> "Sagkeeng is not saying its values are the only values that need to be considered in the alternative means assessment. They are very important values, however, that have not been considered by the Proponent's work or Canada's environmental assessment to date. Specifically, they have not been considered in the Proponent's alternatives assessment. Those Sagkeeng values are also tied to Constitutionally-enshrined Treaty and Aboriginal rights that must be considered meaningfully in this decision-making process.

As early as January 2018, Sagkeeng recommended the Proponent engage in a multiple accounts evaluation to identify a preferred alternative means to decommission the WR-1 Reactor. The Proponent has declined to do so to date. Sagkeeng has herein provided strong inputs to fuel a multi-party, multiple accounts evaluation of alternative means. It shows from a technical and a Sagkeeng values and impacts perspective, that full removal is preferable to ISD. That suggests CNL, AECL and CNSC should stick with the currently approved plan for full removal.

A true multi-party and multiple accounts evaluation would look at differing perspectives and findings, and try to find a jointly preferred, or at minimum a jointly acceptable, solution. Sagkeeng has opened the door with this work, we look forward to Canada and CNL engaging us to take the opportunity to work together toward a more meaningful, collaborative alternative means assessment for this important nuclear decommissioning Project on our Traditional Territory. The results of this report, as well as the forthcoming Sagkeeng psycho-social effects study (Narratives Inc. 2020), can be used to fuel these further discussions and collaborative efforts."

2.8.5 CNL Consideration of Sagkeeng's Alternative Means Assessment

In environmental assessments, proponents engage with interested Indigenous and public parties first on descriptions of feasible alternatives for consideration and then on the details that the proponent built into the analysis. Under CEAA 2012, a qualitative analysis is acceptable, but CNL has integrated some quantitative components and divided the analysis into three main project phases – decommissioning (e.g., closure), institutional control period, and post institutional control period. CNL engaged on the four considered alternatives with Sagkeeng on several occasions, including at the Alternative Means Workshop and through the provision of written information. Sagkeeng accepted the four proposed alternatives as the only alternatives to consider for the purposes of the alternatives assessment, accepting CNL's finding that each alternative was economically and technically feasible.

At one time, Sagkeeng, representatives, through Turtle Lodge, put forward a fifth alternative, called Rolling Stewardship, for consideration. As described by Sagkeeng at the Turtle Lodge ceremony in March 2019, Rolling Stewardship would leave the reactor facility as is, defer decommissioning until another decommissioning approach was developed, and maintain knowledge about the facility during the rolling stewardship period. The duration of the period was undefined by Sagkeeng. CNL considered this alternative. Rolling stewardship is similar to SafeStore, where the reactor is prepared for long-term storage, typically with no staff at the site except to conduct occasional maintenance and monitoring. CNL incorporated this Sagkeeng proposed approach into the alternative means. It was ultimately screened out because it did not include a defined endpoint, and was not sustainable over a long period of time. Subsequently, Sagkeeng used only the four alternatives deemed by CNL to be technically and economically feasible in developing its Alternatives Assessment.

Sagkeeng and their consultants invested significant effort to produce criteria and tests that are meaningful to their community, as represented by the Chief and Council. Sagkeeng developed an alternative means approach that represents their community values and interests. CNL re-evaluated the alternative means assessment based on the information in Sagkeeng's alternative means assessment. Upon much consideration, CNL chose not to make further adjustments to the alternative means and provides an explanation below.

CNL has documented Sagkeeng's preferred alternative in Section 4.0 of the EIS and Section 4 of the Indigenous Engagement Report (CNL 2022).

2.8.5.1 Considerations of Sagkeeng's Tests

CNL disagrees with the revised scoring presented by Sagkeeng in Test 1. This is based on the difference in understanding of how the scores should be applied to each alternative. CNL believes its scoring appropriately assesses differences in alternatives and screens out differences that are small enough that they should not sway the assessment.

CNL also acknowledges that the weighting of each criteria is a subjective exercise. Different perspectives and understandings will value different criteria more or less in their decision making. The revised weightings discussed by Mr. Brown in tests 2 and 3 reflect his perspective and understanding of the Project. Overall, CNL believes the weighting it applied to each criteria is fair and balanced. It assumes that impacts to the public and Indigenous peoples, and the environment in which they live and practice their rights, make up 60% of the evaluation. Impacts on the health and safety of workers who live in the local community are 30%, and impacts to the economic interests of the area are given 10%. CNL feels this adequately places the most emphasis on the health and safety of all people and the environment.

CNL values Sagkeeng's perspective outlined in the results of tests 4-8. They were developed based on Sagkeeng's community values, Aboriginal and Treaty rights, and the likelihood of each alternative receiving Sagkeeng's consent. CNL has committed to documenting Sagkeeng's preferred alternative in the Indigenous Engagement Report (CNL 2022) and Section 4.0 of the EIS, and will continue to work together with Sagkeeng's Chief and Council to find common ground and areas of mutual benefit and opportunity regarding the decommissioning of WR-1.

2.8.5.2 Considerations for an Off-site Disposal in a Purpose-built Facility

CNL has considered the results of Sagkeeng's assessment and believes that Sagkeeng's assessment overemphasizes the assumed benefits of off-site disposal in a 'purpose-built' facility. This is primarily because a 'purpose-built' facility currently does not exist, nor is proposed to exist for decades, and as such, no direct comparison of the benefits of such a facility can be made with certainty. The only information that can be assumed about such a facility is that it will be required to meet at least the same standards for the protection of workers, the public and the environment as the WR-1 Disposal Facility. CNL believes that a more appropriate assumption is that an off-site facility would meet the same regulatory requirements that in situ disposal is required to meet, and thus all options should be given equal credit for the level of protection they provide over the long term. Waiting for a future date to pursue off-site disposal increases risks to the Project being completed. Changes in policy that currently enable waste transportation could also impact the ability to perform the work. Uncertainty in the future was a key part of the determination of how the different alternatives were scored.

2.8.5.3 Considerations for Sagkeeng's Preferred Decommissioning Methods - Alternatives 1 and 2

CNL found Sagkeeng's alternative means assessment focused on the impacts and benefits of each alternative on Sagkeeng's community and does not appear to consider the potential impacts on the host community for any off-site storage or disposal of WR-1 waste. The Sagkeeng assessment implies that risks disappear or are reduced if removed from the Whiteshell Laboratories site. This may be true for members of the Sagkeeng, but this is not the case for the public and Indigenous peoples overall, and all risks are simply transferred to another location and community However, CNL must consider the risk of each alternative to all potentially impacted communities. The argument that the risks are more significant at the Whiteshell Laboratories site than at another central storage site is contrary to the Linear Non-Threshold (LNT) model for radiation exposure risk, which is the model adopted by the CNSC and the wider international community (CNSC 2013). The LNT model assumes there is no lower threshold at which incremental risks start, and assumes a linear relationship between dose and the health risk.

LNT assumes that radiation has the potential to cause harm at any dose level, and the sum of several very small exposures is just as likely to cause a stochastic health effect as a single larger exposure of equal dose value. In other words, the risk from WR-1 would be the same regardless of whether it is the only component in the facility or just a small portion of a larger disposal facility at an off-site location.

2.8.5.4 Conclusion of CNL's Consideration of Sagkeeng's Assessment

The analysis of Sagkeeng's alternative means assessment facilitated a critical review and reflection of CNL's own alternative means assessment and working assumptions. Subsequent engagements also helped CNL better understand Sagkeeng's concern on the alternative means assessment. In review of our alternative means assessment, CNL maintains that the overall approach to assessing Project alternatives was appropriate and reasonable, taking in a broad range of considerations. None of the four options proposed present significant off-site impacts to the public or the environment. In fact, off-site biophysical impacts are negligible. While we defer to the Crown on the matter of rights assessment, CNL is unaware that any alternatives increase or decrease potential impacts on Indigenous rights such as hunting, fishing, gathering and ceremony. Sagkeeng has taken the view that their rights are impacted by this project.

Overall, CNL found that Sagkeeng's priority values and associated criteria and weighting for assessing alternatives are heavily focused on factors that lend support to the complete removal of waste from the Whiteshell Laboratories site. CNL felt Sagkeeng overemphasized the need for and benefit of a purpose-built waste disposal facility. CNL has been clear that full dismantling is not a guarantee of removal of all waste from the Whiteshell Laboratories site. Dismantling will not ensure immediate removal of waste from the site, full access to the lands, and, consequently, a reduction in stigma.

If in situ disposal is not approved, there is not an automatic second alternative that can be readily implemented, other than the status quo (even then this would require ongoing upkeep and maintenance and present increasing risks related to a legacy structure)) Currently, there is no available storage space at Chalk River Laboratories for the reactor components. With full dismantling, the waste could continue to be stored on the Whiteshell Laboratories site in a suitable facility. As best practice would suggest, one of CNL's objectives for this Project is to reduce the decommissioning deferment period and not leave it to future generations. After careful consideration, CNL felt the Sagkeeng's alternative means did not produce a strong technical basis to justify a change to the CNL methodology and scoring. CNL also found the assessment narrowly reflected perceived impacts and benefits to Sagkeeng and did not include other considerations for Alternatives 1 and 2.

CNL has reinforced that all the presented alternatives can be achieved safely and that CNL would not consider any alternative they felt was not safe for the public, the environment, or its workers. This does mean that there are differences in risk to workers for the three options. With increased dismantling and waste handling, the risk increases. CNL has selected its preferred approach of the four safe alternatives. Sagkeeng's specific assessment was informative and it compelled CNL to re-evaluate their assessment and it its outcomes. After thoughtful consideration, while not resulting in changes to the assessment itself, Sagkeeng's assessment has helped deepen CNL's understanding of their historical and contemporary interests in the area. Our learnings are also reflected in some of our next steps.

Sagkeeng has requested a "true multi-party and multiple accounts evaluation", (that) "would look at differing perspectives and findings, and try to find a jointly preferred, or at minimum a jointly acceptable, solution". CNL has strongly considered Sagkeeng's views, opinions and interests and have ongoing recommendations and activities that reflect their input on Alternative Means. CNL is of the view that the Alternatives are relatively fixed and all parties have had an adequate and fair opportunity to present their interests on them. CNL believes that conducting additional Alternative Means Assessments, including by way of another assessment tool such as multiple accounts

evaluation, will not yield any additional insights that have been already made clear. While other views are important, Sagkeeng has clearly indicated that their preferred alternative is full dismantling and transportation of waste to another location/territory. CNL has invested and is committed to the establishment of specific and deliberate tables to address all ongoing issues and concerns. In respect of addressing any potential ongoing concerns about in-situ disposal, CNL has committed to holding discussions with Sagkeeng Chief and Council to collaborate in developing long-term environmental monitoring initiatives. CNL is also interested in hosting workshops and webinars to support information-sharing and understanding, especially regarding the safety of in situ disposal in relation to people and the environment.

CNL believes there are numerous opportunities to work together in the interest of mutual learning and to meaningfully address Sagkeeng's ongoing concerns about in situ disposal and on other matters. These engagements combined with other Traditional knowledge provided by Sagkeeng, formed an important component of Indigenous input into the environmental assessment process. We look forward to our ongoing dialogue with Sagkeeng and other Indigenous Nations, as the Project moves forward.

3.0 PROJECT DESCRIPTION

3.1 Introduction

This section provides a description of the in situ disposal (ISD) strategy for the In Situ Decommissioning of Whiteshell Reactor 1 (WR-1) at the Whiteshell Laboratories Site (the Project). ISD is a safe technique that reduces the risk to workers, compared to full dismantling, while providing long-term safety for the public and the environment. The proposed design of the Project is based on current engineering practices and precedents, and the experience of the engineering and environmental assessment teams and third-party experts. Where there remains uncertainty around the design, conservative assumptions or options have been presented to provide a conservative assessment of potential effects of the Project in the environmental assessment. The final design will adhere to these assumptions and concepts.

3.1.1 Project Overview

Canadian Nuclear Laboratories (CNL) is proposing an ISD approach to decommission Whiteshell Reactor 1 (WR-1). The below-grade reactor systems, components and structures will be permanently disposed of in situ. This approach relies on multiple barriers that passively resist the release of contaminants. Most of the above-grade structures will be demolished and the wastes will be recycled or disposed of in appropriate waste disposal facilities. Some above-grade components may also be placed below-grade for disposal within the WR-1 Building. A concrete cap and engineered cover will then be constructed over the below-grade structure to protect the structure from water. ISD is a permanent, passive decommissioning end state.

The Project activities assessed in this Environmental Impact Statement (EIS) are limited to ISD of WR-1 and the associated building. Removal of the above-grade portion of the WR-1 Building and the east annex and service wings of the WR-1 Complex were assessed as part of the *Whiteshell Laboratories Decommissioning Project Comprehensive Study Report* (CSR; AECL 2001) and are covered under CNL's existing decommissioning licence for the Whiteshell Laboratories (WL) site (Licence No. NRTEDL-W5-8.00/2024). Activities required to prepare for ISD, such as isolation of the WR-1 Building and targeted remediation of hazardous materials, are also covered under CNL's existing decommissioning licence for the WL site. CNL is not proposing any changes to these decommissioning activities.

The decommissioning activities proposed as part of the Project and assessed in this EIS include:

- preparation for ISD;
- grouting of below-grade structures and systems;
- removal of above-grade structures and systems;
- installation of a concrete cap and engineered cover over the grouted below-grade structures and systems;
- final site restoration;
- preparation for institutional control; and
- institutional control (includes both passive and active controls).

3.1.2 Project Schedule

CNL plans to start decommissioning activities for the WR-1 Building in 2022. Once decommissioning and grouting work is complete, the Whiteshell Reactor Disposal Facility (WRDF) will be turned over to institutional control in 2027, which is assumed to last for a minimum of 100 years during which environmental monitoring and surveillance activities will be carried out. This timeframe is consistent with requirements for other near surface disposal projects (range 100 to 300 years), including similar projects under Canadian Nuclear Safety Commission (CNSC) jurisdiction and United States Department of Energy projects. However, it is recognized that institutional control will continue until the CNSC agrees it is no longer needed. The proposed overall schedule for the Project is provided in Table 3.1.2-1.

Table 3.1.2-1: Project Schedule

	Description	Planned Schedule
Regulatory Schedule		
	EIS submitted to the CNSC for review	September 2017
	Detailed Decommissioning Plan submitted to CNSC	September 2017
	Public Review Period of EIS	October-December 2017
	Updated EIS submitted to the CNSC	June 2022
	CNSC, Federal and Provincial Review of updated EIS and responses to information requests/comments	June 2022 – February 2023
	Final EIS submitted to the CNSC	March 2023
	CNSC review and acceptance of Final EIS and preparation of CNSC Environmental Assessment Report	March – July 2023
	CNSC Licence Hearing (tentative)	July 2023 (Part 1) and October 2023 (Part 2)
	Environmental Assessment Decision (tentative)	January 2024
Decommissioning Schedule		
Closure Phase		
1	Preparation for ISD	2022–2025
	WR-1 Deactivation and Segregation Complete	December 2023
2	Grouting of Below-Grade Systems and Structures	2025
	ISD Grouting Complete	January 2025
3	Removal of Above-Grade Structures	2024-2025
	WR-1 Building Demolition and Decommissioning Complete	May 2025
4	Installation of Concrete Cap and Engineered Cover	July 2026
5	Final Site Restoration	2026
6	Preparation of Institutional Control	2026
	Site Turnover for Institutional Control and Monitoring	January 2027
Post-closure Phase		
7	Institutional Control	2027–2127 (minimum)
8	Post-institutional Control	Beyond 2127

Note: Dates are subject to change pending receipt of environmental assessment and licensing approvals.
EIS = Environmental Impact Statement; CNSC = Canadian Nuclear and Safety Commission.

The Project phases are:

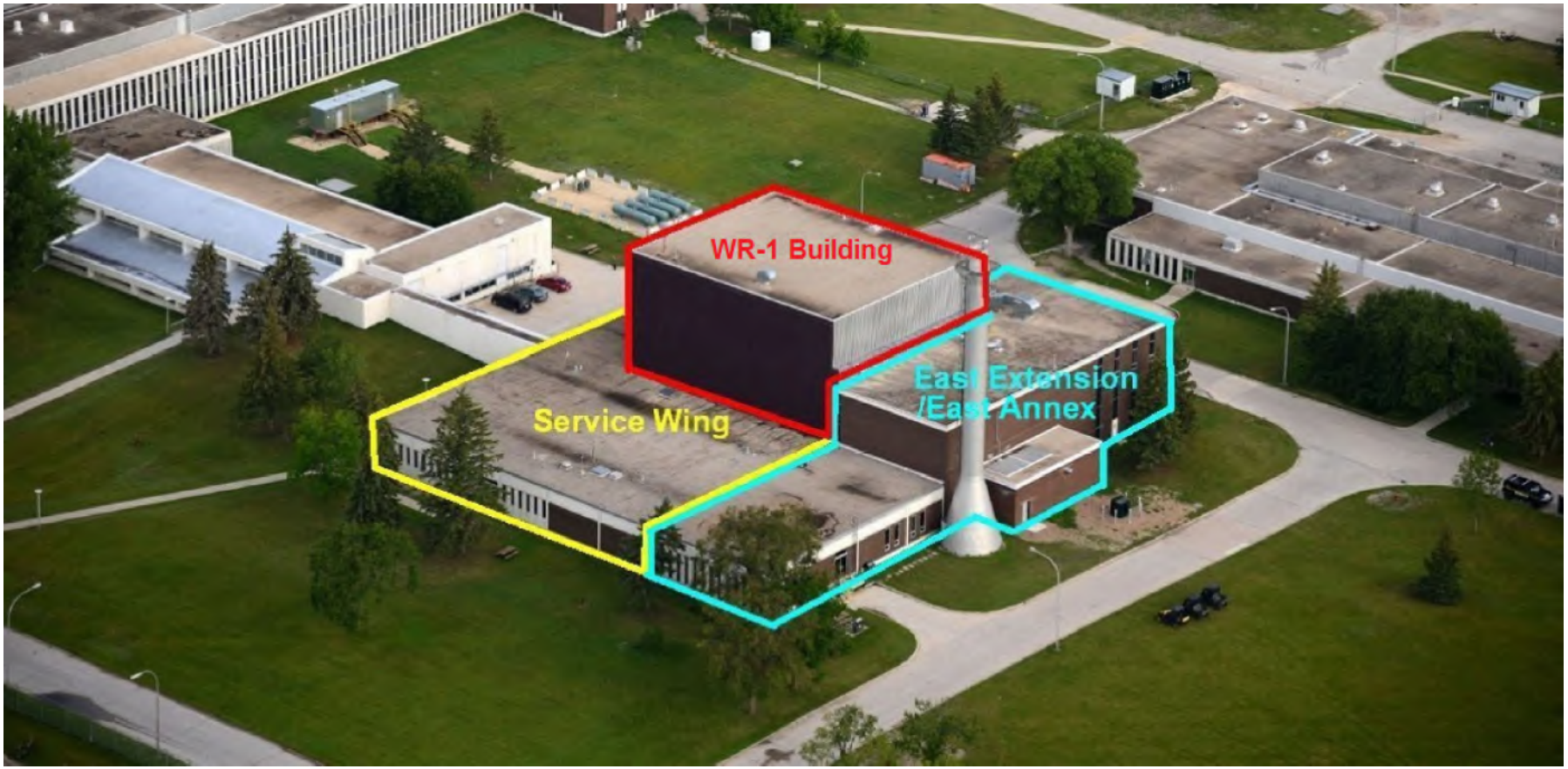
- **Closure phase** – Preparation and implementation of ISD, which includes grouting of below-grade structures and systems, removal of above-grade WR-1 structures and systems, installation of the concrete cap and engineered cover, and environmental controls and final site restoration. These activities last from 2022 to 2027.
- **Post-closure phase** – The post-closure phase has two discrete periods: institutional control and post-institutional control. Institutional control is estimated to last a minimum of 100 years during which long-term monitoring and maintenance activities will continue, to demonstrate compliance with the safety case assumptions. Although the duration of institutional control is estimated at a minimum of 100 years, it is recognized that it will continue until the CNSC agrees institutional controls are no longer needed. It is assumed that institutional control eventually collapses, and knowledge of the facility is lost. There is much uncertainty around when this would occur, if at all. For the purposes of the assessment, it is assumed to occur 100 years after closure of the facility. Post-institutional control occurs after year 2127 and continues indefinitely; however, the timeframe defined for the assessment of potential effects, as part of the normal evolution of the Project's safety assessment is 10,000 years. This timeframe (i.e., 10,000 years) encompasses the phase in which peak effects are anticipated (Golder 2021a).

3.2 WR-1 Building Overview

The WR-1 Building consists of seven floors (Level 100 [bottom floor] to Level 700 [top floor]) (Figure 1.1-2), five of which are below-grade (Levels 100 to 500). Level 100 is located approximately 18.5 m below the main floor level (Level 600), which is located at approximately the ground level. All reactor systems are located below-grade, except for the primary coolant pumps and heat exchangers, which are contained in a shielded room on the reactor hall floor. Access is restricted to the lower four levels, while the upper three floors provide office space and laboratory space. A portion of Level 500 also has restricted access.

The general arrangement of the WR-1 Complex is shown in Figure 3.2.1. The building footprint at ground level measures 63.9 m by 52.7 m and includes the main reactor building and east annex and the service wing. The east annex is a two-storey extension that housed various systems, such as an experimental loop, a mechanical maintenance shop and a chemical laboratory. The service wing is a single-storey extension that contained offices and the reactor control room. The east annex and service wing will be decommissioned and demolished following the original decommissioning plan (AECL 2001).

S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0005_EIS_Sec3\20145046-0005-G-0001_Figure 3_2_1 GENERAL ARRANGEMENT OF THE WR-1 COMPLEX.mxd



NOTE(S)

REFERENCE(S)

WR-1 COMPLEX: TECHNICAL DOCUMENT DOCUMENT {WLDP-26000-041-00 PAGE 6, REV.0}

CLIENT

CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT

EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

CONSULTANT

WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	-
PREPARED	PR/RRD
REVIEWED	KL
APPROVED	AB

TITLE

WR-1 COMPLEX

PROJECT NO.	CONTROL	REV.	FIGURE
20145046		2	**3.2.1**

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3.2.1 Major Components in the WR-1 Building

3.2.1.1 The Reactor Vessel

The reactor vessel, also known as the calandria (shown in Figure 3.2.1-1), is a cylindrical stainless steel tank approximately 5 m high and 2.75 m in diameter. The calandria contains 54 calandria tubes; each calandria tube surrounds a pressure tube (also known as a fuel channel). The calandria tubes prevented the surrounding heavy water moderator from coming into contact with the pressure tubes. Between the calandria tube and the pressure tube is an annular space that was filled with carbon dioxide. The pressure tubes contained the fuel and circulating organic coolant. The calandria is surrounded by radial and axial shielding and extensions of the pressure tube beyond the calandria tubes, which provided connections to the coolant circulation above and below the radiation shields. The reactor was permanently shut down and the fuel from the pressure tubes and the circulating organic coolant removed in 1985. Figure 3.2.1-2 shows the location of the reactor vessel within the WR-1 Building.

3.2.1.2 Shielding

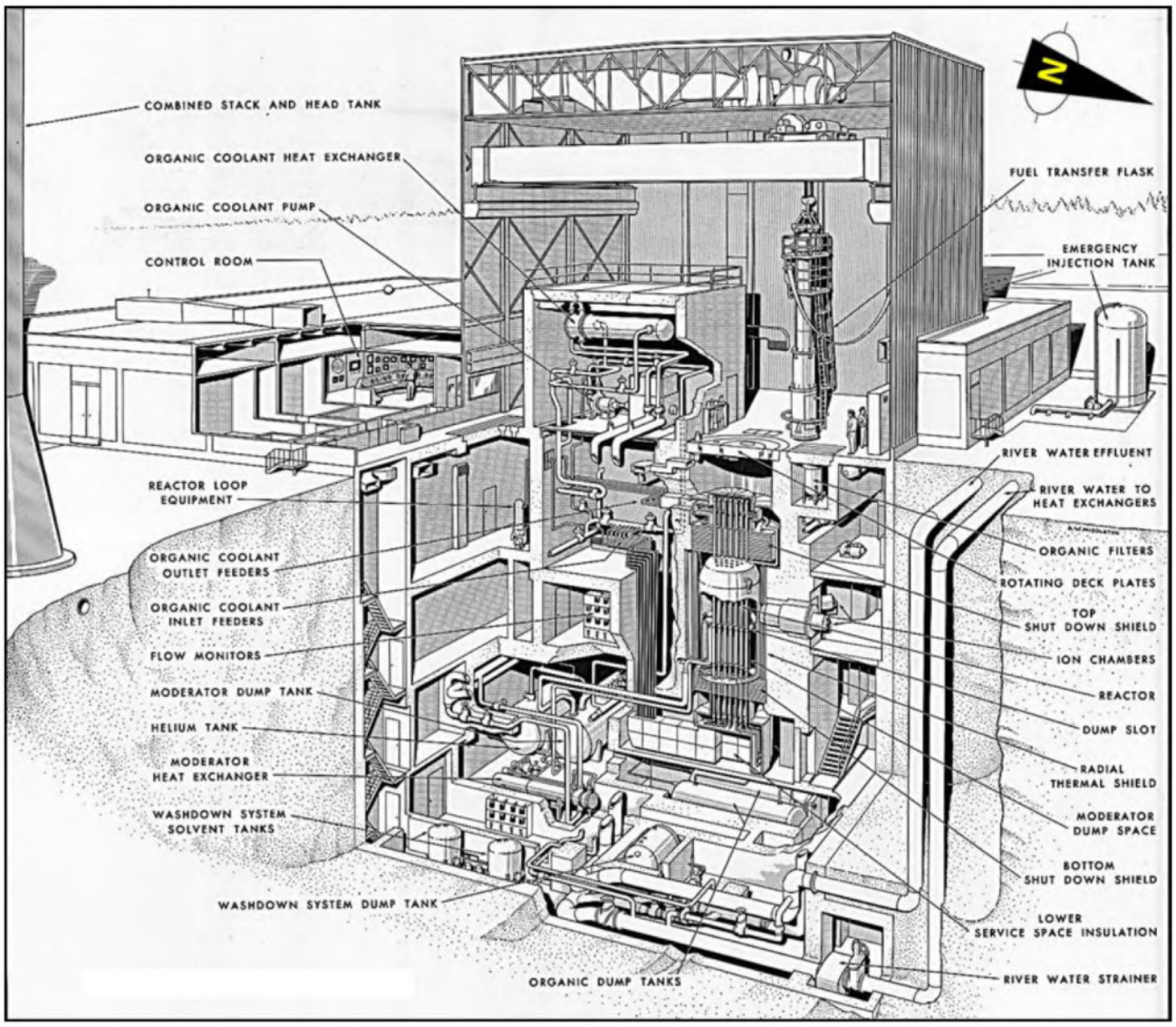
The reactor is surrounded by heavy concrete shielding (more than 2 m thick), which forms the reactor vault walls (Figure 3.2.1-2). Heavy concrete (density of 3,500 kg/m^3) was also used in the upper and lower access rooms and the shutdown shields. Piping through the concrete provided access for heavy water and helium lines and for the reactor vault exhaust duct. There are also three penetrations for the ion chambers.

The top deck plates provided an operational shield between the upper access space and the reactor hall and supported the fuel transfer flask. This shielding consisted of two rotating plates and an outer stationary ring. The plates are composed of cast steel (0.45 m thick) topped by wood fibre hardboard (Masonite; 9 cm thick) and a steel cover plate (0.5 cm thick).

3.2.1.3 Heavy Water and Helium Systems

These systems provided heavy water and helium to various reactor components. The heavy water system's main components are a dump tank, a helium accumulator tank, three circulation pumps, a heat exchanger, the calandria vessel, piping and instrumentation. The helium system consists of two helium pumps, two helium control valves, six reactor dump valves, a helium accumulator tank, five heavy water vapour condensers, a recombination unit, oxygen and helium addition stations, a sampling station, system piping and instrumentation. The heavy water and helium systems include the following auxiliary systems.

- **Boron addition system –** The boron addition system consists of two circuits: an initial charge circuit and a continuous addition circuit. The continuous addition circuit includes a 45 L tank, a metering pump, a mixing pump, a sample station, an addition station and a cation purification column.
- **Moderator demineralizer system –** The moderator demineralizer system consists of three mixed bed ion exchangers and, if necessary, a shield flask was available for the removal of highly contaminated ion-exchange columns. The ion exchange resins have been removed.
- **Heavy water collection and leak detection system –** The heavy water collection system consists of a stainless steel tank, a pump, piping and instrumentation.
- **Helium gas chromatograph –** The helium gas chromatograph includes an analyzer, a sample conditioner, a programmer, a stream selector and a recorder.



REFERENCE(S)
WR-1 BUILDING: DOCUMENT {WLDP-26400-DDP-001, PAGE 25, REV.3}

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
REACTOR VESSEL

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	--
PREPARED	PR/RRD
REVIEWED	KL
APPROVED	AB

PROJECT NO.	CONTROL	REV.	FIGURE
20145046		2	**3.2.1-1**

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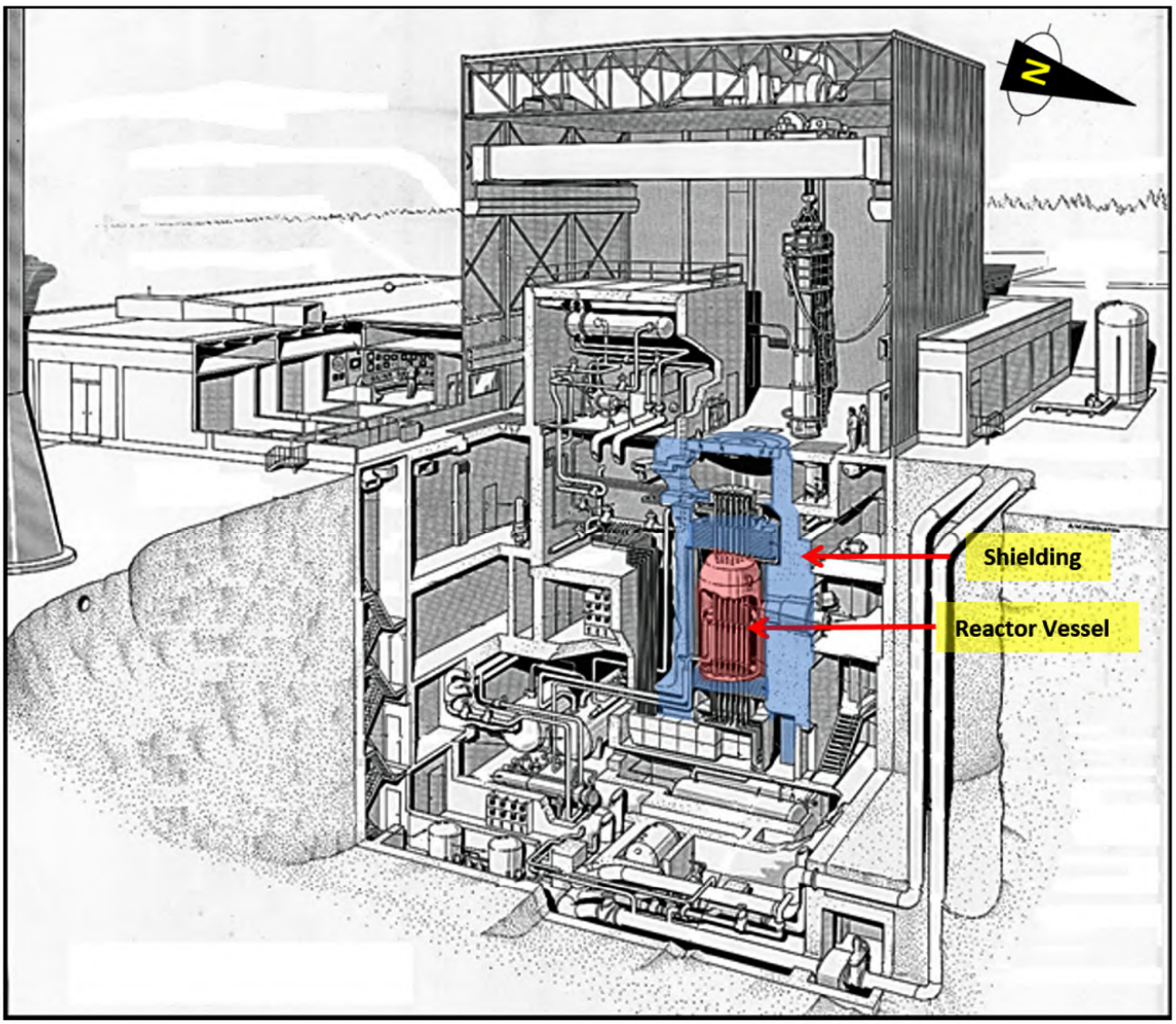

REFERENCE(S)
WR-1 BUILDING: DOCUMENT {WLDP-03700-ENA-001, PAGE 19, REV.0}

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
WR-1 BUILDING - REACTOR VESSEL AND SHIELDING

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	-
PREPARED	PR/RRD
REVIEWED	KL
APPROVED	AB

PROJECT NO.	CONTROL	REV.	FIGURE
20145046		2	**3.2.1-2**

S:\Clients\Canadian Nuclear Laboratories\Manitoba\99 PROJ\20145046\40 PROD\0005 EIS Sec3\20145046-0005-G-0003 Figure 3 2-1-2 WR-1 BUILDING REACTOR VESSEL AND SHIELDING.mxd

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3.2.1.4 Primary Heat Transport System

The primary heat transport (PHT) system (shown in Figure 3.2.1-3) was designed to remove the heat produced in the reactor core. The system was divided into three circuits (A, B and C circuits; C Circuit in the east annex has already been removed) and the heat removed was dissipated to the Winnipeg River through conventional tube-and-shell heat exchangers using an organic primary coolant and river water for the secondary coolant. With this type of heat exchanger, one fluid runs through the tubes and another fluid flows over the tubes inside the surrounding shell to transfer heat between the two fluids. The PHT system had three similar circuits to achieve flexibility for experimental research.

There were four experimental loops in WR-1 (WR-1L2 and three fast neutron loops) and one out-of-reactor hydraulic test loop (WR-1L1 loop) in the reactor building. Each in-reactor loop consisted of a fuelled test section in a reactor lattice position, with piping equipment and instrumentation located in an adjacent loop room necessary to maintain required operating conditions of flow, pressure and temperature in the test section. A fuel position was converted to a loop by disconnecting the inlet and outlet feeders from the PHT system and connecting the feeders to the loop inlet and outlet piping.

3.2.1.4.1 Out-of-Reactor Hydraulic Test Loop (WR-1L1 Loop)

The WR-1L1 loop was a test facility capable of handling full-sized fuel channels and fuel assemblies, and consisted of a circulation pump, a pressurized pump, three test sections, three electric heaters, a make-up tank/degasifier, a condenser circuit, a purification circuit, a loop cooler, piping and instrumentation. Organic coolant was circulated through the test section(s) at operating conditions determined by the experiment being performed.

The three test sections extended between the hatch in the reactor hall floor and the WR-1L1 loop room. Each test section consisted of an outer insulation carbon steel pipe jacket supported from the building and an inner WR-1 fuel channel. The fuel channel was sealed top and bottom to the jacket similar to the in-reactor seals to the calandria extension tubes. A carbon dioxide annulus between the outer jacket and the fuel channel provided insulation. The test sections were arranged in parallel, enabling multiple tests to be carried out simultaneously.

3.2.1.4.2 WR-1L2 Loop

The WR-1L2 loop provided a light water-cooled research facility in the WR-1 Building. The loop was designed to be operated in either the boiling water or the pressurized water mode. Distilled light water was circulated through the test section by one of two pumps. Five immersion heaters on the inlet flow regulated the temperature of the coolant entering the test section. A surge tank and a separator vessel minimized pressure fluctuations in the circuit. The separator vessel stripped the steam from the outlet flow when the boiler circuit was not in use. The steam was then passed to the degassing vessel.

A reflux boiler was used to simulate the heat removed across the boiler section of a power reactor. The condenser cooling circuit consisted of two circulation pumps and a heat exchanger cooled with standby water. A surge tank was also part of the system.

A small coolant flow was passed through a degassing circuit. A heater was located in the circuit for drying the steam so accurate steam flow measurements could be made. The degassing vessel could be operated with a hydrogen atmosphere. All vent and drain valves and bursting disc/relieve valve outlets were connected to this tank. A pump was provided for sampling the tank contents and pumping the effluent to Building 200. Pumps also supplied make-up and emergency coolant to the loop from the distilled water storage tank. A purification circuit consisting of five parallel ion exchange columns and filters was also part of the loop.

3.2.1.4.3 Fast Neutron Loops

Three fast neutron loops (WR-1L4, WR-1L5 and WR-1L6) consisted of the following main components:

- a reflux boiler;
- three centrifugal circulation pumps;
- one vertical centrifugal pressurizing pump (WR-1L6 has two pumps);
- a surge tank; and
- a test section.

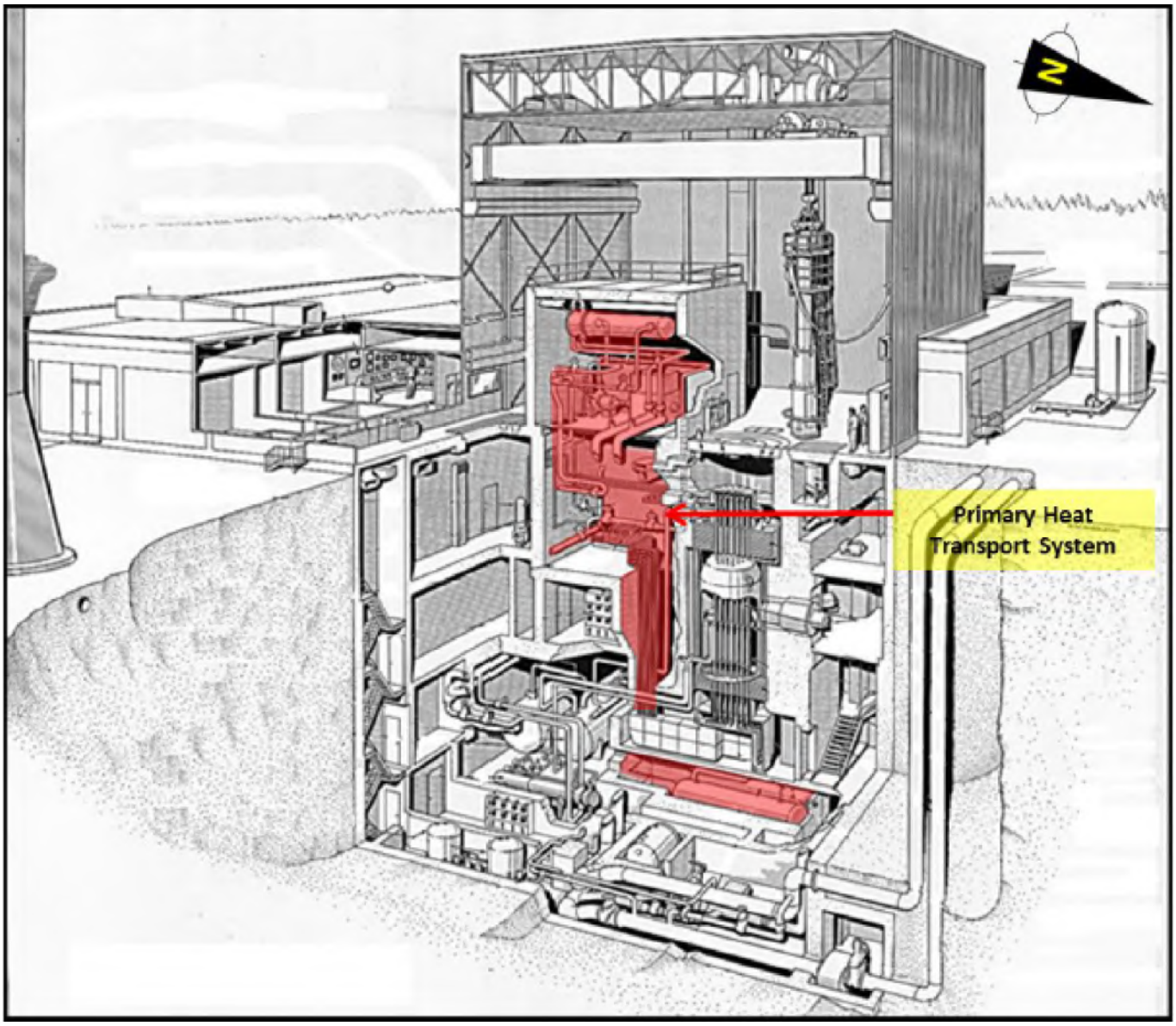
Organic coolant was circulated from bottom to top through the test section and back to the reflux boiler where the heat picked up from the fuel was dissipated to the cooling water. A small bleed flow was taken from the outlet feeder, the A/B degassing tank and pressure control. A similar quantity of degassed coolant was returned to the loop from the A/B circuit degassing pump(s). The pressurizing pump supplied the coolant to the suction of the circulation pumps. The circulation pumps were equipped with flywheels, which provided rundown cooling flow. Small motors were supplied to back up each of the main pump motors.

The WR-1 organic loops were connected to the WR-1 emergency injection system at both the inlet and outlet feeders. Emergency cooling to the test section was assured in the event a pipe rupture occurred at any location in the loop.

3.2.2 WR-1 Auxiliary Systems

3.2.2.1 Water Supply and Drainage System

Water was required as a secondary coolant for the PHT system, experimental loops and auxiliary systems, as well as a primary coolant for various pumps, motors and the WR-1 Building services. Water was also required for fire water, domestic water and distilled water systems. The water supply system is sourced from the Winnipeg River via the pump house. Process and standby water was returned to the Winnipeg River through the process drainage system via the outfall station. An organic trap was provided on the discharge line to precipitate out any organic material carried along in the water being discharged into the river.



CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
WR-1 BUILDING - PRIMARY HEAT TRANSPORT SYSTEM

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	--
PREPARED	PR/RRD
REVIEWED	KL
APPROVED	AB

PROJECT NO. 20145046 | CONTROL | REV. 2 | FIGURE **3.2.1-3**

REFERENCE(S)
WR-1 BUILDING: DOCUMENT {WLDP-03700-ENA-001, PAGE 20, REV.0}

S:\Clients\Canadian Nuclear Laboratories\Manitoba\09 PROJ\20145046\40 PROD\0005 EIS Sec3\20145046-0005-G-0004 Figure 3 2-1-3 WR-1 BUILDING PRIMARY HEAT TRANSPORT SYSTEM.mxd
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3.2.2.2 Spent Fuel Handling and Storage System

The fuel handling and storage systems are shown in Figure 3.2.2-1. Throughout the operation of WR-1, irradiated fuel was removed from the reactor core with the large fuel transfer flask.

3.2.2.2.1 Fuel Storage Block

The fuel storage block provided a facility for storing and washing irradiated fuel, for storing irradiated fuel channels and experimental equipment, and for loading and unloading the fuel transfer flask. When the fuel had decayed sufficiently, it was transferred to the fuel storage bays using the fuel transfer flask. The fuel storage block consists of a concrete shielded, stainless steel lined pool filled with water. A carbon steel operating platform is located 0.3 m above the water level. The operating platform supports storage tubes and an operating walkway. A heavily shielded door controls access to the block with interlocks on the fuel transfer flask to prevent fuelling operations at the block without the door being locked shut. The top shield over the block consists of two carbon steel plates bolted together to form a 0.46 m thick shield, flush with the reactor hall floor.

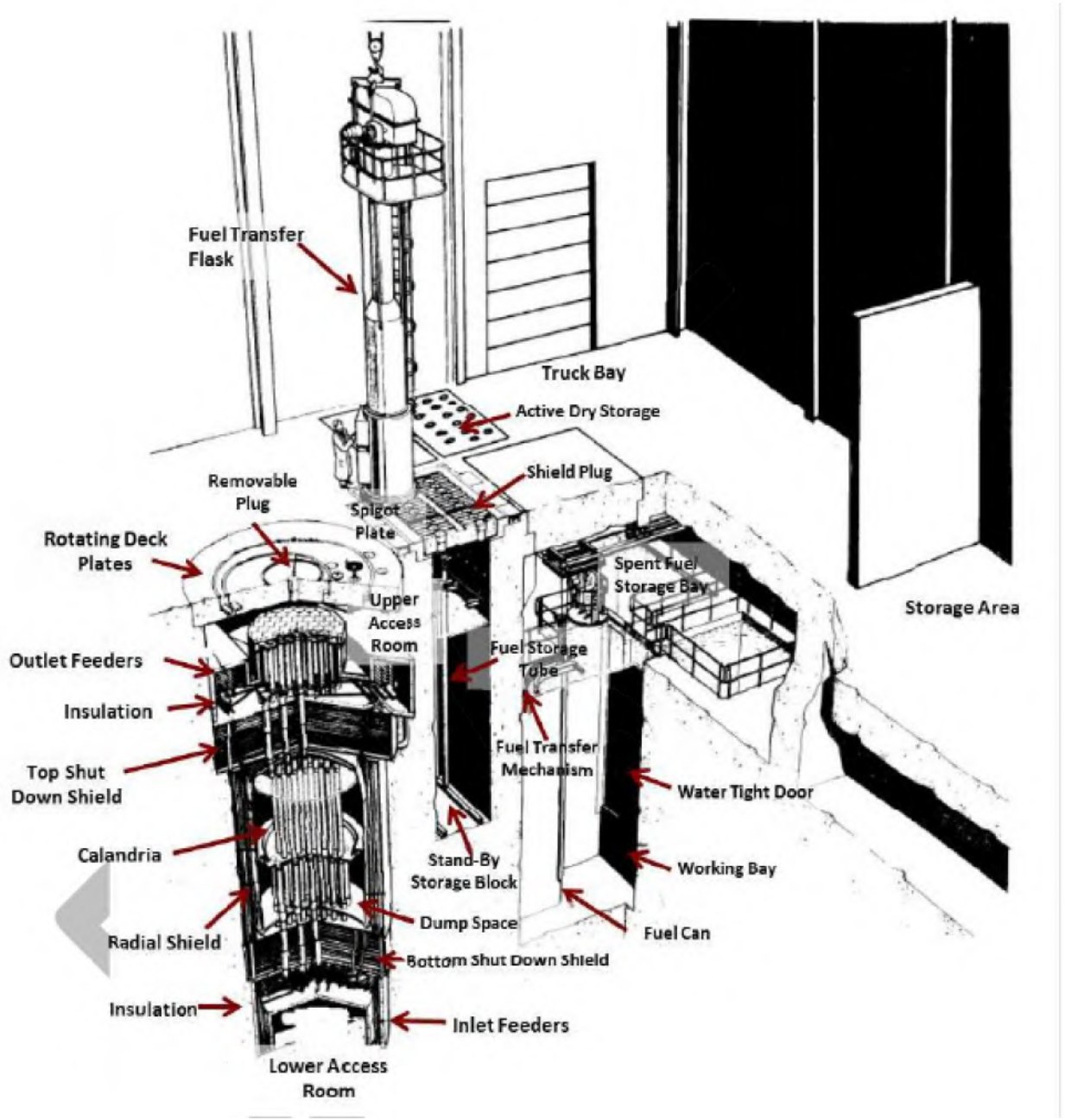
Twenty-eight holes fitted with shielding plugs penetrate the shield and provide access ports to the storage tubes and the fuel channel storage racks below. Twenty-six storage tubes were provided, twenty-four tubes were for fuel storage, one for fuel washing, and one for loading and unloading the transfer flasks. The storage tubes are equipped with overflow drains and level instrumentation. The organic-filled tubes overflowed to the wash-down system's used-organic coolant tank. The wash tube facility consisted of a xylene filled storage tube.

3.2.2.2.2 Spent Fuel Station

The spent fuel station provided shielding in the reactor hall during fuel transfer operations at the fuel storage block and supported the fuel transfer flask and other equipment over the block. The spent fuel station consists of a carbon steel spigot plate recessed in the reactor hall floor, with a guide tube and a fuel transfer trolley mechanism. The spigot plate was used to position the fuel transfer flask at the station. The trolley was manually powered to move spent fuel between the transfer station and the work bay. The fuel transfer flask was interlocked at the station to prevent fuel being lowered unless the trolley was in position to receive it. The guide tube is a stainless steel tube, extending between the spigot plate and the trolley station in the fuel transfer passage. Any organic dripping from the inner vessel was contained by the tube and collected by a drip tray at the base.

The spent fuel room, located one floor below the reactor hall, contains a concrete-shielded work bay, two fuel storage bays and a fuel transfer passage. An electric crane that was used for spent fuel handling is also located there. The bays are constructed of light concrete with an epoxy lining. The underwater corners and joints were reinforced with fibreglass cloth. The storage bays are separated from the work bay by watertight gates. Inflatable seals on the stainless steel gates provided watertight separation of the bays for draining and maintenance. The spent fuel room crane was used to transfer fuel in the storage bay area. Storage racks were provided in each bay.

The work bay provided a fuel separating mechanism, for removing the hanger rod from the fuel end, and a fuel can holding station. An active fuel hanger storage facility was provided in the spent fuel room, consisting of a stainless steel tank located below floor hatch H-24.



REFERENCE(S)

WR-1 FUEL HANDLING EQUIPMENT AND STORAGE BAYS-: DOCUMENT {WLDP-26400-DDP-001, PAGE 48, REV.3}

CLIENT

CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT

EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE

WR-1 BUILDING - FUEL HANDLING EQUIPMENT AND STORAGE BAYS

CONSULTANT

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PROJECT NO.	CONTROL	REV.	FIGURE
20145046		2	**3.2.2-1**

S:\Clients\Canadian Nuclear Laboratories\Manitoba\09 PROJ\20145046\40 PROD\0005 EIS Sec3\20145046-0005-G-0005 Figure 3 2-2-1 WR-1 BUILDING FUEL HANDLING EQUIPMENT AND STORAGE.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
25mm
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The spent fuel bay had a circulation system to remove decay heat from spent fuel and irradiated equipment stored in the spent fuel bays and the fuel storage block. A circulation pump forced water from the change volume tank through a tube-in-shell heat exchanger into the bottom of the storage bays, the work bay and the storage block. A small bypass flow from the supply line was passed through a purification circuit containing a mixed sand and gravel bed filter and an ion-exchange column. The water returned by gravity to a change volume tank. The bay water piping was stainless steel.

3.2.2.2.3 Active Dry Storage System

The purpose of the active dry storage system was to provide a storage facility for irradiated or contaminated hardware. The storage facility consists of a concrete-shielded pit lined with stainless steel. The facility is located in the reactor hall north of the fuel storage block. The top shield consists of an 8.34-tonne carbon steel plate. Twenty-seven stepped access holes with carbon steel lead-filled plugs are provided in three rows.

3.2.2.2.4 Fuel Wash-Down System

The fuel wash-down system was used to encase defective fuel and supply and drain organic coolant used by the fuel transfer flask, the fuel storage block and the spent fuel storage bays. The wash-down system consists of a wash-down station, an organic storage and pumping facility, and an organic drainage facility. The wash-down station is in the floor of the reactor hall. It consists of a top shield, a wash tube and an organic accumulator. The wash tube is a water-jacketed stainless steel tube with a ball valve at the top for sealing it. The external water jacket removed the decay heat from the spent fuel rod being washed.

The wash-down station was designed for washing fuel in organic coolant. Two tanks, located in Room 109, provided a reserve supply of fresh and used organic coolant. A shielded dump tank and filter unit was provided for collecting highly active or contaminated coolant from the wash tube or the fuel transfer flask. The tank contents could also be pumped to Room 635 and drummed.

3.2.2.2.5 Transfer Flasks

A fuel transfer flask was used to transfer irradiated fuel from the reactor to the storage block, the wash-down station and the spent fuel station. The fuel transfer flask is 10.6 m high and 1.24 m in diameter at the base and weighs approximately 41 megagrams (Mg). It consists of outer shielding with the lifting spider, inner vessel, mechanisms and a cooling system.

The outer shielding provided support for the flask equipment and radiation shielding for active fuel carried in it. The inner vessel is a stainless steel, water-jacketed tube with a ball valve and snout at the lower end. The assembly is suspended from the inner vessel hoist by a yoke attached to the upper end. The yoke travels on two screws, which move the inner vessel in the vertical plane. The stationary tube was connected to the building active ventilation system pit exhaust fan through a flexible connection during fuelling operations to remove any organic or radioactive gas released.

The cooling system consists of a stainless steel water tank mounted on the lower platform of the flask circulation pump, connection lines to and from the inner vessel water jacket, and instrumentation. Steam connections were provided to heat the cooling water or the inner vessel, if desired. In an emergency, process water could be circulated though the cooling system on a once-through basis.

The fuel channel transfer flask was used to transfer irradiated fuel channels between the reactor and the storage block, and to transfer irradiated inserts and other radioactive assemblies not requiring cooling. The fuel channel transfer flask is similar to the fuel transfer flask except that all cable drives were manually operated and no instrumentation or interlocks, cooling, or ventilation were provided.

A smaller transfer flask (19 Mg) was used to transfer fuel between WR-1 and the hot cells in the WL Research and Development Building. This flask consists of a stainless steel pipe (8.1 m long), shielded with lead. Loading and unloading was done in WR-1 in a special site at the fuel storage block using the reactor hall crane.

The flask maintenance station was a facility for washing and maintaining the inner vessel of the transfer flask. It was also used as a decontamination facility for the fuel handling equipment. The station is in the reactor hall northwest of the reactor. The station consists of a base plate on the reactor hall floor to support the flask and a shaft 12 m deep with dimensions of 2.1 m by 1.8 m. A manually operated hoist served the bottom platform area. Special mechanisms were provided at the upper platform for removing the flask shutter and inner vessel assemblies.

3.2.2.3 Active Ventilation System

The active ventilation system delivers forced air circulation throughout the WR-1 Building to provide contamination control, environment control for personnel and equipment, and the needed air exchange.

The active ventilation system was designed so that air flows were always towards the zones having the higher contamination level to prevent the spread of contamination. The active ventilation system was sub-divided into four systems: building, cooling, control room and the building extension active ventilation systems. Each system had a fresh air supply, fans, filters, heating and cooling coils and an exhaust system. All systems normally exhausted to a common stack located east of the WR-1 Building. Air flow and pressure were balanced within the zones by manual volume dampers and grilles.

The incoming air was filtered and heated or cooled by preheat and tempering coils, and distribution fans sent air to various parts of the building. A smoke detector monitored the exhaust duct for smoke in the exhaust gases.

The control and relay room air conditioning system drew air to replace air lost to the building active ventilation system. A circulation fan drew the air through cooling coils and a bank of filters. In the event of airborne contamination entering the control room, fresh air could be supplied to flush the room. A fan was used to exhaust directly to atmosphere through a vent in the service wing roof.

3.2.2.4 Active Drainage System

The active drainage system collects liquid effluent from the various areas of the WR-1 Building and the groundwater from around the building base. The active drainage system includes five sumps:

- **Active Drainage Sump A –** general drainage (1.68 m^3 concrete tank);
- **Active Drainage Sump B –** heavy water drainage (2.73 m^3 concrete tank);
- **Organic Drainage Sump A –** organic coolant leakage (1.68 m^3 concrete tank);
- **WR-1 Extension Active Drainage Sump –** general drainage WR-1 extension (3.63 m^3 concrete tank); and
- **Sub-surface Active Drainage Sump –** groundwater around WR-1 Building basement (15 m^3 concrete tank).

Most of the active drainage piping is welded, seamless carbon steel pipe. The floor traps were equipped with a back water valve, which provided a ventilation barrier to prevent the spread of airborne contamination throughout the building. All rooms near WR-1 (other than those containing heavy water or organic piping and equipment) were drained to Active Drainage Sump A.

Floor drains in the moderator room, boron addition room and moderator demineralization drained into the Active Drainage Sump B concrete tank located in the floor of the moderator room. A sump level monitor was located to provide early warning of water in the sump. A remotely operated sampling pump was used to sample the sump effluent for heavy water. Effluent was pumped from this sump to Active Drainage Sump A for processing or to a drumming station to collect heavy water.

The floor drains in rooms containing organic piping or equipment were connected to Organic Drainage Sump A. The drains were positioned in the rooms to handle coolant spills, and the effluent could be pumped to Active Drainage Sump A. The WR-1 extension active drainage sump collected the effluent from the control laboratory fume cabinets and sinks, the mechanical shop and the areas in the building extension. Sump contents were pumped into the Active Drainage Sump A.

Active Drainage Sump A is pumped out to the low level liquid waste (LLLW) treatment system. The LLLW treatment system consists of two high density polyethylene tanks, a sampling station, and two filtering units. The effluent is held in the tanks until ready for sampling. It is sampled, analyzed, filtered and adjusted as required to meet release criteria.

The sub surface drainage sump is a concrete structure located outside the north wall of the WR 1 Building. The purpose of the Sub-Surface Drainage Sump is to collect groundwater from the weeping tiles located under and around the periphery of the WR-1 Building. A network of perforated pipe, embedded in free-draining crushed stone drains the groundwater from beneath the reactor building slab on ground (bedrock) and from the exterior periphery of the foundation walls into the sump. Since no contamination is anticipated to enter this effluent from inside or outside of the WR-1 Building, this sump is typically emptied to the stormwater management system; however, it is possible to route the effluent through the LLLW Treatment System for sampling and treatment prior to release in the event of a spill outside of the WR-1 Building.

3.2.2.5 Emergency Injection System

The emergency injection system consists of two pressurized tanks containing fresh coolant (HB-40 hydrogenated terphenyl used as reactor coolant, also known as OS-84). Tank PO-TK1 was connected to the inlet headers of the PHT A, B and C circuits and to the experimental loops tank and feeders. Tank PO-TK3 was connected to the outlet feeders of A, B and C circuits through the activity monitoring system supply lines.

3.2.2.6 Other Supporting Systems

The various other ancillary systems required to support the WR-1 Building are described below:

- **Thermal shield and concrete cooling system –** The thermal shield cooling system consisted of two circulation pumps, a tube-and-shell heat exchanger, a storage deaerator head tank, piping, instrumentation and miscellaneous equipment. The concrete cooling system consists of two circulation pumps, a U-tube heat exchanger, head degassing tank, six cooling coils, piping, instrumentation and miscellaneous equipment.
- **Compressed air system –** The compressed air system supplies compressed air to the WR-1 Complex from the powerhouse through a carbon steel underground main sheathed in a polyethylene protective coating.

Two air receiver tanks located in the WR-1 Building provide a reserve of compressed air. Compressed air is distributed throughout the building. Mask air was supplied from the instrument air receiver tank. A pressure-reducing station supplied mask air through a humidifier bank. A second pressure reducing station was available if the pressure regulator could not supply the necessary volume.

- **Heating and cooling system –** This system provides process and building heat to the WR-1 Complex and consists of several closed loop, circulating heated propylene glycol solutions or water through in-duct heater coils, room heater units or wall convectors. The main building glycol system consists of a closed loop in which a propylene glycol solution is circulated by one of two pumps. The system includes a heat exchanger and pre-heater coils. Obsolete equipment associated with the heating and cooling system has been partially removed.
- **Activity monitoring system –** The activity monitoring system provided early detection and identification of failed fuel. The activity monitoring system consisted of 19 Geiger tube detectors that monitored the activity of the outlet coolant from the individual fuel channel outlet feeders and 3 Geiger tube detectors that monitored the activity of the three primary heat-transport circuits. When a fuel failure occurred, the Geiger detector monitoring the affected fuel site would show an activity increase, identifying the suspected failure as one of three fuel rods.
- **Fire protection system –**The fire protection system includes the fire detection and alarm system, the pressurized carbon dioxide fire prevention system, the fire water system and the organic leak and smoke detection system. The fire detection and alarm system and the fire water system remain operational, but the other systems have been permanently shut down.
- **Electrical distribution system –** The electrical distribution system supplies power throughout the WR-1 Building and includes wiring, substations, circuits and busses. Emergency or standby electrical power is provided by four sets of diesel-driven generators located in the powerhouse. Highly reliable direct current (DC) power was supplied by rectifying the normal Class IV alternating current (AC) power or the standby Class III AC power. Lead-acid battery banks provided backup power whenever the AC supply to the rectifiers was lost. Only one battery bank remains in the system.
- **Annunciator system –** The annunciator system is operational and consists of alarm units with lighted, engraved windows and plug-in logic circuit boards mounted in cabinets. A tone generator and associated loudspeaker were mounted in each of the two control rooms to provide audible “alarm” and “clear” annunciator for the alarm units in the respective control rooms.
- **Radiological monitoring system –** The radiological monitoring system is operational and consists of an AEP 2180 fixed radiation monitor that is used in the WR-1 Building to monitor external gamma dose rates in the work area. It provides local indication with an alarm unit mounted in the main control room.
- **Auxiliary organic and gas systems –** The auxiliary organic and gas systems are those systems that supported the operation of the PHT system and included the degassing and particulate removal system, the purification system, the relief exhaust system, the organic supply system and the nitrogen supply system. Each system generally consisted of a storage tank, service piping and instrumentation.
- **Neutron power system –** The neutron power system consisted of the ion chambers, amplifiers, signal cables, power supplies and instrumentation.

- **Protective systems –** There were two reactor protective systems: the main protective system and the independent protective system. The main protective system monitored all parameters in the reactor capable of leading to, or causing, a dangerous reactor accident. The independent protective system monitored only two parameters: the reactor flux (neutron and gamma) and the emergency coolant injection tank pressure.
- **Reactor power regulating system –** The reactor regulating system consisted of two regulating channels, each consisting of six blocks: instrumentation, analog control computer, a control station, a routine start-up circuit, routine test equipment and a control valve.

3.3 Current Status of WR-1 and the WR-1 Building

3.3.1 Decommissioning Activities Completed to Date

WR-1 was permanently shut down in 1985 and decommissioned to a secure state in a reduced site access-controlled area. The first stage of decommissioning commenced in 1989 and was completed in 1995. This preliminary decommissioning of WR-1 (1989 to 1995) included:

- de-fuelling the reactor following shutdown in 1985;
- draining the organic coolant (but not flushing) from cooling circuits and transferring to the Waste Management Area for processing;
- removing heavy water and transferring to Chalk River Laboratories for storage;
- transferring all irradiated fuel stored in the fuel storage bays to storage in the Concrete Canister Storage Facility; and
- decontaminating the main floor (Level 600) and first sublevel (Level 500).

The organic coolant system was not flushed, so some coolant is still present within the system. Reactor control systems were isolated and removed. Building services systems are still maintained in an operating mode. This preliminary decommissioning work decreased potential hazards from the facility, reducing the monitoring and surveillance requirements for the deferment period.

The thermal shield and concrete cooling systems were not designed for easy draining, and portions of the systems within the reactor vault remain filled with cooling water. This will be drained as practicable but has been accounted for within the assessment to remain in place for in situ disposal.

3.3.2 Remaining WR-1 Systems

Many of the remaining systems for WR-1 are permanently shut down but are largely intact. Most of the electrical power has been disconnected and the systems have been placed in a safe shut down state. The only system considered as temporarily shut down is the spent fuel storage bay water circulation system. Decommissioning of spent fuel bays was carried out to a level where the bays were cleaned, and the system drained so that they could be placed in operation if they were required to support future research/business programs.

Table 3.3.2-1 summarizes the operational status of the WR-1 systems and identifies the radiological hazards for each system. All the required service systems remain operational to maintain WR-1 in a safe storage and surveillance state. Routine operation of these systems is documented in currently approved procedures. Building services and systems remaining in operation for the WR-1 Building include:

- water supply and drainage system;
- active drainage system;
- active ventilation system;
- compressed air system;
- fire protection system;
- electrical distribution system;
- annunciator system; and
- contamination monitoring system.

Table 3.3.2-1: Summary of WR-1 Building Systems Status

Systems	System Description	Operational Status[a]	Key Hazardous Materials [b]
Major Components			
Reactor Vessel	Section 3.2.1.1	Permanently shut down	**AP** **H-3**
Shielding	Section 3.2.1.2	Operational	**AP** (primary) – The shielding in close proximity to the reactor core, mainly the thermal and biological shields **FP** – Cross-contamination. Highest levels are expected to be the shielding in the upper and lower access rooms **Lead** **Potassium hydroxide**
Heavy Water System	Section 3.2.1.3	Permanently shut down	**H-3** (Primary) **CP** – Corrosion products possible from activation of structures part of the heavy water system in the vicinity of the reactor core and transported to the rest of the system
Helium System	Section 3.2.1.3	Permanently shut down	**H-3** (Primary) **CP** – Contamination likely in helium sample coolers Other parts of the system have the possibility of being cross-contaminated
Primary Heat Transport (PHT) System	Section 3.2.1.4	Permanently shut down; Circuit C (Room 528) dismantled and removed; other systems partially removed	**FP** (Primary) **CP** **AP** – in the sections that is in the reactor core (i.e., the pressure tubes) **Organic coolant**

Table 3.3.2-1: Summary of WR-1 Building Systems Status

Systems	System Description	Operational Status[a]	Key Hazardous Materials [b]
Out-of-Reactor Hydraulic Test Loop (WR-1L1 Loop)	Section 3.2.1.4.1	Permanently shut down	Some cross-contamination from PHT expected **Organic coolant**
WR-1L2 Loop	Section 3.2.1.4.2	Permanently shut down	**CP** (primary) **FP** – Light water cooled loop. This loop is expected to have high level of corrosion products relative to the rest of the WR-1 systems
Fast Neutron Loops	Section 3.2.1.4.3	Permanently shut down, loop 1L6 removed	**FP** (primary) **CP** – 1L4 and 1L5 are contaminated (Class 1). 1L6 has been removed **Organic coolant**
Auxiliary Systems			
Water Supply and Drainage System	Section 3.2.2.1	Operational	Supply water is a MARSAME Class 3. **FP** – Process drain system is known to be contaminated (contains an organic trap)
Fuel Storage Block	Section 3.2.2.2.1	Permanently shut down	**FP** (Primary) **Organic coolant** **Xylene**
Spent Fuel Station	Section 3.2.2.2.2	Permanently shut down	**FP** (Primary)
Active Dry Storage/ Fuel Wash-Down Systems	Section 3.2.2.2.3	Permanently shut down	**FP** (Primary) **CP** – Fuel wash-down system coolant drainage facility is a MARSAME Class 1. Other related structures are a MARSAME Class 1/2
Fuel Transfer Flask	Section 3.2.2.2.5	Permanently shut down	**FP** – Internal contamination Organic coolant
Fuel Channel Transfer Flask 21 Ton Transfer Flask	Section 3.2.2.2.5	Operational	**FP** – Internal contamination Organic coolant
Moderator Demineralizer System	Section 3.2.1.3	Permanently shut down	**H-3** (Primary) **CP**
Heavy Water Collection System	Section 3.2.1.3	Permanently shut down	**H-3** (Primary) **CP**
Helium Gas Chromatograph	Section 3.2.1.3	Dismantled and removed	**H-3** - Possible cross-contamination.
Boron Addition System	Section 3.2.1.3	Partially removed	**H-3** **Boron**
Ventilation System	Section 3.2.2.3	Operational	Active ventilation system is a MARSAME Class 1; remaining system likely clean
Active Drainage System	Section 3.2.2.4	Operational	**FP** **H-3** **CP** **Mercury**

Table 3.3.2-1: Summary of WR-1 Building Systems Status

Systems	System Description	Operational Status[a]	Key Hazardous Materials [b]
Emergency Injection System	Section 3.2.2.5	Mostly dismantled and removed	**FP** – Possible from cross-contamination from PHT system
Thermal Shield and Concrete Cooling System	Section 3.2.2.6	Permanently shut down	**AP** – Possible due to the close proximity to the reactor core **H-3** – Trace amounts from activation of lithium for pH control
Service Air System	Section 3.2.2.6	Operational	None expected
Instrument Air System	Section 3.2.2.6	Operational	None expected
Mask Air System	Section 3.2.2.6	Permanently shut down	None expected
Heating and Cooling System	Section 3.2.2.6	Obsolete equipment partially removed; system remains operational	Likely clean, possibility of leaks from contaminated systems, most likely coolant leaks in heat exchangers in the process heating system
Activity Monitoring System	Section 3.2.2.6	Permanently shut down	**FP** (Primary) **CP** Likely cross-contamination from PHT **Organic coolant**
Fire Protection System	Section 3.2.2.6	Operational	None expected
Electrical Distribution System	Section 3.2.2.6	Operational	No internal contamination expected
Annunciator System	Section 3.2.2.6	Operational	No internal contamination expected
Radiological Monitoring System	Section 3.2.2.6	Operational	**FP** (primary) **CP**
Degassing and Particulate Removal System	Section 3.2.2.6	Partially removed (C Circuit; other selected equipment)	**FP** (Primary) **AP** **Organic coolant**
Purification System	Section 3.2.2.6	Partially dismantled and removed	**FP** (Primary) **AP**
Relief Exhaust System	Section 3.2.2.6	Mostly dismantled and removed	**FP** (Primary) **CP**
Organic Supply System	Section 3.2.2.6	Partially removed (Bulk Storage Tank S0-TK5)	**FP** (Primary) **CP** – Cross-contaminated from used organic coolant **Organic coolant**
Nitrogen Supply System	Section 3.2.2.6	Mostly dismantled and removed	None expected
Neutron Power System	Section 3.2.2.6	Permanently shut down	**AP** – Portions in the vicinity of the reactor core are likely to be activated **FP** – Possibility of cross-contamination
Protective Systems	Section 3.2.2.6	Mostly dismantled and removed	None expected

Table 3.3.2-1: Summary of WR-1 Building Systems Status

Systems	System Description	Operational Status[(a)]	Key Hazardous Materials [(b)]
Reactor Power Regulating System	Section 3.2.2.6	Permanently shut down	Any contaminated parts of this system will remain inside the reactor core

(a) "Partially removed" means some specific equipment has been removed, but some equipment, pumps and motors remain. "Mostly dismantled" usually means equipment removed, but associated piping remains.

(b) Radiological Hazard definitions

- AP = Activation products – Neutron activated structures and components. These will be in close proximity to the reactor core.
- FP = Fission products.
- H-3 = Tritium – a weak beta emitter resulting from the activation of Heavy Water. Has the same chemical characteristics as water.
- CP = Corrosion products possible from activation of particles that pass through the reactor core and then get transported to the rest of the system outside of the core
- MARSAME = Multi-agency Radiation Survey and Assessment of Materials and Equipment.
  Class 1: Class 1 materials and equipment are impacted materials and equipment that have, or had, the following: (1) highest potential for, or known, radionuclide concentration(s) or radioactivity about the action level(s); (2) highest potential for small areas of elevated radionuclide concentration(s) or radioactivity; and (3) insufficient evidence to support reclassification as Class 2 of Class 3 materials and equipment.
  Class 2: Class 2 materials and equipment are impacted materials and equipment that have, or had, (1) low potential for radionuclide concentration(s) or radioactivity above the action level(s); and (2) little or no potential for small areas of elevated radionuclide concentration(s) or radioactivity.
  Class 3: Class 3 materials and equipment are impacted materials and equipment that have, or had, (1) little, or no, potential for radionuclide concentration(s) or radioactivity above background; and (2) insufficient evidence to support categorization as non-impacted.
- PHT = primary heat transport.

Since WR-1 was shut down and preliminary decommissioning activities were completed, many of the areas within the WR-1 Building are no longer designated as controlled areas; this includes most of the WR-1 Building rooms on Levels 600 and 700 (Figure 1.1-2). Some rooms that have been decommissioned and decontaminated at Level 400 and lower may have systems within them that have not been completely decontaminated (some ventilation and drainage systems; WR-1 pipes). Other hazards include asbestos-insulating materials, residual organic coolant in piping and tanks, and building structures and service systems. Administrative controls are in place to restrict access to these areas.

3.3.3 Waste Classification, Inventory and Characterization

The Detailed Decommissioning Plan (CNL 2021a) provides a list of the radiological zoning designation for the rooms in the WR-1 Building, along with a description of the potential for contamination present and an estimate of the contamination level and general dose rates expected in each area. This information will inform the detailed work plans that will be developed specifically to include best industry practices and experience with the aim of limiting risks to workers, the public and the environment from ISD hazards and to be compliant with the site's As Low As Reasonably Achievable (ALARA) policy.

3.3.3.1 Radiological Hazards

The remaining hazards in the WR 1 Building are largely radiological, with asbestos and organic coolant remaining in some reactor components. The available information on the radiological status is primarily based on reactor core modelling from the early 1990s (CNL 2020a). Furthermore, a comprehensive characterization campaign was performed during 2017 and 2018 to address data gaps and to provide quantitative estimates of residual radionuclide content remaining within WR-1 systems (CNL 2020a).

The majority of the remaining radioactivity in the WR-1 Building is situated in the reactor vessel, including the calandria, fuel channels, thermal shield and biological shield. The radiological hazards in the reactor building include potential exposure to radionuclides associated with irradiated reactor fuel, activated reactor components and tritiated heavy water. Corrosion/activation and fission products may also be found in process equipment.

A summary of the results of the comprehensive characterization campaign is provided in Table 3.3.3-1. Table 3.3.3-1 summarizes and compares both the inventory of WR-1 calculated through the historical work and through the recent sampling and validation work. For conservatism, the more bounding estimates are being used in safety and environmental assessment modelling.

Table 3.3.3-1: Summary of Radiological Inventory in WR-1

System	Pre-2018 (Bq)	Post-2018 (Bq)	Bounding Value (Bq)
Bioshield	4.1×10^{9}	n/a	4.1×10^{9}
Core	1.1×10^{15}	4.77×10^{14}	1.1×10^{15}
Out of Core	1.1×10^{12}	8.45×10^{10}	1.1×10^{12}
Total H-3 Out of Core[(a)]	1.27×10^{14}	2.47×10^{15}	2.47×10^{15}
Total	**1.23×10^{15}**	**2.95×10^{15}**	**3.57×10^{15}**

(a) Tritium estimates are conservative to account for uncertainties in the measurements.

Bq = becquerel; n/a = not applicable; H-3 = tritium, a weak beta emitter resulting from the activation of heavy water that has the same chemical characteristics as water.

3.3.3.2 Non-radiological Hazards

Some hazardous materials remain in WR-1 Building, including:

- asbestos-containing materials (ACMs; friable [contains more than 1% asbestos by weight or area and can be crumbled by the human hand] and non-friable [material that contains more than 1% asbestos and cannot be crumbled under hand pressure] asbestos-containing materials);
- residual organic coolant (HB-40 hydrogenated terphenyl used as reactor coolant, also known as OS-84) in the PHT system, unknown volumes potentially present in some of the tanks and some fuel channels;
- lead-based paint and lead shielding;
- polychlorinated biphenyls (PCBs) in fluorescent light fixture ballasts;
- small quantities of mercury in thermostats and switches;
- mould; and
- other hazardous chemicals as listed in Table 3.3.3-2 (HB-40, Lead, Xylene, Boron, Palladium, Potassium Hydroxide, Cadmium, Chromium, Mercury, Beryllium, Platinum, Magnesium Oxide, Gadolinium Oxide, Ozone Depleting Substances, Ion Exchange Columns)

Hazardous substances removed during preparation of ISD will be managed in accordance with CNL's *Environmental Protection* (CNL 2021c) and *Management of Waste* (CNL 2020b) requirements.

3.3.3.2.1 Asbestos

Both friable and non-friable ACM is present in the WR-1 Building. Quantities and locations of ACMs are given in the B100/WR-1 Restricted Area Asbestos Abatement Work Plan (AECL 2015). The term friable is applied to a material that can be readily reduced to dust or powder by hand or moderate pressure. Therefore, ACMs that are friable have a much greater potential for airborne release when disturbed.

In 2014, much of the asbestos was removed from the non-restricted access areas of WR-1. The restricted access areas of the WR-1 Building still contain ACMs that will remain to be grouted within the ISD envelope (i.e., asbestos has been removed from Level 500 and above, and minimal disruption of material will occur during dismantling required prior to grouting).

3.3.3.2.2 Lead

In 2006, Pinchin Environmental Ltd. conducted an industrial characterization of B100 and lead-based paint was found (Pinchin 2007). Later, a more extensive examination was performed for lead (CNL 2018a). This examination included a desktop review of documentation, analysis of paint, caulking, and other samples, and a thorough walkthrough of B100.

3.3.3.2.3 Polychlorinated Biphenyls

As part of the B100 industrial hazards characterization, light ballasts in fluorescent light fixtures suspected of containing PCBs were found in the WR-1 Building (Pinchin 2007). All light ballasts will be examined for PCB containing material, with those identified as PCB containing being removed in accordance with CNL's PCB Waste Management at WL (CNL 2021b) prior to grouting and demolition.

A more extensive examination was later performed for PCB containing materials (CNL 2021a). Table 3.3.3-2 provides the locations where PCBs in concentrations above the solid exemption quantity of 50 mg/kg (SOR/2008-273) or suspected of exceeding the solid exemption quantity were found. These PCB containing materials will be removed in accordance with CNL's Waste Management Program (CNL 2021d) prior to grouting or demolition.

Table 3.3.3-2: Polychlorinated Biphenyl Locations

Room	Description
414/601 - Crawlspace/Reactor Hall	Wire in cable trays
516 - Heating & Air Conditioning Room	Flex duct
516 - Heating & Air Conditioning Room	Foam duct insulation
630 - Corridor	Caulking - outer window (glazing tape, black)
651 - Office (outside)	Caulking - outer doors/windows (white)

If additional PCB-suspect materials are encountered, additional samples may be taken to confirm their exemption or identify them for removal. All PCB-containing waste material generated at the WL site will be sent to an off-site hazardous waste processing facility for treatment and disposal. Waste with both radiological and other hazardous properties may require segregation or use of a treatment facility to be acceptable for disposal.

3.3.3.2.4 Mould

Minor amounts of mould were observed within the WR-1 Building, mainly on pipe insulation and on ceiling tiles (Pinchin 2007).

3.3.3.2.5 Organic Coolant

The components of the PHT system, the auxiliary organic and gas systems and the fuel wash-down system are expected to be coated with used organic coolant. Fresh organic coolant is not flammable at ambient temperature but is combustible with a flashpoint of around 170°C. However, the properties of the coolant change during irradiation, with viscosity increasing and the length of flexibility of the molecules decreasing.

The residual organic is expected to be found as viscous liquid, sludge or as a dried coating, particularly in cold spots in pipes and tanks and in system elbows, joints and pumps.

3.3.3.2.6 Other Hazardous Chemicals

A number of hazardous chemical and materials were used during the operation of WR-1, Table 3.3.3-2 provides a list of these materials, their expected locations within the WR-1 Building and the estimated quantity remaining. Some items could not be directly estimated for various reasons. For example, chromium plating was used on many components without any indication of such in available documentation. In such cases, conservative assumptions have been made to provide a reasonable estimate. For several contaminants (e.g., xylene), there is no confirmation of their presence within WR-1 and their inclusion in this inventory is precautionary, to ensure the effects of the discovery of detectable quantities is not significant. Any additional non-radiological contaminants of potential concern identified during decommissioning will be assessed and remediated as needed to ensure there are no significant effects to the environment.

Table 3.3.3-2: Hazardous Chemicals and Materials within WR-1 Building

Chemical / Material	Expected Location	Description	Safety Concern	Quantity (kg)	Form
HB-40	PHT system; auxiliary organic system and gas system; fuel wash-down system, calandria tubes, tanks	Bulk removed from the reactor cooling circuits; however, components expected to be coated with used organic coolant	■ Flammable at flashpoint around 170°C ■ Limited toxicity; standard safety precautions ■ Contamination from fuel failures and corrosion products	87,700	Liquid in system low points
Lead	Throughout the WR-1 Building	Lead shielding, lead-based coatings, lead-glass windows and solder, paint	■ Sanding and grinding activities could mobilize	40,800	Solid, various shielding uses (e.g., sheets, bricks)
Xylene	Spent fuel handling and storage system; wash-down system – trapped in system low points or blockages	Used as a cleaning solvent	■ Moderate hazard and highly flammable ■ Protection – goggles, protective clothing, proper gloves and adequate ventilation	1.9	Liquid/vapour
Boron	Heavy water system; auxiliary systems, including boron addition system – low points / joints where residual solutes collect	Added as boric acid to heavy water to control reactor reactivity	■ Long-term exposure may cause kidney damage and a risk to pregnant workers ■ Protection – goggles, protective clothing, proper gloves and adequate ventilation	0.0009	Solids/solutes

Table 3.3.3-2: Hazardous Chemicals and Materials within WR-1 Building

Chemical / Material	Expected Location	Description	Safety Concern	Quantity (kg)	Form
Palladium	Organic supply system, helium system – low points / joints where residual solutes collect	Palladium(II) chloride bed absorption columns used in system; columns have been removed, but other equipment may be contaminated 5% palladium on pelletized alumina used in a recombiner	■ Finely divided palladium metal can be pyrophoric ■ Acute oral toxicity ■ Serious eye damage/irritation ■ Skin sensitization ■ Flammable solid	15.5	Solids/solutes
Potassium Hydroxide	Chemical addition tank in the concrete cooling system – low points / joints where residual solutes collect	Used for pH control of cooling water	■ Strong base ■ Protection – chemical protection suit, including self-contained breathing apparatus	0.01	Solids/solutes
Cadmium	Ion chamber component and as plating and fuel storage block	Alloy cladding component	■ Carcinogen and development and reproductive toxicant	91.4	Solid/plating
Chromium	Various thermocouples and as plating on various components (e.g., condenser tubes; boiler tubes)	Alloy cladding component	■ Carcinogen and suspected respiratory toxicant	148	Solid/plating
Mercury	Various thermocouples and as plating on various components (e.g., condenser tubes; boiler tubes)	Electric relay switches, industrial lighting bulbs and fluorescent tubes	■ Developmental toxicant; wide range of suspected toxic effects	0.33	Liquid/vapour
Beryllium	WR-1 – fuel elements	Alloy in cladding fuel elements	■ Carcinogen and respiratory toxicant	—	Trace solid residuals
Platinum	Flux detectors	Used as wire in the detector	■ Limited hazard ■ Protection – standard safety precautions	—	Trace solid residuals
Magnesium Oxide	Flux detectors	Used as an insulator	■ Negligible hazard	—	Trace solid residuals
Gadolinium Nitrate	SLOWPOKE demonstration reactor liquid absorber safety system	Gadolinium nitrate solution flowed into the pool to shut the reactor down	■ Moderate hazard ■ Protection – goggles, protective clothing, proper gloves and adequate ventilation	—	Trace solid residuals
Ozone Depleting Substances	Multiple systems	Air conditioning and refrigeration systems	■ Negligible hazard ■ Environmental concern	—	Trace solid residuals

Table 3.3.3-2: Hazardous Chemicals and Materials within WR-1 Building

Chemical / Material	Expected Location	Description	Safety Concern	Quantity (kg)	Form
Multiple Ion Exchange Columns	Heavy water system, distilled water system, spent fuel bay circulation system, thermal shield cooling system, boron addition system, SLOWPOKE demonstration reactor auxiliary systems, WR-1L2 loop, fast neutron loop	Numerous ion exchange columns are incorporated into the systems of WR-1	■ Negligible hazard ■ Specific resin type should be confirmed before removal ■ Protection – standard safety precautions	—	Trace solid residuals

PHT = primary heat transport.

3.4 Project Requirements

Numerous design, strategic and regulatory requirements were considered for the development of the Project. These requirements are discussed in the following sections.

3.4.1 Design Requirements

The objective of the Project is to safely decommission WR-1 and the WR-1 Building, providing a reduction of Canada's long-term nuclear legacy liabilities through permanent, passive disposal. The Project will meet the following design requirements:

- Isolate and contain contamination inside the reactor vault and limit releases of radiological and other hazardous substances from the facility.
- Confirm that the effects on people and the environment, both during and after decommissioning, are within acceptable limits (e.g., dose limits, exposure limits and air quality criteria).
- Doses to members of the public are below 0.3 millisieverts per year (mSv/a)[1] (i.e., all processes other than human intrusion).
- The dose to workers and to the public will be ALARA.
- Demonstrate long-term safety through a combination of site characteristics and engineered design features.

3.4.2 Strategic Requirements

The Project must also meet the following strategic requirements:

- Isolate radioactive contamination such that risk to the public and environment is kept ALARA.
- Comply with CNL's Compliance Program requirements:
  - Radiation Protection Program;
  - Environmental Protection Program;

[1] 0.3 mSv/a dose constraint specified in the CNSC REGDOC-2.11.1, Vol. III (CNSC 2018).

- Waste Management Program;
- Occupational Safety and Health Program;
- Emergency Preparedness Program;
- Nuclear Criticality Safety Program;
- Security Program;
- Nuclear Materials and Safeguards Management Program; and
- Fire Protection Program.

3.4.3 Regulatory Requirements

The Project will:

- comply with federal and provincial regulations, guidelines, acts, standards and codes (see Section 1.6.2: Relevant Standards, Codes and Guidelines, and CNL's *Environmental Protection* [CNL 2021c]);
- provide long-term protection of the public and the environment; and
- be designed so that the effective dose rates received by any individual meet the limits in Section 13(1) of the Radiation Protection Regulations (SOR/2000-203) (Table 3.4.3-1).

Table 3.4.3-1: Effective Dose Rates

Item	Person	Period	Effective Dose (mSv)
1	Nuclear Energy Worker, including a pregnant energy worker	(a) One-year dosimetry period	50
		(b) Five-year dosimetry period	100
2	Pregnant Nuclear Energy Worker	Balance of the pregnancy	4
3	A person who is not a Nuclear Energy Worker	One calendar year	1

mSv = millisievert.

3.4.4 Guiding Standards

Regulating nuclear safety in Canada is the responsibility of the CNSC. Therefore, the Project has been designed to be compliant with the CNSC guidance documents. The International Atomic Energy Agency (IAEA) is a valuable resource to provide guidance for decisions concerning safety related to CNL's plans to decommission WR-1. The Project has been designed to be in alignment with CNSC and IAEA safety standards (e.g., REGDOC-2.11.1, *Waste Management, Volume III: Assessing the Long-Term Safety of Radioactive Waste Management* [CNSC 2018], *Disposal of Radioactive Waste* [IAEA 2011] and *The Safety Case and Safety Assessment for the Disposal of Radioactive Waste* [IAEA 2012]).

3.4.5 Project Components

As described in Section 3.2 WR-1 Building Overview, CNL is proposing ISD, for the decommissioning of WR-1. The decommissioning activities proposed as part of the Project include:

- preparation for ISD;

- grouting of below-grade structures and systems;
- removal of above-grade WR-1 Building structures and systems;
- installation of a concrete cap and engineered cover over grouted WR-1 Building area;
- final site restoration;
- preparation for institutional control; and
- institutional control.

A detailed description of these activities is provided in the sections below. Other Project components such as temporary supporting infrastructure, waste generation and management, end-state and post-closure activities, and human resource requirements and expenditures also contribute to the overall containment strategy and are discussed in this section. The revised decommissioning plan for each of the WR-1 Building components described in Section 3.3 are provided in Table 3.4.5-1.

Table 3.4.5-1: Decommissioning Plan for the WR-1 Building Systems

Systems	System Description	Decommissioning Plan
Major Components		
Reactor Vessel	Section 3.2.1.1	Leave in place (within existing shielding below grade).
Shielding	Section 3.2.1.2	Leave in place and grout.
Heavy Water System	Section 3.2.1.3	Leave in place and grout.
Helium System	Section 3.2.1.3	Leave in place and grout.
Primary Heat Transport (PHT) System	Section 3.2.1.4	Above-ground portion: To be relocated below-grade. Below-ground portion: Leave in place and grout.
Out-of-Reactor Hydraulic Test Loop (WR-1L1 Loop)	Section 3.2.1.4.1	Leave in place and grout.
WR-1L2 Loop	Section 3.2.1.4.2	Leave in place and grout.
Fast Neutron Loops	Section 3.2.1.4.3	Leave in place and grout.
Auxiliary Systems		
Water Supply and Drainage System	Section 3.2.2.1	Leave in place and grout.
Fuel Storage Block	Section 3.2.2.2.1	Leave in place and grout.
Spent Fuel Station	Section 3.2.2.2.2	Leave in place and grout.
Active Dry Storage / Fuel Wash-Down Systems	Section 3.2.2.2.3	Below-ground portion: Leave in place and grout. Above-ground portion: To be removed during building demolition.
Transfer Flasks	Section 3.2.2.2.5	To be removed before building demolition
Moderator Demineralizer System	Section 3.2.1.3	Leave in place and grout.

Table 3.4.5-1: Decommissioning Plan for the WR-1 Building Systems

Systems	System Description	Decommissioning Plan
Heavy Water Collection System	Section 3.2.1.3	Below-ground portion: Leave in place and grout. Above-ground portion: To be removed during building demolition.
Boron Addition System	Section 3.2.1.3	Leave in place and grout.
Ventilation System	Section 3.2.2.3	Below-ground portion: Leave in place and grout. Above-ground portion: To be removed before or during building demolition
Active Drainage System	Section 3.2.2.4	Below-ground portion: Leave in place and grout. Above-ground portion: To be removed before or during building demolition.
Emergency Injection System	Section 3.2.2.5	Below-ground portion: Leave in place and grout. Above-ground portion: To be removed before or during building demolition.
Thermal Shield and Concrete Cooling System	Section 3.2.2.6	Drain as practicable. Leave in place. Surround by grout.
Compressed Air System	Section 3.2.2.6	Leave in place and grout.
Heating and Cooling System	Section 3.2.2.6	Below-ground portion: Leave in place and grout. Above-ground portion: To be removed during building demolition
Activity Monitoring System	Section 3.2.2.6	Leave in place and grout.
Fire Protection System	Section 3.2.2.6	Below-ground portion: Leave in place and grout. Above-ground portion: To be removed during building demolition
Electrical Distribution System	Section 3.2.2.6	Below-ground portion: Leave in place and grout. Above-ground portion: To be removed during building demolition
Annunciator System	Section 3.2.2.6	Below-ground portion: Leave in place and grout. Above-ground portion: To be removed during building demolition
Radiological Monitoring System	Section 3.2.2.6	Below-ground portion: Leave in place and grout. Above-ground portion: To be removed during building demolition
Degassing and Particulate Removal System	Section 3.2.2.6	Below-ground portion: Leave in place and grout. Above-ground portion: To be removed during building demolition.
Purification System	Section 3.2.2.6	Above-ground portion: To be removed during building demolition. Below-ground portion: Leave in place and grout.
Relief Exhaust System	Section 3.2.2.6	Leave in place and grout.

Table 3.4.5-1: Decommissioning Plan for the WR-1 Building Systems

Systems	System Description	Decommissioning Plan
Organic Supply System	Section 3.2.2.6	Above-ground portion: To be removed during building demolition. Below-ground portion: Leave in place and grout.
Nitrogen Supply System	Section 3.2.2.6	To be removed during building demolition.
Neutron Power System	Section 3.2.2.6	Leave in place and grout.
Protective Systems	Section 3.2.2.6	To be removed during building demolition.
Reactor Power Regulating System	Section 3.2.2.6	Leave in place and grout.

NOTE: All pipes and conduits penetrating outer walls to be cut away from the wall and the penetration to be sealed prior to grouting.

3.4.6 In Situ Disposal

The following sections describe the general process for ISD of WR-1. While the order of execution may vary, the overall scope of activities is not expected to change considerably throughout the Project.

3.4.6.1 Preparation for In Situ Disposal

Preparation for decommissioning will involve a combination of sealing penetrations in the exterior walls of the WR-1 Building; penetrating internal walls and equipment to provide flow paths for grout, displaced air and dissipated heat; and establishing temporary infrastructure to support grout production and placement.

3.4.6.1.1 Deactivation of the Building

The first stage of decommissioning the WR-1 Building will be to disconnect all building services. Deactivation of these services may require the following steps:

- isolation of building electrical supply;
- draining of all devices containing ozone-depleting substances by qualified personnel and removal of hazardous waste materials, as necessary;
- removal of asbestos and other hazardous material as needed to access pipes and connections;
- removal of radioactive liquids from drain lines;
- removal of remaining surplus equipment (e.g., cabinets, sinks);
- removal of utility services, systems and major components (e.g., heating boilers, chiller);
- characterization, packaging and transfer of radioactive and hazardous waste material for management in an approved waste storage facility or transfer to an off-site storage facility; and
- installation of temporary services to support safe execution of the decommissioning work.

Temporary services may include lighting, emergency signals, ventilation, sump water collection and electrical power for tooling. The goal of this step is to reduce the risk of cutting into pressurized or electrified systems during grout preparation work and allow most building materials to be penetrated, cut or removed as appropriate.

3.4.6.1.2 Seal Building Penetrations

There are several locations where penetrations exist in the exterior walls of the building to allow mechanical and electrical services to enter. All below-grade penetrations in the exterior walls and floor of the building will be sealed with an engineered plug, ensuring a continuous and uninterrupted barrier to isolate WR-1. This activity will include construction of forms as necessary for doorways, hatches, chases, ducts or other openings that must be sealed.

3.4.6.1.3 Create Grout Flow Paths

To permit grout to fill the below-grade systems to the extent practicable, it may be necessary to penetrate interior walls, piping systems or tanks. Pathways may also be created between rooms to allow the flow of grout and air out of all areas of the below-grade structure. For piping systems and tanks, penetrations may also be made at strategic locations to:

1) reduce buoyancy loads from empty tanks and large pipes surrounded by liquid grout; and

2) further improve the grout flow into specific piping systems.

3.4.6.1.4 Supporting Infrastructure

CNL plans to assemble a batch mixing plant or similar equipment on site to provide consistent quality and timely application of grout. Grout produced by the batch plant would be transferred by trucks or pumped from the batch plant through piping to a number of placement points throughout the building. A water tank, piping, power, material silos, staging areas and settling ponds may also need to be constructed for the Project.

3.4.6.1.5 Targeted Remediation

Some hazardous materials will be removed from the building prior to ISD. Materials planned for removal include, for example:

- all PCB-containing materials above exemption quantities;
- easily removable lead that is not currently being used for shielding;
- asbestos as necessary to access systems to perform decommissioning; and
- liquid organic coolant, as practicable.

A survey of the building did not identify any major sources of additional hazardous material, but for environmental assessment purposes it was assumed that a conservative amount of these hazardous materials is left in place when grouting. If additional hazardous materials are discovered during decommissioning, they will be assessed for removal prior to grouting. This step will help to further reduce the levels of hazardous materials left within the structure for ISD.

3.4.6.2 Grouting of Below-Grade Structures and Systems

Grout is used for filling void spaces and because of its flowable nature, it can be introduced into the smaller, less accessible spaces of most structures easier than other fill materials. Filling of structural void spaces for ISD serves the purpose of stabilizing the structure to prevent subsidence and impeding the flow of groundwater through the WRDF. The introduction of grout also limits inadvertent intruder access to the WRDF (US DOE 2013) .

The EIS and solute transport modelling are based on target properties of grout. CNL has specified the minimum requirements for the grout that will be used in WR-1 (Table 3.4.6-1).

Table 3.4.6-1: Target Physical Properties of Grout

Property	Target	Basis
Bleed Water after 24 hr (vol.%)	0	Eliminate need for liquid removal
Maximum Temperature Rise during Curing	<25°C difference between grout interior and exterior	Manage effects of heat of hydration
pH	<13.5	Compatible with materials and contaminants in most of the rooms to be grouted
Compressive Strength	>3.4 MPa at 28 days	Non-structural grout, needs only to support its own mass
Effective Porosity (vol.%)	<0.6	Used in solute transport model
Dry Bulk Density (kg/m^3)	2,100	Used in solute transport model
Hydraulic Conductivity (m/yr)	<0.03	Used in solute transport model

vol.% = volume percent; MPa = megapascal.

The grout has been designed to achieve the required physical properties listed in Table 3.4.6-1 to flow easily into the void spaces of the WR-1 below-grade structure. The design takes into account the effects of using local fill materials (e.g., sand) and the materials the grout will interact with in the WR-1 below-grade structure (e.g., aluminium and lead). The grout design includes guidance on appropriate quality control measures to be applied during mixing and placement of the grout.

Detailed performance requirements and a supporting test plan were prepared by Savannah River National Laboratory (SRNL 2018). CNL engaged a vendor to develop a grout formulation that meets or exceeds the requirements specified by SRNL, using locally available materials. A similar grout design process (where an existing formula was adapted to use local materials) has already been successfully performed by CNL (Golder 2018b). The formulations have been tested to validate their performance against the required and assumed properties, to confirm they perform as well as or better than estimated in the solute transport model, prior to the installation of any grout into WR-1 (Golder 2022a).

Preliminary screening of the grout formulation using various combinations of locally available materials was completed, with many of the formulas easily meeting all the key target criteria. The primary candidate for the bulk fill formula was carried forward for a second phase of testing (i.e., Stage 2 testing) and refinement. This bulk fill formula is given in Table 3.4.6-2.

Table 3.4.6-2: Grout Formulation for Stage 2 Testing

Material	Quantity per m^3
Portland Cement	89 kg
Fly Ash	297 kg
Sand	1,570 kg
Gravel	0 kg
Water	232 kg
Polycarboxylate Polymer	1.77 L
Diutan Gum Based Viscosity Modifying Admixture	260 g

The bulk fill formula tested meets the target properties with the exception of dry bulk density (Golder 2022a). As stated in Table 3.4.6-1, the target value for dry bulk density is 2,100 kg/m^3, while the value of the tested bulk fill recipe was 2,007 kg/m^3 (Golder 2022a). The target value reflects a recipe containing both sand and aggregate; however, the tested bulk fill recipe does not contain aggregate since it was determined that the fresh and cured property targets could be achieved through the use of sand alone. Therefore, the results for dry bulk density of the tested bulk fill recipe have been deemed acceptable, as tested, by CNL (Golder 2022a).

Grouting of the below-grade structure will be carried out in stages. The safety case for the WRDF is built on the conservative assumption that the only major aspect of the grout to its function as a barrier is the hydraulic conductivity of grout used in the groundwater flow model. Since there is no expectation for grout to completely penetrate and fill every void space, the existence of voids and cold joints is not detrimental to the overall safety of the system. Instead, the structure will be filled to eliminate as many void spaces as is reasonably achievable. The overall fill design will target the elimination of transport pathways through large diameter pipes or ducts by cutting or “air gapping” the pipes, ducts, and other conduit. The term “Air Gapping” indicates providing a physical space cut in piping so that when grout fill is placed, that space is filled with grout and will provide a “grout break” in the pipe, limiting its potential to be a groundwater pathway. The placement of the grout will be completed using an engineered fill schedule (i.e., grouting plan). Multiple lifts of grout will be poured to systematically fill as practical the reactor building voids.

The safety case of the proposed ISD does not currently require that the reactor vault be grouted. The existing structure provides sufficient barrier to releases, and additional grout would not considerably increase the effectiveness of that barrier. If during grouting it is safe and efficient to allow grout to fill the reactor vault, it may be done. Likely the risks involved to properly install grout in the reactor vault, or within the calandria, will outweigh the benefits of additional grout. This option will be reassessed as more detailed grouting plans are developed and the available technologies and strategies from various vendors can be reviewed.

The maximum lift size (depth of fresh grout) will be determined for each room based on the structural properties of the room, the heat generated by the curing grout, and the presence of equipment that could be crushed, filled or dislodged if grout is poured too quickly. Each lift of grout will be given sufficient time to cure before additional grout is poured. Smaller lifts may be used in specific areas, for example to fill targeted voids, or specific systems. Quality control measures on grouting operations will be implemented to ensure all requirements for the grout are met and the final product will perform as expected. Grout filling via an engineered grout placement plan that relies on delivery of grout pumped through lines is the approach used by other reactor grouting projects. It is not expected that high pressure application of the grout will be required (US DOE 2013).

3.4.6.3 Removal of Above-Grade WR-1 Building Structures

The above-grade WR-1 components and portion of the building will be dismantled and removed after grouting has been completed. The main reactor hall, the concrete room that contains the above-grade portion of the PHT system, the reactor hall bridge crane and the ventilation stack will be demolished. Recyclable materials will be segregated and recycled where practicable. Materials that cannot be separated easily from hazardous materials such as asbestos will be sent for storage/disposal off site. No hazardous material or equipment from outside the WR-1 Building will be disposed of inside the WRDF as part of the Project.

The balance of the WR-1 Building outside ISD is expected to contain minimal radiological contamination. The above-grade building will be decontaminated to the extent practicable to allow the bulk of the construction materials to be reused, recycled, or disposed of in a conventional (non-radiological) landfill. Segregation and radiological surveys (i.e., characterization of material to be disposed of) of the building rubble will be undertaken, as required.

Hazardous substances exceeding release criteria will be removed and managed in accordance with CNL's *Environmental Protection* (CNL 2021c) and *Management of Waste* (CNL 2020b) requirements. Radiologically contaminated asbestos, if present, will be packaged for storage at an approved waste management facility. Radiologically clean asbestos will be removed and will be disposed of in accordance with *Occupational Safety and Health and Waste Management* requirements at an approved off-site landfill. Decommissioning activities will be undertaken in compliance with the site decommissioning licence requirements and executed in a manner protecting workers, the public and the environment.

The building will be dismantled and demolished in an orderly manner. For example, the building will be stripped to the bare shell, with all of the wood, plaster and room dividers removed. The roof will then be removed, leaving the steel and concrete structure available for final demolition. If feasible, the building material and structure will be recycled. After demolition, the area will be backfilled and graded as necessary to achieve the required drainage conditions.

Final radiological and environmental clearance surveys will be performed on the soil surrounding the foundation, and subsequent remediation will be completed as required. Soil surrounding the building will be remediated if it exceeds the soil clean-up criteria (CNL 2019). Soil surrounding the building footprint is not expected to exceed the clean-up criteria; however, if soil contamination is encountered, it would be removed using standard excavation equipment and practices. Dust suppression methods (e.g., water misting, use of applicable immobilization agents on the soil surface) will be applied during excavation as required to suppress dust levels. The contaminated soils will be managed through CNL's Waste Management Program and placed in an approved waste management facility.

3.4.6.4 Installation of Concrete Cap and Engineered Cover

After grouting has been completed and the other portions of the WR-1 Complex are demolished, a reinforced concrete cap and engineered cover (AECOM 2020) will be constructed on top of the grouted area. The concrete cap can serve as a deterrent to prevent a person who might inadvertently enter the area from being able to contact building contamination (US DOE 2013). It will also resist animal and plant intrusion into the WRDF. The concrete cap will have a design life of 100 years, aligning with the recommended institutional control period, and require no maintenance.

An engineered cover will be installed over the concrete cap to:

- direct surface water away from the WRDF and limit water infiltration;
- protect the concrete cap from the environmental elements including freezing and thawing cycles; and
- support the growth of native vegetation (grasses, shrubs) where possible.

The engineered cover will also have a design life of 100 years and will manage stormwater consistently with the surrounding topography. It will resist wind and water erosion, as well as burrowing animals and tree root penetrations.

3.4.6.5 Final Site Restoration

Upon completion of the installation of the final concrete cap and engineered cover, a grass seed mixture native to the area will be used to establish vegetative cover. Maintenance of the concrete cap and engineered cover includes restricting weed growth and preventing surface erosion and abrasion. The surrounding grounds that were disturbed during demolition and decommissioning activities will be graded and restored with a grass seed mixture compatible with the surrounding area. Stormwater management features for the reclaimed WL site will have physical characteristics similar to the natural drainage systems in the general geographic region in terms of dynamic stability, robustness and longevity. The Project site and final cover will be graded to promote drainage from the site to the Winnipeg River.

3.4.6.6 Preparation for Institutional Control

The grouted area will be fenced with signage as part of the institutional controls. Routine surveillance of the site will include inspecting the concrete cap and engineered cover for subsidence, erosion and animal or other intrusions. Additional groundwater monitoring wells will be installed, as required, to monitor the performance of the WRDF.

3.4.7 Temporary Supporting Infrastructure

Temporary infrastructure may be required to support the Project during closure activities, including:

- batch mixing plant or similar equipment for preparation of grout;
- construction trailers;
- safety and security fencing; and
- equipment paddock and lay down area.

3.4.8 Waste Generation and Management

The handling and disposal of waste material resulting from decommissioning of WR-1 will be conducted in accordance with CNL company-wide requirements:

- waste characterization and tracking;
- waste minimization requirements;
- management of solid and liquid waste; and
- WL waste materials management.

For a summary of the anticipated waste stream volumes and clearance criteria, refer to the Detailed Decommissioning Plan (CNL 2021a). In accordance with established CNL Off-Site Transportation of Dangerous Goods requirements (CNL 2018b), prior to transporting any materials, the owners of the disposal or storage facilities will be contacted to verify acceptance of the materials, and a notification will be sent to the appropriate authorities as required.

3.4.8.1 Radiological Wastes

Radiological wastes will be collected during the Project. The sources of these wastes include:

- **Preparation of reactor systems for ISD** – contaminated tools and personal protection equipment will be generated.
- **Removal of the WR-1 Building above-grade structure** – contaminated equipment and structures will need to be handled, such as active ventilation.
- **Grouting activities** – contaminated personal protective equipment will be generated.

Radioactive wastes from the above-listed activities are not planned for ISD and will be managed through the CNL Waste Management Program. However, waste materials from penetration of structures and systems (e.g., small sections of pipe, wall cores) may be left in place for grouting if they can be made secure and do not interfere with the safe execution of the work.

3.4.8.2 Hazardous Non-radiological Wastes

Some small quantities of non-radiological hazardous wastes may be collected from the WR-1 Building during the Project. Hazardous wastes will be managed in accordance with CNL's waste management practices (CNL 2020b) and Environmental Protection Program (CNL 2021c), and will meet all federal, provincial and municipal requirements. The collected wastes will be shipped off site to an appropriate hazardous waste facility. The factors that determine if any material is collected for disposal or remains in the building for ISD, are worker safety and risk to the environment.

3.4.8.3 Clean Wastes and Likely Clean Wastes

Removal of the WR-1 Building above-grade structure and decommissioning of the temporary supporting infrastructure will generate clean and likely clean waste. Likely clean wastes will be monitored for radioactivity in accordance with Radiation Protection and Waste Management Program requirements to confirm that the waste is clean. Any waste not meeting criteria for classification as clean will be managed as radioactive waste. Disposal methods for clean waste materials will meet all federal, provincial and municipal requirements. The disposition options are reuse or recycle, disposal in an off-site landfill or other approved waste management facility as appropriate.

3.4.8.4 Transporting Waste Off-Site

The transport of radioactive waste is regulated under the Packaging and Transport of Nuclear Substances Regulations (SOR/2015-145). Key activities consist of:

- loading the waste into an approved shipping container;
- loading the container onto the vehicle;
- monitoring the vehicle for contamination and cleaning it, if necessary; and

- driving the transport vehicle to an approved facility.

The Waste Management Program (CNL 2020b) defines the process for managing wastes from point of generation to ultimate disposition and provides direct support and oversight to ensure waste generating activities are performed in a manner that protects the workers, the public and the environment. The Transportation of Dangerous Goods Program (CNL 2018b) interfaces with the Waste Management Program and is responsible for the coordination and transport of all types of wastes (including radiological, hazardous and non-regulated construction and demolition material) from the Project. Specific requirements in the management of transporting radioactive wastes from the Project to Chalk River Laboratories for long-term storage and/or disposal include liaising with the Chalk River Laboratories Waste Receiver and transportation subcontractors and preparing dangerous goods shipments (including classifying the shipment and/or packages and preparing shipment documentation) in accordance with all applicable regulations. The main function of the Transportation of Dangerous Goods Program is to protect personnel, property and the environment from the effects of radiation and hazardous materials during transport by establishing and maintaining requirements and procedures necessary to facilitate the safe transport of dangerous goods and non-regulated waste materials from the Project.

3.4.9 End-State and Post-closure Activities

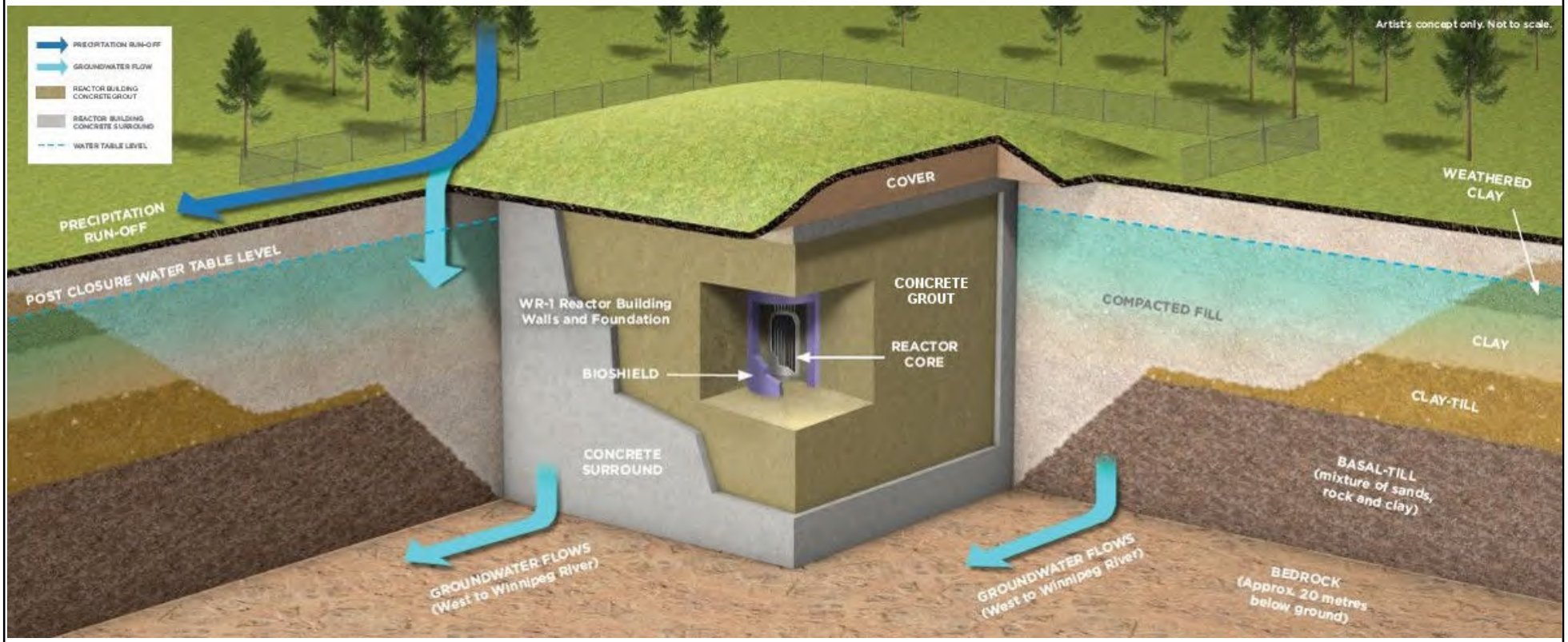
The final end-state for WR-1 is a permanent passive waste disposal facility that applies a Defense-in-Depth strategy through the use of multiple barriers, which passively resist release of contaminants (Figure 3.4.9-1). The primary pathway for release of contamination from the structure is by groundwater that has infiltrated into the sub-surface structure, picked up contamination and then carried it out of the sub-surface structure to the surrounding environment. Each of the barriers of the WRDF contributes to containing and isolating the waste from people and the environment. The barriers of defence against contaminant release include reactor system components, grout, internal walls, outer foundation walls, the local geosphere, a concrete cap and engineered cover, and active environmental monitoring. Combined, they form a rigorous system of barriers to provide long-term safety to the public and the environment, with environmental monitoring to be conducted to verify the effectiveness of the barriers.

3.4.9.1 In Situ Disposal System

For the Project, the concept for long-term waste management is based on the passive containment and isolation of the waste within the WRDF. Containment is achieved through robust design based on multiple barriers that includes using combined inherent natural and engineered barriers to provide safety following the decommissioning of WR-1. Systematically, the natural and engineered barriers consist of the reactor core and bioshield, grout fill, building foundation, concrete cap and engineered cover, and finally the geologic surround. This concept is shown schematically on Figure 3.4.9-1. The Project is designed to provide containment by controlling the rate of release of nuclear and hazardous substances from the WRDF, and isolation by limiting access to the waste by people and the environment.

S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0005_EIS_Sec3\20145046-0005-G-0009_Figure 3_4_9-1 WR-1 In SITU Disposal System.mxd

WR-1 EXCAVATION, FOUNDATION AND GROUNDWATER FLOW - PROJECTED POST-DECOMMISSIONING



NOTE(S)

REFERENCE(S)

1. OBTAINED FROM CANADIAN NUCLEAR LABORATORIES, 2017

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	-
PREPARED	RRD
REVIEWED	KL
APPROVED	MM

TITLE
WR-1 IN SITU DISPOSAL SYSTEM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0005	2	**3.4.9-1**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A
0 25mm

3.4.9.1.1 Reactor Core and Bioshield Components

The majority of the remaining radiological contamination in WR-1 is located in the reactor core components (combined calandria and fuel channels). The radiological contamination is both on the internal surfaces (surficial contamination) and embedded in the material itself (activated components). In some cases, the components themselves are the contaminant (e.g., lead). Although sources of contamination, the reactor core components function as barriers providing contaminant isolation and containment These components are the initial barrier to contaminant migration, and must first break down through corrosion and dissolution for contamination to be released to groundwater.

Breakdown of the reactor system components is expected to occur gradually over thousands of years. Corrosion rates for the reactor materials were based on estimates from literature for an aerobic environment and ranged from 1.78E-3 m/yr for aluminum to 1.0E-8 m/yr for Ozhennite and Zr-Nb alloy. Details on the selection of corrosion rates and calculation of times required for complete dissolution of each reactor component are provided in Golder's groundwater flow and solute transport modelling document (Section 4.1.3 of Golder 2021b).

The selection of corrosion rates for the WR-1 components was based on the following information:

- Analogous information of corrosion rates in aerobic humid conditions, which will be similar to the conditions expected in the Project.
- The ISD environment is expected to be alkaline. Steel and other alloys are known to corrode very slowly in alkaline conditions.

The corrosion rates used in the GWFSTMR were validated through the Wasteform Synthesis Report (Arcadis 2021) and it was concluded that the corrosion rates used in WR-1 assessment are generally consistent with the long-term measurements. It was assumed that corrosion would occur on both sides of the reactor components.

Information on barrier (concrete bioshield, grout fill, and foundation concrete) degradation was limited in the sources reviewed (Golder 2020), and the assumed step function used in the WR-1 assessment (based on information provided by Walton et al. [1990]; and Clifton et al. 1995) is considered justified. Simulations were completed as a part of the WR-1 assessment to evaluate the sensitivity of model results to the assumptions on degradation of grout and concrete. Results of these simulations were found to be relatively insensitive to the applied degradation rates.

The following documents were reviewed to support the selected corrosion rates and barrier degradation:

- *High-Performance Cement-Based Grouts for use in a Nuclear Waste Disposal Facility* (AECL 1992)
- *Low-pH Cementitious Materials Design and Characterisation* (Alonso et al. 2007)
- *Moisture Transport Review* (Arnold et al. 2009)
- *Properties of Concrete in the Cover Zone: Water Penetration, Sorptivity and Ionic Ingress* (Carter et al. 1996)
- *Implications of the Use of low-pH Cementitious Materials in High Activity Radioactive Waste Repositories* (Garcia et al. 2008)
- *Electrical Conductivity Sensors for Water Penetration Monitoring in Building Masonry Materials* (Guizzardi et al. 2016)

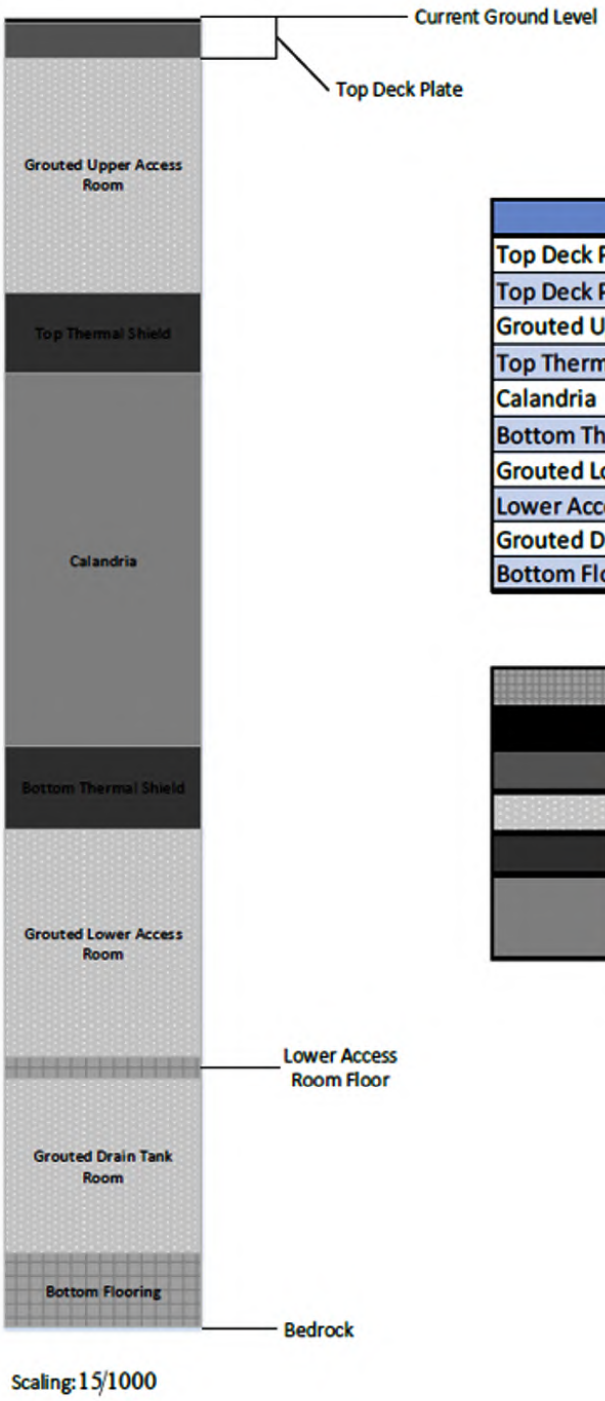
- *Summary of Laboratory Permeability Testing of Cementitious Backfill Grouts* (Golder 2018a)
- *Long-Term Behaviour of Fly Ash and Slag Cement Grouts for Micropiles Exposed to a Sulphate Aggressive Medium* (Ortega et al. 2017)
- *Long Term Behaviour of Cementitious Materials in the Korean Repository Environment* (Park and Kim 2013)
- *Groundwater and Soil Vapour Containment Design at an Industrial Site* (Schmertmann et al. 2017)
- Natural Analogues in Support of the Canadian Concept for Nuclear Fuel Waste Disposal (Cramer 1994)
- A Natural Analogue Study of Cement Buffered, Hyperalkaline Groundwaters and Their Interaction with a Repository Host Rock II (Linklater 1998)
- On the Chief Methods of Construction Used in Ancient Rome (Middleton 1888)
- A Mineralogical and Stable Isotope Study of Natural Analogues of Ordinary Portland Cement (OPC) and CaO-SiO2-H2O (CSH) Compounds (Milodowski et al. 1989)
- Post-closure Safety Assessment of a Used Fuel Repository in Sedimentary Rock (NWMO 2013)
- The ROMACONS Project: A Contribution to the Historical and Engineering Analysis of Hydraulic Concrete in Roman Maritime Structures (Oleson et al. 2004)
- Chemical, Mineralogical and Petrographic Characterization of Roman Ancient Hydraulic Concretes Cores from Santa Liberata, Italy and Caesarea Palestinae, Israel (Vola et al. 2011)

3.4.9.1.2 Grout

The details of the various levels within the final grouted below-grade structure are shown in Figure 3.4.9-2. The grout fills as practical all the reactor system components, as well as any small amounts of contamination that are present outside of the reactors system components at the time of grouting. The primary purpose of grouting of the facility is to stabilize the structure and resist subsidence over time. But additionally, this has a twofold benefit: 1) it slows down the process which will corrode the system components, extending their lifetime as the initial barrier to containment, and 2) it slows the movement of contamination from outside of the system components, as well as contamination from the degraded system components. The grout will slowly degrade over time, allowing water movement to increase as it degrades, though this is expected to occur gradually over thousands of years.

A literature review was conducted (Golder 2020) as part of the grout formulation study. The hydraulic conductivity of the grout used in the WR-1 assessment (5×10^{-8} m/s) was a factor of five times greater than the highest value cited in the literature reviewed, and a factor of 50 times higher than the grout performance specification of 9.5×10^{-10} m/s (see Section 3.4.6.2). Testing carried out on the preferred bulk fill grout formula (Golder 2022a) indicated an average hydraulic conductivity value of 1.27E-11 m/s, confirming that it is lower than values derived through the literature study and used as the grout performance specification, and is significantly lower than the value used in the solute transport model.

The safety case for the WRDF is built on the conservative assumption that the only major aspect of the grout to its function as a barrier is the hydraulic conductivity used in the groundwater flow model. Sensitivity scenarios completed confirm that variations in hydraulic conductivity of the grout affect the rate of water movement through the WRDF and thus influence the performance of the containment system; however, they do not control the overall safety of the containment system.



Scaling: 15/1000

Layers	Height (m)
Top Deck Plate: Masonite	0.08
Top Deck Plate: Carbon Steel	0.46
Grouted Upper Access Room	3.15
Top Thermal Shield	1.12
Calandria	5.032
Bottom Thermal Shield	1.12
Grouted Lower Access Room	3.07
Lower Access Room Floor	0.3
Grouted Drain Tank Room	2.36
Bottom Flooring	0.99

	Reinforced Concrete
	Masonite Benelex 70
	Carbon Steel A27-58-Gr 65
	Grout
	Carbon Steel A353 Gr B
	SS 304L, Al B210-61 Alloy 5052, Zr-2.5%Nb, Ozhennite

REFERENCE(S)

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
DETAILS OF THE END-STATE OF BELOW-GRADE STRUCTURES

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	--
PREPARED	RRD
REVIEWED	KL
APPROVED	AB

PROJECT NO. 20145046 | CONTROL | REV. 2 | FIGURE **3.4.9-2**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm 0

S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\09_PRO\20145046\40_PROD\0005_EIS_Sec3\20145046-0005-G-0006_Figure 3_4_9-2 DetailsEndStateBelowGradeStructures.mxd

3.4.9.1.3 Internal Walls

Internal building walls and floors may provide an additional barrier between sections of grout however, this is not relied on in the safety analysis. While penetrations exist in these interior walls (to allow services to pass between rooms), they are mostly sealed for operational purposes such as fire-stopping. Any remaining penetrations are plugged by grout during the grouting process and are small in relation to the walls themselves. The internal walls and floors are largely painted or otherwise coated to seal the concrete to protect it from wear, to provide traction, or for preventing internal contamination of the concrete. These coatings provide a waterproof barrier in many locations and will limit the speed at which water may move into, and out of, the structure, further limiting the speed at which the system components or grout may degrade and the rate at which the contamination can leave the grouted areas. The coatings on these walls must first degrade to allow more water movement through these materials before degradation of the concrete can begin. Conservatively, this is not relied upon in the assessment. Concrete degradation, similar to the grout, is expected to occur gradually over longer periods.

3.4.9.1.4 Building Walls and Foundation

The below-grade concrete external walls and foundation of the WR-1 Building provide a single, continuous, final barrier to the release of contamination. Penetrations in the exterior walls and the foundation are sealed to ensure long term performance. Like the internal walls, the exterior walls also have coatings that restrict water movement, and were constructed of sulphate resistant concrete to resist sulphate attack, common in Manitoba soils. Degradation of the exterior walls and the foundation is expected to occur gradually over a long period of time.

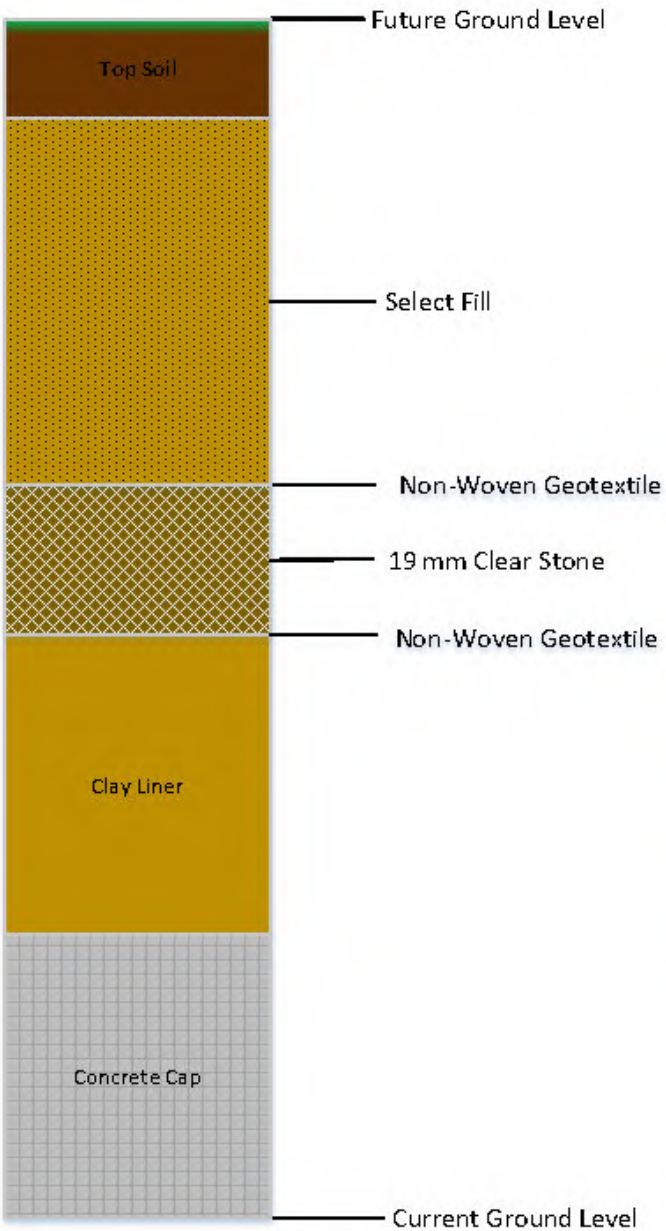
A literature review of cementitious material degradation rates was conducted (Golder 2020) as part of the grout formulation study. The hydraulic conductivity of the concrete foundation used in the WR-1 assessment (5×10^{-10} m/s) was more than an order of magnitude greater than the highest value cited in the literature reviewed. To validate the results of the literature study and the hydraulic conductivity values used in the assessments, a *Building Condition Assessment* (Golder 2022b) was completed to evaluate the integrity of the existing subsurface concrete foundation and bottom slab of WR-1 prior to grouting the existing structure of the WR-1 Building. Hydraulic conductivity testing was completed on core samples of the concrete as a part of this assessment, which indicated a range in hydraulic conductivity of approximately 1.2×10^{-11} m/s to 9.8×10^{-11} m/s. The hydraulic conductivity used in the WR-1 assessment is therefore conservative compared to values determined from the Building Condition Assessment.

3.4.9.1.5 Local Geosphere

The soil conditions at WR-1 provide an additional barrier to release of contamination into the environment. The local soils are primarily clay-based and provide a natural barrier to groundwater movement. The soils provide a final barrier to groundwater movement, reducing the groundwater speed to less than 5 m per year (CNL 2022). The soil also chemically sorbs contaminants to further reduce their concentrations in any surface water emissions. A geosynthesis report (CNL 2022, summarized in Section 6.3.1 Geology) has been prepared to support the groundwater flow and solute transport assessment. It discusses the characteristics of the local and regional geosphere as it pertains to performance of the geosphere as a barrier. Buried or embedded services outside of the WRDF that may provide a preferential hydraulic pathway will be removed or sealed.

3.4.9.1.6 Concrete Cap and Engineered Cover

The concrete cap and engineered cover do not provide a barrier for the release of contamination in the traditional sense; instead, they provide a barrier to keep the environment out of the WRDF since human and animal intrusion, plant ingress and water infiltration all directly or indirectly contribute to the release of contamination. The concrete cap is intended to deter intrusion, while the engineered cover protects the concrete cover and WRDF from frost and limits surface water infiltration. The concrete cap will be made of reinforced concrete. The engineered cover will be sloped to direct surface water away from the WRDF, include a drainage layer for any infiltrating surface water, and include a compacted stone layer to deter burrowing animals and roots. Limiting the amount of water entering the WRDF limits the release of contamination as groundwater is the main transport pathway for contamination. The detailed design (AECOM 2020) of engineered cover was confirmed to limit groundwater recharge through vertical infiltration to 0.8 mm/year. Figure 3.4.9-3 provides a conceptual preview of the concrete cap and engineered cover design.



Layers	Height (mm)
Top Soil	300
Select Fill	1100
19 mm Clear Stone	450
Clay Liner	900
Concrete Cap	850

	Top Soil
	Select Fill
	19 mm Clear Stone
	Clay
	Reinforced Concrete

Scaling: 50/1000

REFERENCE(S)

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
DETAILS OF THE CONCEPTUAL CONCRETE CAP AND ENGINEERED COVER SYSTEM

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	--
PREPARED	RRD
REVIEWED	KL
APPROVED	AB

PROJECT NO.	CONTROL	REV.	FIGURE
20145046		2	3.4.9-3

S:\Clients\Canadian Nuclear Laboratories\Manitoba\09 PRO\20145046\40 PROD\0005 EIS Sec3\20145046-0005-G-0007 Figure 3 4 9-3 DetailsConceptualConcreteCapEngineeredCoverSystem.mxd

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3.4.9.1.7 Post-closure Monitoring

Groundwater monitoring provides verification that the ISD facility is performing as expected. Monitoring also provides an early warning system in the event that something unexpected has occurred and provides the data necessary to make decisions about mitigating actions required.

3.4.9.2 Post-closure Activities

CNL is developing the WL Closure Land-Use and End-State Plan, along with appropriate criteria for site remediation, including the WRDF associated with the ISD of WR-1. The plan defines the post-closure end-states, the post-closure land-use classifications and allocation, and the physical release criteria that must be met at the site closure. These end-state definitions, land-use classification and allocation, and physical release criteria are applicable to all decommissioning activities being carried out under the WL Closure Project. Following completion of the work, the lands, including any remaining infrastructure, will enter long-term care and maintenance in accordance with the institutional control requirements. As the proponent of the Project, CNL will be responsible for implementing and managing the proposed follow-up monitoring program. The responsible owner of the site (the Government of Canada through Atomic Energy of Canada Limited [AECL]), will be responsible for the provision of funds for the follow-up monitoring program, with these costs included in CNL's submission of a decommissioning financial guarantee and accompanying cost estimate that has been submitted to the CNSC as per the WL site decommissioning licence.

In general, affected areas will be remediated to meet the WL site soil clean-up release criteria. Some lands will have restrictions on future use and/or development to ensure there are no adverse effects to the safety assessment and modelling assumptions associated with the WRDF. These areas will require ongoing institutional controls, including access restrictions and environmental monitoring. These processes will require approvals from the CNSC. Through the regulatory process, stakeholders will also have an opportunity to provide input that could help shape how the WL site is used in the future. Future use of the WL site will depend on the ability to release parts of the site so they have no restrictions on use upon completion of the Project.

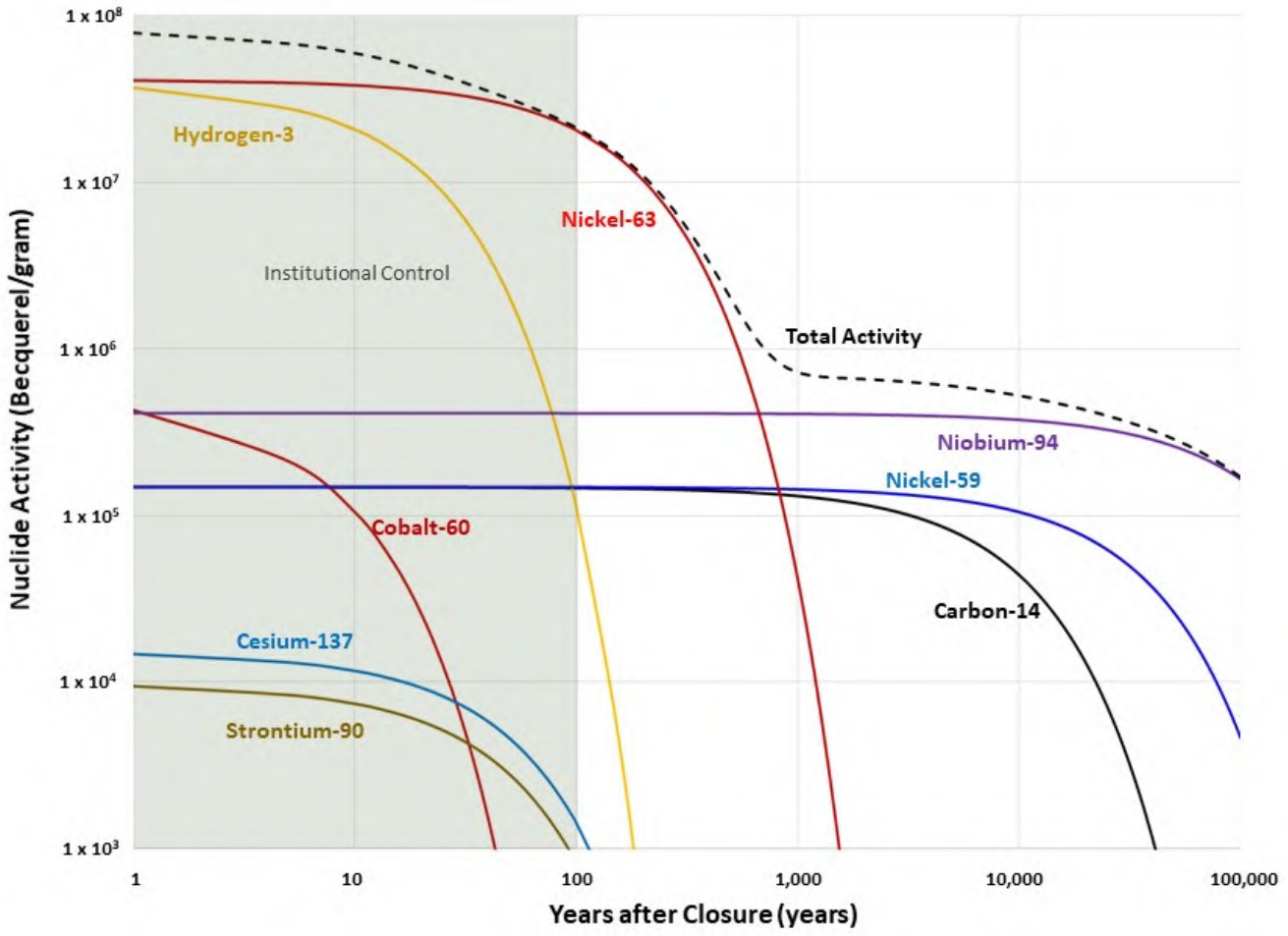
The post-closure phase has two separate periods: institutional control and post-institutional control. Institutional controls are requirements placed on the licensee by the CNSC for the long-term safety of a decommissioned facility. During institutional control, long-term environmental monitoring and maintenance active will continue. CNL operates an Environmental Assessment Follow-up Program at the WL site that will be revised to include activities to manage monitoring for the Project. It will reflect the priorities and requirements that are necessary to sufficiently assess the ongoing performance of the WRDF. Since the groundwater flow surrounding WRDF is downward toward the bedrock, contamination releases, if any, would be expected to also be driven deeper with the groundwater. As such, the monitoring program will focus on groundwater contamination, though other sampling methods may also be included such as short-term air monitoring or vegetation samples to confirm that the Environmental Assessment Follow-up Program is comprehensive and appropriate.

Institutional control will continue until the CNSC agrees that it is no longer needed. This is consistent with similar United States Department of Energy projects such as:

- Feed Materials Production Center in Ohio;
- Mound Plant in Ohio; and
- Rocky Flats Plant in Colorado.

For assessment purposes, a period of 100 years (from 2027 to 2127) of institutional control was selected. This timeframe is based on the results of the groundwater flow and solute transport model, and the expected quantities of contaminants within the WRDF over time. For prominent contaminants of concern, such as tritium (hydrogen-3) and cobalt-60, the total activity of these nuclides remaining in the WRDF after 100 years quickly decreases to zero (Figure 3.4.9-4). During the 100-year period, the peak release rate and dose rate from those contaminants are also expected to have occurred. Sampling during institutional control will verify these short-term results or signal the need for intervention.

It is recognized that institutional control could extend for hundreds of years beyond 2127; however, to assess the effects of an institutional control failure, a duration had to be selected. The 100-year period is a reasonable duration for the failure assessment given the results of the groundwater flow and solute transport model. Post-institutional control phase is assumed to occur after the year 2127.



REFERENCE(S)

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
ACTIVITY CONCENTRATION IN THE IN SITU DECOMMISSIONED FACILITY OVER TIME

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	--
PREPARED	RRD
REVIEWED	KL
APPROVED	AB

PROJECT NO.	CONTROL	REV.	FIGURE
20145046		2	3.4.9-4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
25mm
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S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PRO\20145046\40_PROD\0005_EIS_Sec3\20145046-0005-G-0008_Figure 3_4_9-4 ActivityConcentrationDecommissionedFacilityOverTime.mxd

3.4.10 Human Resource Requirements and Expenditures

The closure and post-closure phases of the Project will require administrative and supervisory staff, engineering and environmental monitoring personnel and construction workers. There are currently about 321 employees on the WL site. CNL anticipates employment to peak at approximately 430 employees. The employment is expected to decline to less than 10 employees by 2027. A large workforce is not required during institutional control.

4.0 INDIGENOUS ENGAGEMENT

4.1 Introduction

Canadian Nuclear Laboratories (CNL) has prepared this stand-alone section to document Indigenous engagement with respect to the In Situ Disposal (ISD) of the WR-1 Reactor at the Whiteshell Laboratories (WL) site (Project). This section was updated and enhanced since the March 2020 draft version of the WR-1 Decommissioning Project draft Environmental Impact Statement (EIS). This section is intended to clarify the engagement between the First Nations, the Manitoba Métis Federation, and CNL with respect to the Project, in particular, interests and relevant mitigations while meeting the requirements outlined by the Canadian Nuclear Safety Commission (CNSC) *REGDOC-3.2.2* (CNSC 2019).

This section of the EIS is divided into five major subsections, each of which are described below:

- **Section 4.1 – Introduction:** This section provides an outline for Section 4.0 and describes how CNL is working with Indigenous peoples to include their interests, Traditional Knowledge, and perspectives in the environmental assessment for the Project.
- **Section 4.2 – Indigenous Engagement:** This section describes engagement by each Indigenous Nation. This section summarizes key interests and concerns and explains how CNL is addressing the interests and concerns. This section also summarizes how CNL has verified with each Nation that the interest/concern is adequately captured and identifies next steps. CNL is committed to facilitating opportunities for the Nations to continue to be involved in the environmental assessment process for and beyond the scope of this Project. This section describes both short-term and long-term planned engagements and initiatives related the Project and the Whiteshell Laboratories Closure Project.
- **Section 4.3 – Influence of Traditional Knowledge and Indigenous Feedback on the Environmental Assessment:** This section describes how Traditional Knowledge and Indigenous Feedback has influenced the environmental assessment approach, including identification of valued components (VCs), defining spatial boundaries, description of the environment, and identification and evaluation of Project interactions, and inclusion in monitoring programs.
- **Section 4.4 – Summary of Issues Raised During Engagement Activities that Influenced the Environmental Impact Statement:** This section highlights insights, recommendations, and concerns that led to changes of this EIS.
- **Appendix 4.0-1 – Summary of Engagements and Summary of Interests and Concerns Tables:** This appendix provides a list of all key engagements with the Manitoba Métis Federation and the First Nations who are engaged on the Project. CNL has indicated which engagements focused on specific Project topics such as VCs, baseline studies, and monitoring. The section also includes a table of summarized interests and concerns for each engaged First Nation and the Manitoba Métis Federation and proposed next steps to address each topic.

This section of the EIS is supported by CNL's Indigenous Engagement Report (IER; CNL 2022) for the WR-1 Decommissioning Project, which was updated concurrent with this submission. The IER was prepared in accordance with CNSC's *REGDOC-3.2.2 Indigenous Engagement* (CNSC 2019). The IER outlines CNL's approach to Indigenous engagement to support the environmental assessment process for the proposed Project. The IER is a more detailed version of Section 4.0 that provides additional information and context on CNL's

engagement activities for the Project, which are summarized and incorporated in this EIS. The IER remains a living document that will continue to be updated.

CNL has demonstrated its commitment to continue to engage with the Manitoba Métis Federation and the First Nations about both the Project and also more broadly, the WL site decommissioning and environmental remediation. CNL is developing long-term relationships with First Nations and the Manitoba Métis Federation on whose traditional territory CNL operates and with those that have territory and modern-day interests near CNL operations. Consistent with the Government of Canada's approach to reconciliation, CNL is working closely with Atomic Energy of Canada Limited (AECL), a federal Crown corporation and owner of the site, to engage and build long-term relationships with Indigenous peoples, on matters beyond the scope of this environmental assessment and licence amendment for the Project.

Discussions regarding long-term relationships and on specific aspects of projects such as the Project will be ongoing up until and after the CNSC Commission Hearing on the Project. Because of the ongoing nature of these discussions and relationships, CNL intends to provide a revised IER as part of the Commission Member Document package for the CNSC Commission Hearing on the Project.

4.1.1 Regulatory Requirements

Project information distribution and Indigenous participation are important aspects of the environmental assessment process. CNLs approach to Indigenous engagement complies with the regulatory documents *REGDOC-3.2.1, Public Information and Disclosure* (CNSC 2018) and *REGDOC-3.2.2, Indigenous Engagement* (CNSC 2019). Additional information on REGDOC-3.2.1 is provided in Section 5.1.2 Regulatory Requirements. *REGDOC-3.2.2* notes that when a licensee's activities could adversely affect potential or established Indigenous and/or treaty rights, that the licensee shall identify and engage with potentially affected First Nations and the Red River Métis, and develop/maintain any Indigenous Engagement Reports to support Project activities.

Consideration was also given to CNSC's *Generic Guidelines for the Preparation of an Environmental Impact Statement* pursuant to the *Canadian Environmental Assessment Act, 2012* (CNSC 2016), along with *REGDOC-2.9.1, Environmental Protection: Environmental Principles, Assessments and Protection Measures* (CNSC 2020), which explains that the CNSC determines the requirements for public and Indigenous engagement on a case-by-case basis, including consideration of:

- interests of the public, the Red River Métis, and the First Nations;
- the complexity of the facility or activity and its potential interactions with the environment and the public; and
- additional factors such as other jurisdictional mandates or types of decisions.

Regulatory requirements related to these activities are summarized in Section 2.0 of the IER (CNL 2022). The *Canadian Environmental Assessment Act, 2012* (CEAA 2012) provides a clear description of the environmental effects on Indigenous peoples that are to be considered. The CNSC *REGDOC 3.2.2* (CNSC 2019) provides more detailed information and sets out the "requirements and guidance for licensees" with respect to engagement.

As the CNSC *REGDOC-3.2.2* provides specific requirements and guidance on consideration of rights and activities (i.e., hunt, trap, fish, gather, or conduct ceremonies) results of CNL's review are specifically addressed in the IER and this EIS. In accordance with *REGDOC-3.2.2*, the scope of CNL's Indigenous engagement includes:

- Build list of Indigenous Nations (through consultation with the CNSC);

- Gather information on Indigenous engagement activities that have taken place up to the date of writing and a proposed schedule for interim reporting on these activities to the CNSC; and
- Plan Indigenous engagement activities through closure and post closure of the Project and continue to engage with Indigenous peoples.

CNL also enhanced the scope of this section by adding the following:

- a section demonstrating compliance with regulatory requirements;
- a narrative of engagement activities for each First Nation and the Manitoba Métis Federation; and
- an enhanced summary of each First Nation and the Red River Métis to demonstrate CNL's understanding of the historical, legal, socio-economic, traditional use, and other characteristics, including documenting (where available) their interests in the vicinity of the Project;
- a section providing a summary of engagement outcomes;
- a description of CNL's approach to long-term relationships with Indigenous peoples; and
- a section describing the influence of Traditional Knowledge on the environmental assessment.

Interests and concerns raised through the Indigenous engagement process were considered for inclusion in the environmental assessment. For example, the Winnipeg River was identified by every First Nation and the Manitoba Métis Federation as a critically important feature of their traditional rights and culture. As such, CNL created the Winnipeg River VC. Indigenous concerns and interests are described in tabular format at the outset of subsections of Section 6.0 Environmental Effects (Sections 6.2 Atmospheric Environment through 6.9 Socio-economic Environment) and a compiled summary table is provided in Section 4.4. The table also identifies the corresponding section of the EIS that was changed or altered as a result of the Indigenous input.

4.2 Indigenous Engagement

This section summarizes CNL's engagement objectives and includes a brief description of the First Nations and the Manitoba Métis Federation CNL has engaged with. It also includes the methods used to meet CNL's Indigenous engagement goals and objectives. This section documents engagement activities that have been undertaken between 2016 and up to September 30, 2022, and was subject to verification efforts with the First Nations and the Manitoba Métis Federation.

Table 4.2-1 below quantitatively describes and summarizes the various Indigenous engagement activities undertaken for the Project. The table is intended to demonstrate two key points:

- CNL has utilized a wide assortment of engagement tools including, information sharing, formal two-way dialogue, supporting detailed investigative studies, providing capacity funding, and the consideration of long-term relationship agreements. The engagement activities in the columns reflect the increasing degree of engagement.
- CNL has reached out to and/or engaged all the First Nations and the Manitoba Métis Federation and organizations on the list below in the manner as demonstrated. At the same time, CNL has engaged more extensively with those First Nations, the Red River Métis, through the Manitoba Métis Federation, and organizations that live and practice traditional activities in closest proximity to the WL site, and that have identified an interest to be involved. Each First Nation and the Red River Métis has their specific interest in the type and depth of engagement on the Project. CNL has adapted its engagement activities accordingly.

Table 4.2-1: Project Identified First Nations and the Red River Métis Engagement and Involvement

Project Identified Indigenous Nations and Organizations	Comments submitted via EA (2017 Draft EIS)	CNSC Participant Funding Issued	MOUs & Contribution Agreements[1] (CNL Funding)	TKLUS or Other Studies	Reviewed the 2020 EIS	Relationship Agreements or similar agreements
Sagkeeng First Nation	YES	YES	YES	■ TKLUS ■ Harvest Foods Study ■ Alternative Means Assessment ■ Psychosocial Assessment	YES	Drafted[2]
Manitoba Métis Federation	YES	YES	YES	■ TKLUS ■ Harvest Foods Study	YES	Drafted
Black River First Nation	YES	YES	YES	■ TKLUS	YES	Signed
Brokenhead Ojibway Nation	YES	YES	YES	■ TKLUS ■ Technical Review of the WR-1 EIS	YES	Not requested
Hollow Water First Nation	YES	YES	YES	■ TKLUS	YES	Signed
Wabaseemoong Independent Nations	YES	YES	Not requested	■ TKLUS ■ Technical Review of the WR-1 EIS	No comments received	Not requested
Shoal Lake No. 40 First Nation (Treaty No. 3)	None received	Not requested	Not requested	Not requested	No comments received	Not requested

[1] CNL has also funded a number of workshops and community engagement meetings with all First Nations and the Manitoba Métis Federation.

[2] A long-term relationship agreement with Sagkeeng First Nation is contemplated in the Technical working group documents and Sagkeeng First Nation, CNL, and AECL have signed an agreement that supports its development and the development on other key initiatives to help address Sagkeeng's interest and concerns related to the project.

Table 4.2-1: Project Identified First Nations and the Red River Métis Engagement and Involvement

Project Identified Indigenous Nations and Organizations	Comments submitted via EA (2017 Draft EIS)	CNSC Participant Funding Issued	MOUs & Contribution Agreements[1] (CNL Funding)	TKLUS or Other Studies	Reviewed the 2020 EIS	Relationship Agreements or similar agreements
Iskatewizaagegan No. 39 Independent First Nation (Shoal Lake No. 39 First Nation) (Treaty No. 3)	None received	Not requested	Not requested	Not requested	None received	Not requested
Northwest Angle No. 33 First Nation (Treaty No. 3)	None received	Not requested	Not requested	Not requested	None received	Not requested
Grand Council Treaty #3	None received	Not requested	Not requested	Not requested	None received	Not requested

MOU = Memorandum of Understanding.

4.2.1 Engagement Objectives

As part of its corporate, environmental and social responsibility, CNL recognizes and encourages the ongoing engagement of the First Nations, and the Manitoba Métis Federation, the National Government of the Red River Métis, through the course of the environmental assessment for the Project. Through information sharing and engagement activities, CNL seeks to build Project awareness and learn about interests and concerns to strengthen mutual understanding, opportunities for collaboration and long-term relationships. CNL engages with First Nation and Red River Métis leadership, representatives and members on the potential effects of the Project on the environment and on Indigenous and/or treaty rights including rights to trap, hunt, fish, gather or conduct cultural ceremonies.

CNL has five overarching Indigenous engagement goals:

- **Build awareness and mutual understanding,** and by supporting and facilitating opportunities for mutual learning, including current and traditional use, and values and perspectives on nuclear decommissioning, environmental remediation and radioactive waste management, demonstrate CNL's long-term commitment and approach to safe and responsible management of AECL's radioactive waste and decommissioning liabilities (e.g., through Project and site monitoring activities).
- **Share information on the Project, including the potential effects on the environment**. This includes developing meaningful, user-friendly information and communication products for the First Nations and the Red River Métis and provide accessible and current information on Project activities.
- **Seek input and feedback from the Manitoba Métis Federation and the First Nations** regarding Project related activities, and traditional and current uses of the land surrounding the WL site. Initiate early and meaningful two-way communication channels between CNL and the First Nations and the Manitoba Métis Federation to determine the best methods for sharing information and to provide opportunities for Indigenous peoples to provide input on project considerations including design, the environmental assessment process, and assessment of effects. This includes exploring opportunities for Indigenous economic participation on the Project.
- **Develop long lasting relationships with the First Nations and the Manitoba Métis Federation** to support continued involvement in the Project, community healing and reconciliation. This will extend beyond the scope of the environmental assessment process for Project.
- **Meet or where possible exceed all regulatory-based communication and engagement requirements** and facilitate engagement that reflects current memorandums of understanding and Contribution Agreements, and that considers the interests, needs and schedule of each Indigenous Nation.

In addition, CNL applied CNSC's guidance on engaging with First Nations and the Manitoba Métis Federation and appropriate methodologies for assessing environmental effects and impacts on Indigenous peoples and their rights. While it is recognized that determination of impacts to rights is a Crown responsibility, CNL recognizes that Indigenous engagement activities may give rise to a legal duty to consult.

As the CNSC *REGDOC-3.2.2* provides specific requirements and guidance on consideration of rights and activities (i.e., hunt, trap, fish, gather, or conduct ceremonies), results of CNL's review are specifically addressed in the IER (CNL 2022) and the EIS. The potential effects that were considered in EIS included both adverse and positive effects to the current use of land and resources for traditional purposes, physical and cultural heritage, and

environmental, health, social, and economic conditions of Indigenous Peoples potentially affected by the designated Project, including interferences of the Project with the following:

- quantity and quality of resources available for harvesting (e.g., species of cultural importance, traditional and medicinal plants);
- access to culturally important harvesting areas or resources of importance;
- experiences of being on the land (e.g., changes in air quality, noise exposure, effects of vibrations from blasting or other activities);
- current and future availability and quality of country foods (traditional foods);
- the use of travel ways, navigable waterways, and water bodies;
- commercial and non-commercial fishing, hunting, trapping and gathering, and cultural or ceremonial activities and practices;
- commercial, non-commercial, and trade economies; and
- cultural heritage, and structures, sites or things of historical, archaeological, paleontological or architectural significance to the First Nations or the Red River Métis, including, but not limited to:
  - the loss or destruction of physical and cultural heritage;
  - changes to access to physical and cultural heritage;
  - changes to the cultural value, spirituality, or importance associated with physical and cultural heritage;
  - changes to sacred, ceremonial or culturally important places, objects, or things, including languages, stories, and traditions; and
  - changes to visual aesthetics over the life of the Project and post-project abandonment or decommissioning.

To meet these objectives, CNL has developed specific strategies to increase the effectiveness of the program so Indigenous engagement requirements for the Project are met. These strategies include:

- presenting information in easy-to-understand formats (e.g., webinars, infographics, one-pager summary documents);
- engaging technical experts to communicate information through a variety of formats;
- accomplishing all required activities in a timely manner;
- providing various means for the First Nations and the Red River Métis to access information (e.g., presentations, infographics, site tours, website information, and community visits);
- support and capacity funding for meaningful and timely engagement and the development of longer-term relationship agreements with the First Nations and the Manitoba Métis Federation; and
- support the First Nations and the Manitoba Métis Federation's review of the EIS documentation to allow them to validate if CNL has documented their interests and concerns accurately.

4.2.2 Identified First Nations and the Red River Métis

A list of the Indigenous Nations with a potential interest in the Project was identified by CNL and included in the IER. Identification of the First Nations and the Red River Métis was based on consultation with the CNSC, through CNL's previous Indigenous engagements, and through the use of publicly available sources of information including:

- First Nation and the Red River Métis and organization websites;
- the Aboriginal and Treaty Rights Information System (ATRIS; Government of Canada and INAC 2016); and
- Crown-Indigenous Relations and Northern Affairs Canada First Nation community profiles.

The list was based on the identified potential or established Indigenous or treaty rights of the First Nations and the Red River Métis in the vicinity of the Project and is provided in Table 4.2.2-1 along with a brief rationale for inclusion. The inclusion of specific Nations considers the nature of the established and/or claimed rights and potential effects on those rights caused by the proposed Project based on a preliminary assessment of existing and available information. As such, the working list is subject to change based on information and dialogue with the identified First Nations, the Red River Métis, and Indigenous organizations. A map of the First Nations and treaty areas is provided on Figure 4.2-1, while Figure 4.2-2 shows recognized areas for Red River Métis' natural resource harvesting, and Figure 4.2-3 shows the expansion of the recognized Métis harvesting area.

Table 4.2.2-1: The Indigenous Nations Identified as Having Potential Interest in the Project

First Nations, the Red River Métis and/or Representative Organizations	Identification Rationale and Proximity to the WL Site*
Sagkeeng First Nation (Treaty No. 1 and 3)	■ Asserted and/or established Aboriginal and Treaty rights exist in the vicinity of the WL site. ■ Occupy one reserve located 52 kilometres (km) north of the WL site, and downstream along the Winnipeg River. ■ Existing relationship and interest in the WL site. ■ The WL site is within the boundaries of the area over which Sagkeeng claims unsurrendered Aboriginal title, a proceeding for which is ongoing in the Manitoba Court of King's Bench.
Brokenhead Ojibway Nation (Treaty No. 1)	■ Asserted and/or established Aboriginal and Treaty rights exist in the vicinity of the WL site. ■ Occupy three reserves: 44 km northwest, 55 km northwest and 73 km southwest of the WL site respectively. ■ Interest expressed comments on Project Description.
Red River Métis represented by the Manitoba Métis Federation	■ The Manitoba Métis Federation is the official democratic and self-governing political representative for the Red River Métis Community. The Manitoba Métis Federation is considered the government of the Red River Métis. Potential asserted and/or established Métis harvesting rights in the vicinity of the WL site. ■ Interest expressed comments on Project Description.
Black River First Nation (Treaty No. 5)	■ Asserted and/or established Aboriginal and Treaty rights exist in the vicinity of the WL site. ■ Occupy one reserve 75 km north of the WL site.

Table 4.2.2-1: The Indigenous Nations Identified as Having Potential Interest in the Project

First Nations, the Red River Métis and/or Representative Organizations	Identification Rationale and Proximity to the WL Site*
Hollow Water First Nation (Anishinaabe (Ojibwa)) (Treaty No. 5)	■ Asserted and/or established Aboriginal and Treaty rights exist in the vicinity of the WL site. ■ Occupy one reserve, 113 km north of the WL site.
Shoal Lake No. 40 First Nation (Treaty No. 3)	■ Potential asserted and/or established Aboriginal and Treaty rights exist in the vicinity of the WL site. ■ Treaty No. 3 territory includes parts of eastern Manitoba, including the WL site. ■ Occupy three reserves: 94 km southeast, 110 km southeast and 140 km southeast of the WL site, respectively.
Iskatewizaagegan No. 39 Independent First Nation (Shoal Lake No. 39 First Nation) (Treaty No. 3)	■ Potential asserted and/or established Aboriginal and Treaty rights exist in the vicinity of the WL site. ■ Treaty No. 3 territory includes parts of eastern Manitoba, including the WL site. ■ Occupy four reserves: 93 km southeast, 102 km southeast, 110 km southeast and 140 km southeast of the WL site, respectively.
Northwest Angle No. 33 First Nation (Treaty No. 3)	■ Potential asserted and/or established Aboriginal and Treaty rights exist in the vicinity of the WL site. ■ Treaty No. 3 territory includes parts of eastern Manitoba, including the WL site. ■ Occupy three reserves: 111 km southeast, 140 km southeast and 176 km southeast of the WL site, respectively.
Wabaseemoong Independent Nations (also known as Wabaseemoong Independent Nations of One Man Lake, Swan Lake and White Dog) (Treaty No. 3)	■ Potential asserted and/or established Aboriginal and Treaty rights exist in the vicinity of the WL site. ■ Treaty No. 3 territory includes parts of eastern Manitoba, including the WL site. ■ Occupy four reserves: 80 km east, 85 km east, 95 km east and 140 km southeast of the WL site, respectively.
Grand Council of Treaty 3 (specific to this Project includes: Shoal Lake No. 40 First Nation, Iskatewizaagegan No. 39 Independent First Nation (Shoal Lake No. 39 First Nation), Northwest Angle No. 33 First Nation, Wabaseemoong Independent Nations, and Sagkeeng First Nation)	■ Umbrella treaty organization which represents 28 First Nations and 5 with potential interest in the Project. ■ Treaty 3 territory includes parts of eastern Manitoba, including the WL site.
Chiefs of Ontario (specific to this Project includes: Shoal Lake No. 40 First Nation, Iskatewizaagegan No. 39 Independent First Nation (Shoal Lake No. 39 First Nation), Northwest Angle No. 33 First Nation, and Wabaseemoong Independent Nations)	■ First Nations umbrella organization that represents 133 First Nations and 4 with potential interest in the Project.

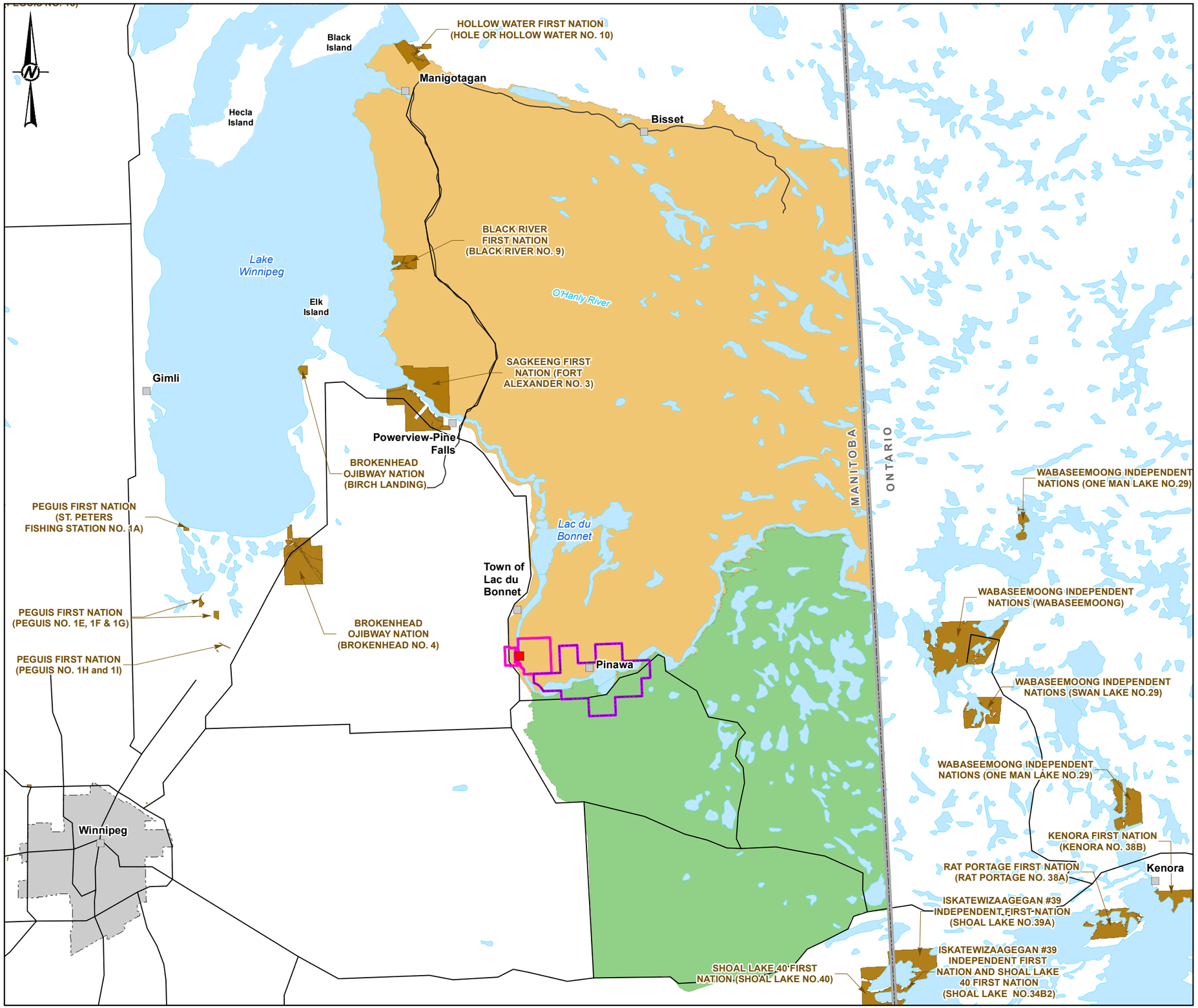
* Two applications were used in the calculation of distances (Arc GIS 10.4 and Google Earth Pro). Distances were measured as a straight line from the WL site to the approximate centre of each reserve.

Each of the Nations listed in Table 4.2.2-1 were provided written notification regarding the Project and efforts were made to follow up with each via telephone to determine their relative interest in participating in engagement activities. A record of communication with regional Indigenous Nations is provided in Appendix 4.0-1 and a summary narrative of engagement with each identified First Nation and the Manitoba Métis Federation is provided in Section 4.2.4 Summary of Engagement.

Although efforts were placed on reaching out to all of the Indigenous Nations and Indigenous organizations identified, particular effort was placed on outreach to the Nations and organizations who expressed interest or provided comments during the federal Project Description process. These Nations were Sagkeeng First Nation (Sagkeeng), Black River First Nation, Brokenhead Ojibway Nation, Hollow Water First Nation, Wabaseemoong Independent Nations and the Red River Métis.

In the fall of 2020, CNL received two verbal confirmations from Brokenhead Ojibway Nation that they were no longer available to engage with CNL on this Project due to other community priorities. CNL offered to fund a community liaison position to enable ongoing engagement, but the community declined. CNL will continue to keep Brokenhead Ojibway Nation informed about the Project and is prepared to re-engage as desired by the community. While there was limited feedback from Shoal Lake No. 40, Iskatewizaagegan No. 39 Independent First Nation, and Northwest Angle No. 33 First Nation, in our initial outreach on the Project, CNL has contacted them in February 2021 to provide a Project status update and to determine their interest in meeting to discuss the Project further.

The IER provides background information on the First Nations, the Red River Métis, and/or representative organizations with a potential interest in the Project and includes, where possible, reference to the individual community's elected council, geographic location, population, and associations or memberships. The IER will be revised as these First Nations, the Manitoba Métis Federation and organizations provide additional information as the Project progresses. The information summarized in this EIS reflects a summary of information available to CNL as of September 30, 2022.



LEGEND

- WR-1 BUILDING
- WHITESHELL LABORATORIES SITE

BASE FEATURES

- CITY/TOWN
- PROVINCIAL BOUNDARY
- MAJOR ROAD
- WATERCOURSE
- WATERBODY
- FIRST NATION RESERVE
- REGISTERED TRAPLINE NO. 23

BIG GAME HUNTING AREA

- AREA NO. 26
- AREA NO. 36

0 20 40

1:700,000 KILOMETRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY PROVIDED BY CNL (2016-11-22),
3. BIG GAME HUNTING AREAS - DEVELOPED BY MANITOBA WILDLIFE MANAGEMENT AREAS, PROVINCE OF MANITOBA
4. REGISTERED TRAPLINE NO. 23 - PROVIDED BY THE MANITOBA LAND INITIATIVE, 2017
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
INDIGENOUS COMMUNITIES AND TREATY AREAS

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/PR/RRD
REVIEWED	KL
APPROVED	AB

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0006	2	4.2-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm 0

Document Path: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0006_EIS_Sec4\20145046-0006-HL-0001_Figure 4_2-1_Indigenous Communities and Treaty Areas.mxd

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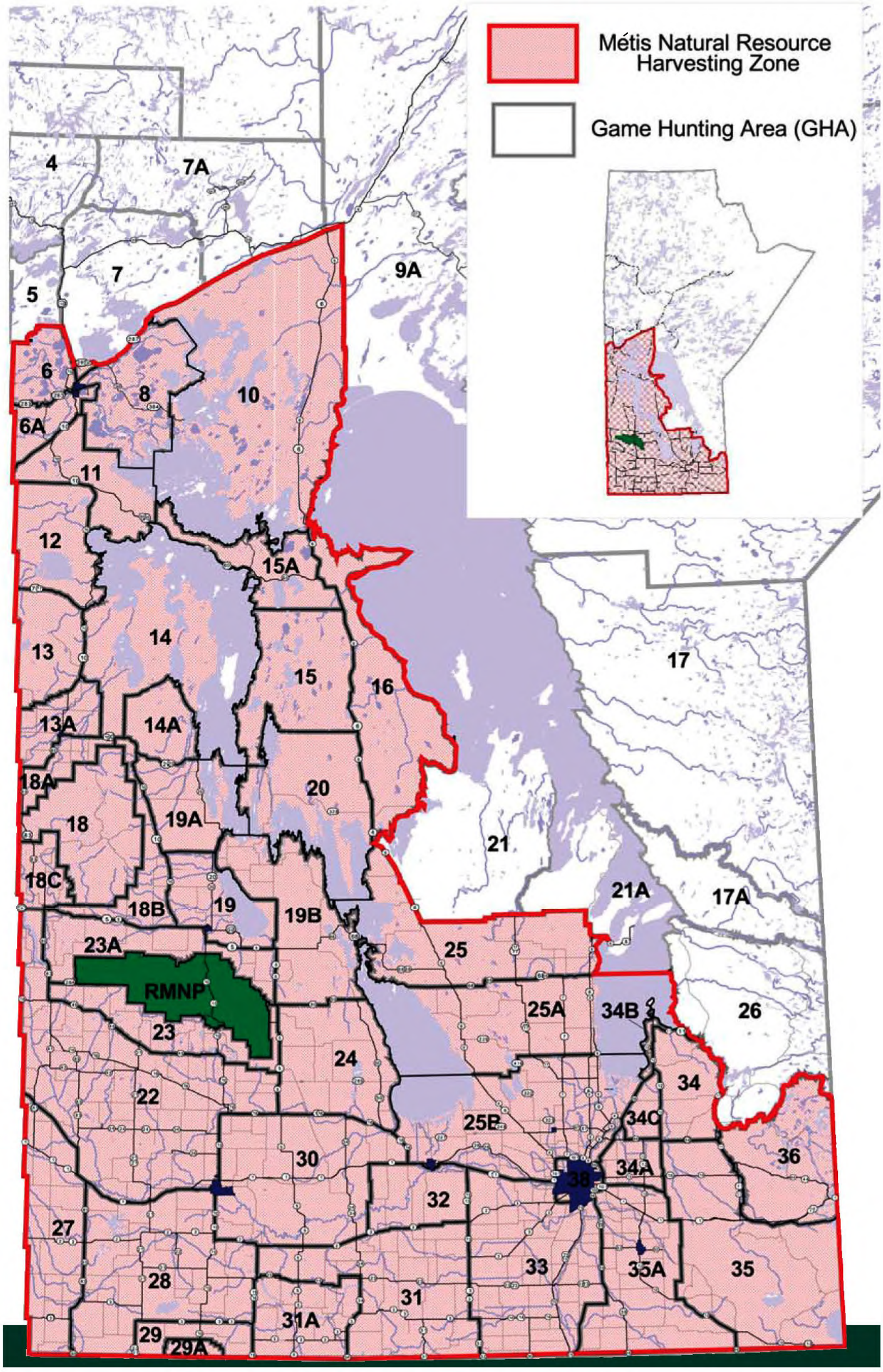
PATH: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0006_EIS_Sec4\20145046-0006-HL-0002_Figure 4_2-2 Recognized Areas for Metis Natural Resource Harvesting.mxd PRINTED ON: 2022-12-08 AT: 9:35:14 AM



NOTE(S)

REFERENCE(S)

1. INFORMATION OBTAINED FROM HTTP://WWW.MMF.MB.CA/DOCS/RECOGNIZED_AREAS_FOR_HARVESTING_MAP.PDF

CLIENT	CANADIAN NUCLEAR LABORATORIES LTD.
CONSULTANT	WSP GOLDER
MM-YYYY	DECEMBER 2022
DESIGNED	SO
PREPARED	RRD
REVIEWED	KL
APPROVED	AB
PROJECT	EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE
TITLE	**RECOGNIZED AREAS FOR THE MANITOBA MÉTIS FEDERATION NATURAL RESOURCE HARVESTING**

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0006	2	4.2-2

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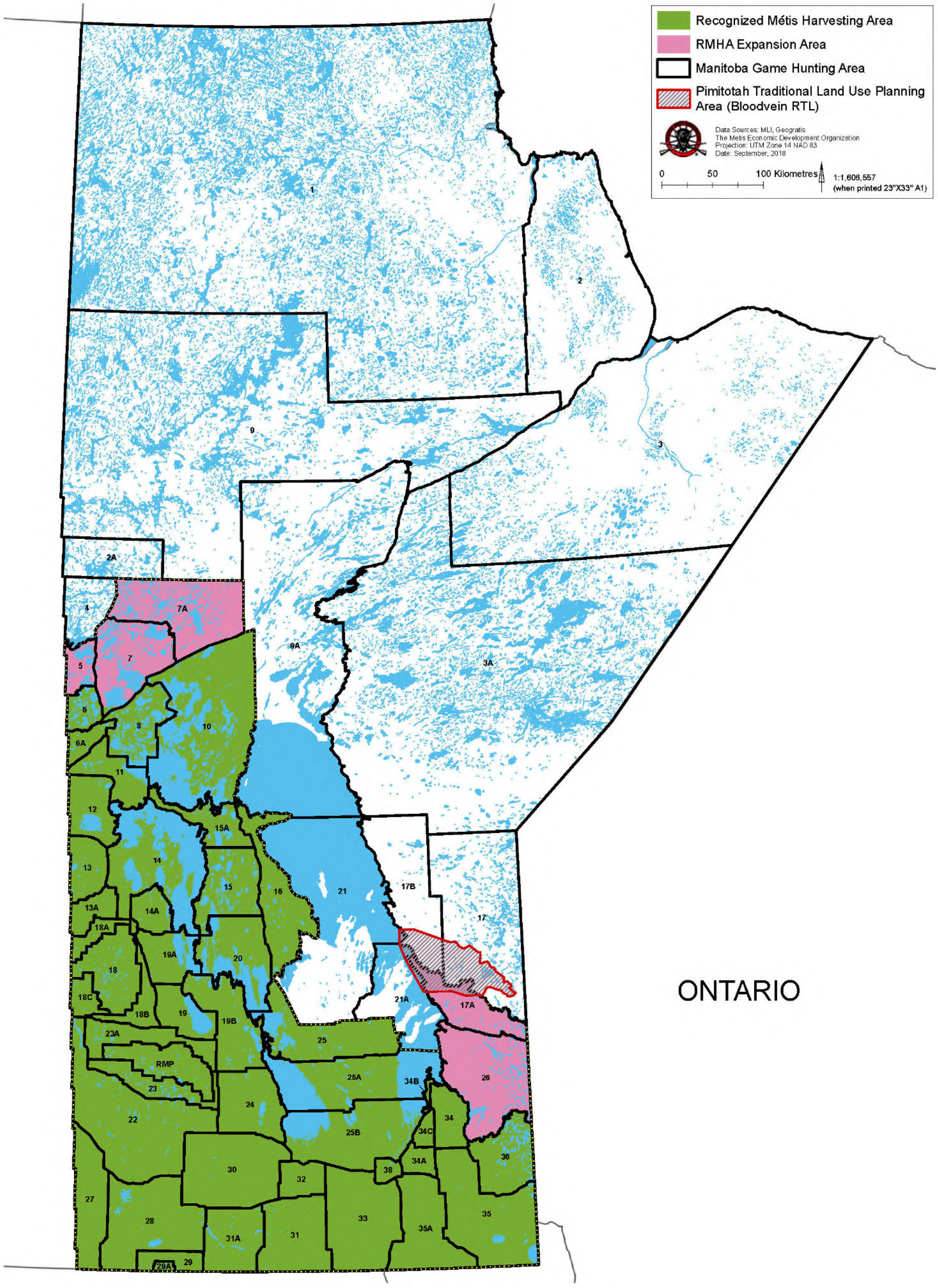
PATH: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0006_EIS_Sec4\20145046-0006-HL-0003_Figure 4_2-3 Expansion of the Recognized Metis Harvesting Area.mxd PRINTED ON: 2022-12-08 AT: 9:34:46 AM



NOTE(S)

REFERENCE(S)
1. INFORMATION OBTAINED FROM MLI, GEOGRATIS
THE METIS ECONOMIC DEVELOPMENT ORGANIZATION:
HTTP://WWW.MMF.MB.CA/DOCS/HARVESTING/2018RESOLUTION_RMHAEXPANSION_26SEPT18.PDF

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	SO
PREPARED	RRD
REVIEWED	KL
APPROVED	AB

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
EXPANSION OF RECOGNIZED MANITOBA MÉTIS FEDERATION HARVESTING AREA

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0006	2	4.2-3

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4.2.3 Engagement Methods

Section 4.2.4 describes the engagement that CNL has undertaken with the identified Indigenous Nations: Sagkeeng, the Manitoba Métis Federation; Black River First Nation, Brokenhead Ojibway Nation, Hollow Water First Nation, Wabaseemoong Independent Nations, Shoal Lake 40, Iskatewizaagegan No. 39, Northwest Angle No. 33, and Grand Council Treaty #3. CNL recognizes the importance of seeking direction from the First Nations and the Red River Métis, through engagement with the Manitoba Métis Federation, on how they want to engage on this Project. CNL also recognizes and respects that each Indigenous Nation is unique and may have different approaches, needs, and interests for engagement on this Project. For example, some Nations have indicated they would prefer to establish funding agreements in the form of Contribution Agreements that outline specific engagement activities of interest to the Nation.

The Contribution Agreements signed by CNL and the First Nations or the Manitoba Métis Federation have supported participation in environmental monitoring activities, funding for community liaison positions, and further participation in the environmental assessment process, including technical reviews of CNL's responses to the Nation's comments on the draft EIS. Contribution Agreements have also funded Traditional Knowledge studies conducted by the First Nations and the Manitoba Métis Federation, food intake studies, and an Alternative Means Assessment that incorporated Sagkeeng's community values, alternative weighting, and additional criteria for consideration. These efforts have assisted CNL in understanding the potential impacts of this Project to Aboriginal and Treaty rights. The CNSC provided funding for the Manitoba Métis Federation and Wabaseemoong Independent Nations to conduct their Traditional Knowledge studies. The CNSC has also provided funding to Sagkeeng to conduct a Psychosocial Impact Assessment to help inform the CNSC's rights impact assessment and to inform the CNSC assessment of effects of this EIS.

Various engagement methods were designed to share information with and receive input while fulfilling CNL's corporate and regulatory objectives. The methods CNL has utilized to date or plans to undertake, are highly diverse and vary based on expressed community need and desired methods. This includes general information activities focused on community meetings, workshops and long-term relationship building. Section 4.2.4 describes engagement activities for each community, in general using the methods summarized in Table 4.2.3-1 below. Project-specific examples are included; however, relationship-building engagements and funding are also key activities.

As CNL is undertaking closure of the WL site in addition to the Project, it is important to the First Nations and the Red River Métis and CNL that these relationships endure, grow, and adapt to future activities. As such, CNL is currently working in collaboration with AECL, the Manitoba Métis Federation, and local First Nations to establish an Indigenous Advisory Committee. The Indigenous Advisory Committee is an additional mechanism for engagement and does not replace or impede ongoing bilateral engagements with each First Nation or the Manitoba Métis Federation. For more information on the Indigenous Advisory Committee, refer to Section 4.2.5.2 Long-term Initiatives and Engagements. CNL is also developing and executing relationship agreements, that include liaison positions, to help address each Nation's unique interests and concerns related to the Project and the Whiteshell Laboratories Closure Project overall.

Starting in March 2020, the COVID-19 pandemic impacted in-person engagement activities. CNL has followed public health requirements and guidance throughout and adapted to restrictions providing online platforms for virtual meetings with First Nations and the Manitoba Métis Federation. In accordance with local health authorities, CNL has held some in-person meetings and workshops. CNL remains committed to an ongoing engagement program in alignment with current pandemic restrictions.

Table 4.2.3-1: Engagement Methods and Example Activities

Engagement Method	Example Activities
Contribution Agreements and Relationship agreements	■ Project-specific Agreements (i.e., Contribution Agreements) ▪ Provision of funding to assist in resource capacity development, including peer review studies and engagements with Indigenous organization consultants and staff, review of the draft EIS and review of CNL's responses to community comments on the EIS, community liaison positions ▪ Capacity assistance, as appropriate, including costs to support meetings such as hall rental or production of printed materials, in-kind access to the technical expertise of CNL staff, reimbursement for some expenses to participate in engagement activities such as site visits, and tours. ■ Broader relationship agreement discussions with CNL
Meetings and Workshops *(Learning, dialogue and engagement)*	■ Virtual and/or in-person meetings/workshops ■ Community meetings/open houses ■ Presentations representatives ■ Targeted community initiatives (e.g., environmental monitoring and youth event) ■ Technical meetings to provide an opportunity to discuss more detailed information concerning the Project ■ WL site visits, including WR-1 tours ■ Benchmarking trip to a site that underwent a similar disposal technique
Communications Activities and Information Sharing	■ Letters to First Nations and the Red River Métis, through the Manitoba Métis Federation, and/or organization representatives (accompanied by follow-up calls) ■ E-mail correspondence and/or phone ■ Distributing the IER for review prior to submission ■ Distribution of specific sections of the EIS for review ■ Distributing copies of maps, technical studies or reports upon request ■ Invitations to attend informational webinars ■ Distribution of community newsletter on the Project ■ Project notifications and newspaper advertisements ■ Public information sessions, including display materials and handouts ■ Media notifications/releases ■ Webpage content ■ Participation and presentation on environmental monitoring on site ■ Indigenous Ceremony on site

4.2.3.1 CNL's Long-term Relationship with Indigenous Peoples

CNL recognizes First Nations and the Red River Métis as stewards of the land and CNL is working towards developing long-term meaningful relationships with each Nation that occupies and have traditional territories and modern-day interests near its operations. CNL recognizes each Nation has its own unique set of interests and concerns associated with both the Project and Whiteshell Laboratories Closure Project and CNL is committed to taking a distinctions-based approach to engagement to ensure each Nation's interest and concern are addressed. CNL also takes a holistic, relationship-based approach to engagement with each Nation, working closely with AECL, to help address interest and concerns regarding all aspects of the Project and Whiteshell Laboratories

Closure Project. As a federal Crown corporation and site owner, AECL is committed to taking meaningful actions to support healing and to advance reconciliation through nation-to-nation dialogue and relationship-building.

This shift in CNL's Indigenous engagement approach from project-based engagement to a holistic, relationship and distinction-based approach will support meaningful actions to build foundations for trust, understanding, and mutually beneficial relationships, including addressing broader issues and concerns such as the historical siting of the WL site.

CNL is currently working with each Nations formalizing these relationships through relationship-building and corresponding agreements. These agreements are intended to help enable greater integration of Traditional Knowledge, ceremony, and cultural and stewardship practices in the decommissioning, monitoring, and closure of the Project and the Whiteshell Laboratories Closure Project. These agreements will also enable dialogue and participation through the development of monitoring programs, culturally appropriate communications, trauma-informed engagement. In addition, they help to enhance community engagement, building trust and strengthen relationship-building, as well as setting up mechanisms to facilitate Indigenous participation and input into CNL's environmental monitoring program, economic development and procurement opportunities, future land use, and other areas of collaboration.

CNL has signed a relationship agreement with Black River First Nation and Hollow Water First Nation, and a relationship agreement with the Manitoba Métis Federation. CNL intends to pursue a long-term relationship agreement with Sagkeeng after other priority areas are addressed3. CNL is committed to ongoing engagement and enhancing our relationships with these Nations.

CNL continues to build relationships with local First Nations and the Manitoba Métis Federation to support overall decommissioning of the WL site, including the Project. CNL is committed to learning about Indigenous values through ceremony and on-going dialogue, and discussing, incorporating, and addressing concerns to the extent possible.

4.2.4 Summary of Engagement

This section provides a summary of engagement that CNL has undertaken with each First Nation and the Manitoba Métis Federation. The engagement activities captured in this section cover engagements as of September 30, 2022. For each Nation, the following subsections are discussed:

- **Engagement.** This subsection summarizes the engagement CNL has had with the First Nation and the Manitoba Métis Federation or organization.
- **Interests and Concerns.** This subsection addresses each of the interests/concerns identified under feedback. CNL has also provided a narrative discussion that describes:
  - CNL's understanding of the interest or concern raised, a summary of CNL's response to the interest/concern and discussions on the topic;

[3] At the time of submission, CNL, AECL and Sagkeeng are preparing a press release and organizing a signing ceremony to announce a long-term Sagkeeng-led CEMP. Once the CEMP is implemented, Sagkeeng and CNL will discuss and develop a long-term relationship agreement.

- where CNL has verified or has attempted to verify, with the First Nations and the Manitoba Métis Federation that their interest/concern has been addressed; and
- where CNL is as of September 30, 2022, with each First Nation, the Manitoba Métis Federation or organization and how CNL plans to address outstanding interests and concerns (i.e., next steps), including identification of commitments.

Supporting this narrative section, CNL has also included within Appendix 4.0-1 the Tables of Interests. The Tables of Interests describe how CNL is addressing the interest/concern (Column 3) and impacts on the EIS (Column 4).

- **Verification.** The purpose of the verification section is to describe the steps taken to confirm CNL has correctly characterized the Nation's interest and concern. The purpose of the verification process at this stage is to confirm that CNL has documented all the interests and concerns, VC, information provided by the Nation, and the Nation's position are correctly described and captured in the revised EIS and supporting documents. CNL has and is continuing to work with the First Nations and the Manitoba Métis Federation to verify that their interests and concerns have been addressed. This work will continue after the submission of the revised EIS. Verification means that CNL has received verbal or written confirmation from the First Nation, Manitoba Métis Federation or organization, that how CNL has addressed or responded to the Nation's or organization's interests or concerns have either been accepted or in cases where CNL is unable to fully address interests or concerns, this is understood and acknowledged by the First Nation, the Manitoba Métis Federation or organization. Based on the CNSC's guidance, as well as practices commonly employed in EIS work by other proponents, verification includes:
  - Consolidating all interests and/or concerns raised to confirm accuracy in reporting and tracking. Where applicable this has been done through sharing a summary of interests and concerns with each First Nation, the Manitoba Métis Federation or organization.
  - Providing a summary of how interests or concerns has led to a change in this EIS and providing an opportunity to review the consolidated material in the context of this EIS. Specific sections of the EIS where Traditional Knowledge was incorporated or where changes occurred due to a particular interest and/or concern were provided to each Nation for their review and feedback.
  - Responding to all comments on the 2017 draft EIS and/or the 2020 draft EIS and sharing responses to the respective First Nation, the Manitoba Métis Federation or organization. In some cases, the interest/concern raised has been resolved. However, there are also other issues where there may be a difference in opinion and the First Nation, the Manitoba Métis Federation or organization may have not confirmed that the response by CNL is deemed acceptable. In this case, the acceptable verification is an acknowledgement and understanding of the differing positions of CNL and the First Nation, the Manitoba Métis Federation or organization.
  - Where direct submissions or comments from specific First Nations, the Manitoba Métis Federation, and organizations were received, including targeted technical comments on the 2017 draft EIS and comments on the 2020 revised draft EIS, CNL has provided written responses to the First Nations, the Manitoba Métis Federation, and organizations indicating where changes have been incorporated in this EIS.
  - CNL requested feedback from all identified First Nations, the Manitoba Métis Federation, and organizations on assumptions CNL had made in this EIS with respect to traditional land use around the

WL site. CNL has incorporated information from traditional land use and knowledge studies that have been completed by the Sagkeeng, the Manitoba Métis Federation, Black River First Nation, Brokenhead Ojibway Nation, Hollow Water First Nation, and Wabaseemoong Independent Nations and has asked these Indigenous Nations for verification that the studies were reflected accurately in this EIS.

- CNL provided the tables of interests and concerns to all First Nations and the Manitoba Métis Federation that have voiced interests and concerns related to the Project and requested feedback (1) that CNL had captured accurately the interests and concerns, and (2) where possible, verification that the Nation or organization was satisfied with how the interests or concerns have been addressed by CNL. CNL incorporated proposed changes that were recommended by the First Nations and the Manitoba Métis Federation to the table of interests and concerns

- **Next Steps.** This subsection describes the key next steps for engagement both from a relationship building and environmental assessment perspective. It also discusses how CNL plans to address outstanding issues of concern and interest. CNL is aware that not all issues can be quickly or easily resolved as some issues go beyond the scope of the Project or there remain a difference of opinion on certain issues. CNL will continue to listen, respond to, and, where possible, address all issues raised.

CNL has developed a system to gather, document, and verify information in this EIS for the Manitoba Métis Federation and each First Nation. In general, CNL followed the below process:

Process Step #1 – Receive feedback identifying particular interests or concerns from a First Nation, Manitoba Métis Federation, or organization through one or more of the following sources:

- Ongoing engagement and information sharing with the First Nations and the Manitoba Métis Federation.
- Comments on the 2016 Project Description or any draft revision of the EIS.
- Traditional Knowledge and Land Use Studies (Sagkeeng, the Red River Métis, Black River First Nation, Brokenhead Ojibway Nation, Hollow Water First Nation, and Wabaseemoong Independent Nations).
- Additional studies completed concerning the Project (i.e., Sagkeeng First Nation's Psychosocial Impact Assessment [Narratives 2020] and Alternative Means Assessment [Sagkeeng and Firelight 2020]; and two harvester consumption surveys).

Process Step #2 – Share this EIS (directing to applicable sections informed by Indigenous engagement), asked for additional feedback, offered support to assist the process, and offered to meet to discuss how Indigenous interests and concerns have been incorporated:

a) If the offer to meet with CNL was accepted, where applicable, CNL completed one or more of the following: targeted engagement on a particular interest or concern, shared draft responses to comments provided, supported additional studies, incorporated additional feedback, and supported further participation in the environmental assessment process.

b) If CNL did not receive a response from the Nation or the offer for further discussions on a topic or interest was declined, CNL shared draft responses to comments on this EIS or specific topic of interest and outlined future opportunities to engage should the community like to re-engage in the future.

Process Step #3 – Acknowledgement that CNL had adequately documented the Nation's position, interest, or concern. Where applicable, CNL incorporates any additional feedback from the Nation by revising responses and/or EIS documentation. Where applicable, CNL provides a rationale for any feedback CNL could not incorporate.

Process Step #4 – Share each finalized summary of interests and concerns and verification status (as understood by CNL) for confirmation by each First Nation, Manitoba Métis Federation, or organization to confirm whether CNL had adequately captured their interest or concern:

a) If the First Nation, the Manitoba Métis Federation, or organization responds and confirms that the summary was a sufficient representation of their interests and concerns and wished to further discuss how interests and concerns have been incorporated, and/or clarified/revised summary of interests and concerns. Alternatively, acknowledgement and understanding that CNL has not adequately addressed an interest/concern and an agreement on the difference of opinion.

b) If no response or no confirmation of summary of interests and concerns was received, CNL offered further discussion on how to revise summary of interests and concerns with First Nation, the Manitoba Métis Federation or organization.

Process Step #5 – Finalized the draft EIS.

One of the key outcomes of the engagement verification process is the development of tables that summarize interests and concerns for each Nation. These tables of interests and concerns identify the specific comments that have been formally submitted as part of the engagement process or identify the concerns and comments that have been raised orally or in direct submissions to CNL. These tables are dynamic and continue to reflect the latest identification of interests, concerns and their status. These tables identify CNL's response to the feedback and document next steps. CNL continues to engage with each Nation and is working to develop commitments to address concerns. The tables are located in Appendix 4.0-1. Appendix 4.0-1 also provides a list of engagements and identifies engagements relevant to the EIS.

In addition to the summary of engagement for each Nation in the sections below, Section 4.3 provides an overview of how Traditional Knowledge has influenced the environmental assessment, and Section 4.4 provides a specific list of all the changes to the EIS based on feedback from First Nations and the Manitoba Métis Federation.

4.2.4.1 Sagkeeng First Nation

Sagkeeng, formerly the Fort Alexander Band No. 262, is an Anicinabe First Nation, and signatory to Treaty No. 1, with land cessions within the settlement boundary. Sagkeeng has potential, asserted and/or established Aboriginal and Treaty rights in the vicinity of the Project (beyond Treaty No. 1), is within proximity to the WL site, and has an existing relationship and expressed interest in the WL site.

A map of Sagkeeng is provided in Appendix D of the IER (CNL 2022).

Sagkeeng occupies one area of reserve lands: Fort Alexander 3 Reserve No. 06362. The Reserve is situated approximately 52 km north of the WL site, at the southeastern tip of Lake Winnipeg, and along the shores of the Winnipeg River. The reserve covers an area of 8,771.3 ha. Sagkeeng has a total registered population of 8,037 (as of September 2019). Roughly 56 percent of the registered population resides off-reserve lands (4,471; INAC 2019a).

Since 2016 when CNL started engaging with Sagkeeng on the proposed Project, Sagkeeng's position has remained that complete removal and remediation (i.e., CNL's Alternative #2) of WR-1 should be selected as the decommissioning method for WR-1.

Throughout the environmental assessment process, CNL has engaged Sagkeeng to share information and build awareness about the proposed ISD of WR-1, and understand Sagkeeng's Aboriginal and Treaty rights and main concerns and interests regarding the Project to determine how CNL and Sagkeeng can work collaboratively to address Sagkeeng's concerns. A main component of this engagement is to identify Sagkeeng's concerns and potential impacts from the Project on their rights and identify ways to help address the community's concerns. Sagkeeng has asserted their Aboriginal rights based on the location of the Project in their traditional territory, where their members use the land around the site for hunting, fishing and other cultural purposes.

Over time, CNL has increased and strengthened engagement with Sagkeeng on the Project to better understand Sagkeeng's concerns, potential impacts, collaborate on ways to help address these concerns, and to build a lasting working relationship. CNL continues to learn and adapt its approaches based on feedback and direction from the community. In 2021, CNL has worked closely with AECL and has shifted towards a relationship-based engagement approach to support addressing Sagkeeng's concerns related to the Project, the Whiteshell Laboratories Closure Project, and the historical siting and operations of the WL site.

CNL, AECL, and Sagkeeng have established a technical working group table to identify, develop, and implement initiatives that will help to address Sagkeeng's interests and concerns related to the WL site. From this working group, Sagkeeng, CNL, and AECL have signed an agreement to support an independent Sagkeeng Community Environmental Monitoring Program (CEMP), that considers monitoring for country foods and community risk communications plan. Sagkeeng, CNL, and AECL have also established a community liaison committee to enhance community engagement, build trust, and strengthen relationship-building.

With these initiatives in place and others in development, the relationship with Sagkeeng is positive and positioned for success. Future discussions with Sagkeeng will include participation and input into CNL's environmental monitoring program, economic development and procurement opportunities, future land use, the development of a Long-Term Relationship Agreement and other areas of collaboration and interest to the community. Sagkeeng has expressed its interest in continuing to develop the relationship along these terms, and has emphasized that for engagement to be meaningful, it must be ongoing. CNL understands and appreciates Sagkeeng's desire for engagement to be sustained and substantive. CNL will continue to work closely with AECL and Sagkeeng through the technical working group table to strengthen their relationship and implement the initiatives to help address Sagkeeng's concerns.

4.2.4.1.1 Engagement

In relation to this Project, engagement began in April 2016, when CNSC initiated a teleconference with Sagkeeng, CNL, and AECL to discuss the proposed decommissioning of WR-1. In May of that year CNL and Sagkeeng had an introductory meeting to discuss the preliminary concerns of Sagkeeng and how they would like to be engaged moving forward. In August 2016, CNL sent out formal letters to identified First Nations and the Manitoba Métis Federation requesting their input on the proposed Project.

In 2017, CNL continued to engage with Sagkeeng, meeting with community representatives in January to present an overview of the WR-1 decommissioning as well as hosting an open house that Sagkeeng representatives attended. In May, CSNC led a meeting with Sagkeeng, Wabaseemoong Independent Nations, CNL, and AECL,

to discuss engagement and to present on CNSC's role as regulator and the Project. Later in July, Sagkeeng participated in a site tour followed by a dialogue on site activities.

In September 2017, CNL provided an opportunity for five members from each First Nation community and the Red Manitoba Métis Federation to attend a full day workshop to both learn and share on how CNL and the First Nations and the Manitoba Métis Federation collectively protect and care for the environment. The goal was to provide some hands-on experience coupled with ample discussion, learning and dialogue on opportunities moving forward both as a career option and as a relationship between the site and the First Nations and the Manitoba Métis Federation. On October 31, 2017, CNL's Annual Safety Reports were distributed to each First Nation community including the "Environmental Monitoring in 2016 at Whiteshell Laboratories" report, and the "2016 Progress Report on the Environmental Assessment Follow-up Program for Whiteshell Laboratories". CNL also provided an invitation to engage on these documents. In November 2017, CNL mailed hard copies of community specific reports along with the draft EIS Executive Summary and had a teleconference with Sagkeeng representatives to discuss how to move forward with the community.

On January 3, 2018, CNL and Sagkeeng signed a Memorandum of Understanding (MOU) and entered into a participation funding agreement in support of Sagkeeng conducting a Traditional Knowledge Land Use Study. The agreement also was supportive of Sagkeeng's review and community engagement of the environmental assessment for the Project. As outlined in the MOU, CNL also committed to continuing to work with Sagkeeng in the development of a Contribution Agreement. In early 2018, Sagkeeng's Chief and Council, other Sagkeeng representatives, CNL, and CNSC met to discuss Sagkeeng's comments on the draft EIS and requests for additional engagement on the Alternative Means Assessment, concerns about potential psychosocial impact, and other key issues. In April, CNL supported representatives from all participating First Nations and the Manitoba Métis Federation, including Sagkeeng, to participate in a benchmarking trip to Hallam, Nebraska, the site of a reactor that underwent ISD in 1969. The trip was intended to provide First Nations and the Manitoba Métis Federation with additional information on ISD and provide them with the opportunity to see what a site could look like after in situ disposal. Sagkeeng members were invited but did not attend; however, Sagkeeng's consultant attended the trip and reported back to the community.

In August 2018, CNL met with Sagkeeng to discuss Sagkeeng's Traditional Knowledge Land Use Study (Sagkeeng and Firelight 2020) and also invited Chief Henderson to dine with CNL's Board of Directors. In the fall of 2018, CNL met with Sagkeeng to discuss their comments on the 2017 draft EIS. Following this, CNL had a subsequent meeting with Sagkeeng to discuss action items. CNL also partnered with Sagkeeng to conduct a food consumption survey of their members. The results of the survey were compiled in a summary memo that was shared with Sagkeeng in November 2018. The survey helped validate the assumptions for the Harvester receptor modelled in the human health risk assessment (Section 6.7 Human and Ecological Health).

In response to concerns expressed by Sagkeeng on the draft EIS Alternative Means, CNL and Sagkeeng met in January 2019 for two preparatory meetings for a three-day Alternative Means Workshop planned for February. In February, CNL and Sagkeeng met to conduct the Alternative Means Workshop where Sagkeeng was to present their community perspectives on the Project and alternatives considered. CNSC and AECL participated as observers at this workshop; however, due to poor weather, CNSC participated by teleconference. The workshop's purpose was to provide an opportunity for Sagkeeng to present their community values and preferred weighting of criteria with respect to the WR-1 decommissioning alternatives, and for CNL to present the proponent's four assessed alternatives and associated weighting and assessment. The workshop was also an opportunity for parties to openly share their thoughts and seek a path forward. Day one started with a cultural water ceremony and traditional drum following which both CNL and Sagkeeng's consultant presented on their respective

Alternative Means Assessment and weighting criteria. After lunch on day two, Chief Henderson informed participants that there would be a change in the agenda. Sagkeeng ended the workshop, citing the need to take a cultural pause, and invited all the participants to attend a ceremony at Turtle Lodge prior to continuing this discussion. An Elder also addressed the participants at the workshop before it ended and spoke to the importance of ceremony to help guide the process.

As requested, CNL, AECL, CNSC, and Sagkeeng convened in March 2019 at Turtle Lodge, an internationally recognized Indigenous education and wellness center, located in Sagkeeng, in March 2019 for a ceremony. Turtle Lodge also provided a presentation on radioactive waste issues to the participants. CNL also hosted Turtle Lodge on site in July 2019 for a tour of the WL, to discuss Project updates, and plan for a ceremony on the WL site.

CNL provided a Project update to Sagkeeng and the CNSC in September 2019 and hosted a ceremony on the WL site. The ceremony was an opportunity to reconnect with the land and to conduct ceremony of importance to Sagkeeng. A sacred fire was lit on the site. The ceremony included Chief Henderson, Sagkeeng Councillors, Elders from Sagkeeng and other invited First Nations. A traditional drum group performed, and water and smudging ceremonies were conducted. CNL staff participated and observed the ceremony, providing an important opportunity for growth and cultural learning. Representatives from CNSC and AECL participated in the day's events. CNL continued to engage with Sagkeeng by participating in a meeting in September 2019 where CNL provided an overview of Whiteshell's Licencing Renewal, the Project, and radiation protection.

On December 11, 2019, CNL and Sagkeeng met in Winnipeg to discuss feedback Sagkeeng provided through the site licence intervention, in-person meetings, e-mail, and submitted comments on the draft EIS. In addition, this meeting was to explore what the possibility of a long-term relationship agreement could look like as well as discuss establishing an Indigenous Advisory Committee, and other areas of interests (e.g., environmental monitoring and end state planning). The purpose was to develop concrete actions to address items of interest to both Sagkeeng and CNL and continue to grow their relationship. Sagkeeng's Chief and full Council attended the meeting. Key topics that were discussed included the EIS, Indigenous Advisory Committee, Indigenous Liaison position, environmental monitoring, capacity building, end state engagement, and asset donations. Several action items were identified and continue to be reviewed and updated by Sagkeeng and CNL.

In February 2020, CNL received a letter from Sagkeeng regarding their position on the Alternative Means Assessment and providing Sagkeeng's opinion on the adequacy of the revised draft EIS and identifying specific opportunities in the EIS for improvements. In the letter, Sagkeeng clearly stated that:

- Sagkeeng's position remains that the assessment of alternatives has not been adequately completed since it did not incorporate Sagkeeng's specific views and community values, and
- Sagkeeng is opposed to leaving the WR-1's radioactive materials in the ground and focused on finding the most preferred alternative that can be consented to by Sagkeeng.

The letter also clarified that Sagkeeng's position will remain as stated above unless and until CNL is able to demonstrate that ISD is objectively better than full removal, including when considered against Sagkeeng's priorities and criteria. Accompanying the letter was a comment table, in which Sagkeeng raised specific concerns and asked specific questions about the EIS, along with a number of other supporting technical documents, reflecting Sagkeeng's position on the then-draft EIS. In reply to the e-mail accompanying that letter, CNL requested a meeting with the Sagkeeng consultation team on February 19, 2020.

In March 2020, CNL and Sagkeeng met to discuss the February letter from Chief Henderson. CNL had also intended to discuss the long-term relationship agreement. However, despite best efforts, CNL and Sagkeeng did not align on the purpose of the meeting and this matter was postponed. CNL responded to the questions during the meeting and also provided detailed responses in a letter to Sagkeeng the following month.

In response to the numerous discussions with Sagkeeng regarding the Alternative Means Assessment, CNL and Sagkeeng signed an MOU in June 2020 where CNL supported the completion of Sagkeeng's Independent Alternative Means Assessment that would incorporate Sagkeeng's community values, alternative weight criteria and other key elements. CNL has included details of Sagkeeng's final report in this EIS package. CNL and Sagkeeng continued to meet monthly from June to August to discuss topics of interest to Sagkeeng, including the Project, environmental monitoring, an Indigenous Liaison position, and the long-term relationship agreement.

In September 2020, Sagkeeng and CNL signed another MOU to fund a Sagkeeng Community Liaison position. CNL provided on-site training to the Liaison and met with Sagkeeng to review and discuss action items. Sagkeeng also participated in a tree survey on the WL site and a workshop to initiate the development of a work plan for Sagkeeng's Liaison. CNL and Sagkeeng's Liaison have been in discussions and are working towards completing a work plan.

On October 19, 2020, CNL received Sagkeeng's Alternative Means Assessment report outlining criteria and their weights as developed by Sagkeeng. Their alternatives assessment incorporated Sagkeeng's values and included additional independent technical tests and weighting provided by Sagkeeng's technical Consultant. More information on Sagkeeng's Alternative Means Assessment is provided in Section 4.2.4.1.3 Sagkeeng's Alternative Means Assessment. The report is also discussed in Section 2.8 of the EIS and is included as a supporting document to the IER.

CNL hosted a multi-community event at the WL site on October 20, 2020. The purpose of the half-day site visit was to discuss CNL's environmental protection program and to observe CNL's fish processing, which is part of CNL's routine environmental monitoring program. Participants included Sagkeeng's Liaison Officer, a representative from Manitoba Métis Federation, and two representatives from Black River and Hollow Water First Nations. A presentation was provided by CNL's environmental specialist on CNL's environmental protection program. Participants also made a number of recommendations on how to incorporate species of interest to the First Nations and the Manitoba Métis Federation into CNL's monitoring program. Afterwards, CNL and the participants made their way to the environmental lab where participants observed CNL processing fish they had caught that morning. Participants asked CNL's environmental technicians a number of questions about where the fish were caught and the method for catching them. A workshop report was produced and circulated to participants for review and comment. CNL did not receive any feedback on the report from the participants.

On October 20, 2020, CNL and Sagkeeng also signed an MOU to support Sagkeeng's consultant's review of CNL's responses to Sagkeeng's comments on the 2017 and 2020 draft EIS. Later that month, on October 28, CNL received Sagkeeng's Psychosocial Assessment report (Narratives 2020). The report describes the historic and intergenerational trauma that Sagkeeng experienced from a variety of sources including Residential schools, Child and Family Services, the former upstream pulp mill and the WL site, including WR-1. The report also described potential psychological, social, and cultural impacts of each alternative means of decommissioning WR-1. The assessment was conducted to inform CNSC's Indigenous rights impact assessment and the overall environmental assessment. Further information on the study is provided in Section 4.2.4.1.4 Sagkeeng's Psychosocial Impact Assessment. CNL had a brief check-in with Sagkeeng's Liaison Officer on November 2,

2020, and discussed a few potential engagement initiatives. The next step was to seek Chief and Council's direction on these engagement initiatives.

On November 3, 2020, CNL provided Sagkeeng with a briefing note highlighting monthly engagement activities with Sagkeeng. The monthly briefing notes are designed to provide Project and engagement updates to Sagkeeng's Chief and Council. This briefing note highlighted engagement activities that took place in September and October, provided Project updates, as well as a detailed Project timeline.

CNL, the CNSC, and Sagkeeng met on November 12, 2020, to discuss Sagkeeng's Psychosocial Assessment. During the meeting, Sagkeeng and Narratives Inc. presented an overview of their psychosocial assessment and highlighted key findings and recommendations from the report.

CNL received Sagkeeng's feedback on CNL's responses to Sagkeeng's comments on the draft EIS on November 16, 2020. CNL began their review of Sagkeeng's feedback and worked with Sagkeeng to schedule a time to discuss the comments on the EIS. Sagkeeng presented the Alternative Means Assessment on November 19, 2020, to CNSC and CNL. CNL and Sagkeeng's Liaison Officer met on November 25, 2020, to discuss future engagement initiatives. Meeting notes were provided to Sagkeeng's Liaison Officer.

Later that month, on November 26 and December 1, 2020, Sagkeeng's consultation engagement team met with CNL to review and discuss Sagkeeng's comments on the EIS in order to seek clarification and discuss CNL's proposed next steps for addressing Sagkeeng's comments. AECL and the CNSC were present at both meetings as observers. As part of the evolution and learning from our earlier engagement, CNL and Sagkeeng discussed Sagkeeng's comments on the EIS by theme. Each theme was associated with several comments from Sagkeeng. These themes included: psychosocial effects; consent for in situ disposal; the Alternative Means Assessment and alignment with IAEA guidance; community engagement; considering the Project under IAA 2019 versus CEAA 2012; consideration for historical land use and past grievances; and future land use. For each theme, CNL indicated its perspective on what was in scope of this EIS and what was out of scope of this EIS and provided a summary of CNL's understanding of Sagkeeng's concern to verify they understood Sagkeeng's concern correctly. CNL also provided for each theme, a summary of activities CNL has undertaken in an effort to address Sagkeeng's concern and outlined proposed next steps to test with Sagkeeng. During the meetings, Sagkeeng raised concerns about fear and stigma not being considered as a primary pathway in the EIS.

On November 30, 2020, CNL had a teleconference with the CNSC and Sagkeeng's lawyer to discuss Sagkeeng's funding needs going forward to continue with environmental assessment involvement.

On December 22, 2020, CNL sent a letter in response to Sagkeeng's Alternative Means Assessment report and a letter of response to Sagkeeng's Psychosocial Impact Assessment report. These letters propose recommended next steps on how CNL could work to address Sagkeeng's concerns. CNL also requested a meeting with the Chief and Council to better understand their concern and discuss CNL's recommendations.

On January 13, 2021, CNL sent Sagkeeng responses to Sagkeeng's comments on the draft EIS. On January 18, 2021, CNL sent a copy of the new sections of the EIS that discussed the considerations given to Sagkeeng's Alternative Means Assessment and psychosocial assessment reports. CNL followed up from the response letters on February 2, 2021. CNL will re-engage Sagkeeng to finalize these responses after submission of the draft EIS.

In February 2021, AECL hosted a leadership teleconference with representatives from Sagkeeng, CNL and the CNSC to discuss the principle of Free, Prior and Informed Consent (FPIC) in relation to the Project. During the meeting, Sagkeeng clearly expressed that according to its Anishinaabe law, and its understanding of international

law, its consent is required for the Project to proceed. CNL and AECL acknowledged Sagkeeng's perspective but disagreed, and indicated their willingness to work collaboratively with Sagkeeng, understanding that while consent is the preferred outcome, the Project will benefit from greater collaboration even where consent is not achieved. CNL and AECL believe that meaningful engagement and participation in decisions that affect Sagkeeng members, their community, and territory is critical to fostering understanding and identifying mutually acceptable opportunities in respect of the Project. The meeting led to further discussions between CNL and Sagkeeng in March 2021 regarding capacity funding to support more direct engagement with Sagkeeng members.

On February 20, 2021, CNL provided Sagkeeng with updated versions of Sagkeeng's Alternative Means Assessment write up in Section 2 of the EIS that incorporated Sagkeeng's feedback (see Section 2.8 for more information). On February 26, 2021, Sagkeeng provided additional feedback on the write up, which CNL incorporated into the revised copy for their review. On the same day, Sagkeeng also provided feedback on the Psychosocial Impact Assessment summary that is in Section 4.2.4.1.4 and the IER (CNL 2022). CNL incorporated Sagkeeng's feedback in both the Psychosocial Impact Assessment Write-up and the IER (CNL 2022).

In March 2021, CNL met with Sagkeeng's Chief and Council via teleconference to review Sagkeeng's engagement proposal to establish a community Liaison committee made up of select Sagkeeng members to be involved in the environmental assessment process for the Project.

In April 2021, senior leadership from CNL, AECL, and Sagkeeng's Chief and Council met to discuss Sagkeeng's Psychosocial Impact Assessment Report. The meeting marked a turning point in CNL's and Sagkeeng's relationship as both CNL and AECL recognized the findings of the Sagkeeng Psychosocial Impact Assessment Report and the trauma experienced by members in relation to the historical siting of the WL site. CNL, AECL, and Sagkeeng's leadership agreed to work collaboratively to develop and implement key initiatives recommended by Sagkeeng to help address the Nation's concerns regarding the Project and the Whiteshell Laboratories Closure Project. Sagkeeng recommended a Technical Working Group be developed to oversee the development of these initiatives.

Later in the month of April, Sagkeeng's Liaison's Officer visited the WL site to pick up new infographics regarding the Project for distribution around Sagkeeng's community. During the site visit, Sagkeeng's Liaison's Officer also participated in a refresher course on the Project. The infographics were distributed in central locations in Sagkeeng. On April 20, 2021, CNL invited Sagkeeng to participate in a WR-1 information webinar focused on the protection of the environment before, during, and after the WR-1 decommissioning.

In June 2021, Sagkeeng's consultation team and representatives from CNL and AECL participated in the first Technical Working Group meeting. The purpose of the Technical Working Group is to identify, develop, and implement initiatives that will help to address Sagkeeng's interests and concerns in a way that is meaningful to Sagkeeng. Four initiatives were identified including establishing a community liaison committee; a Healing and Resiliency Action Plan to address recommendations in Sagkeeng's Psychosocial Impact Assessment Report; an Indigenous-led CEMP; and a formal leadership table between Sagkeeng, AECL, and CNL. Sagkeeng, CNL and AECL also anticipate developing a long-term relationship agreement through the Technical Working Group. Through the Technical Working Group, Sagkeeng, CNL, and AECL drafted a Contribution Agreement to support the development of these initiatives. CNL and Sagkeeng also developed a subcommittee to work together to review and update EIS-related documents to accurately reflect Sagkeeng's position, interests, and concerns.

On June 24, 2021, CNL provided Sagkeeng with the summary table of Sagkeeng's interests and concerns and a list of the community's VCs on the Project. Sagkeeng provided feedback on July 14, 2021, on the list of VCs and

July 16, 2021, on the summary of interest and concerns table. After sending Sagkeeng a revised table which incorporated their feedback, Sagkeeng provided additional feedback on July 26, 2021, on the summary of interests and concerns table. CNL met with Sagkeeng on July 28, 2021, to review their summary of interest and concerns table and list of VCs. CNL incorporated Sagkeeng's feedback and sent the updated summary of interests and concerns table, the updated VC table and resent the Psychosocial Impact Assessment write-up to reflect sentiments shared at the leadership meeting discussion. Specifically, CNL recognizes that Sagkeeng has experienced a great deal of trauma and that the alienation between Sagkeeng and their traditional territory caused by the siting of the WL site and subsequent lack of engagement through the operations of the site has contributed to that trauma. Sagkeeng provided feedback on all three documents on August 23, 2021.

On the same day, Sagkeeng also provided substantial feedback on Section 2.0. After receiving this information, CNL and Sagkeeng met via teleconference on August 24, and September 7, 2021, to discuss Sagkeeng's comments on the reviewed EIS documentation. On August 31, 2021, CNL provided Sagkeeng with a marked-up copy of Section 2.0, at Sagkeeng's request. The first review meeting, on August 24, 2021, focused on discussing Sagkeeng's feedback on the Summary of Interests and Concerns table and the list of Sagkeeng's VCs. During the meeting, CNL demonstrated to Sagkeeng that CNL had incorporated Sagkeeng's recommended changes to the list of VCs. Sagkeeng did not have any additional edits to make on the list of VCs. Sagkeeng also recommended the VC list be a topic of discussion with their liaison committee once established. CNL will engage with the Sagkeeng Community Liaison Committee once established on Sagkeeng's list of related species and topics of interests. Any revisions to this table will be reported in future updates of the IER for the public record. The second meeting focused on discussing Sagkeeng's feedback on the Psychosocial Impact Assessment Write-up and general feedback on Section 2.0.

On September 14, 2021, Sagkeeng's Consultation Team and representatives from AECL and CNL held a Technical Working Group meeting to establish next steps to develop the priority initiatives to help address Sagkeeng's concerns on the Project. These initiatives include a Healing and Resiliency Plan, a CEMP that includes country foods monitoring and is closely tied to a community-driven risk communications program, and a community liaison committee.

On September 20, 2021, following the discussion with Sagkeeng's consultation team on the EIS sections, CNL provided an updated copy of the summary of interests and concerns table and Psychosocial Impact Assessment write-up that reflected Sagkeeng's additional feedback from the meetings on August 24 and September 7, 2021.

As a precursor to developing a Healing and Resiliency Plan, CNL, AECL, a representative from the CNSC, and Sagkeeng's Liaison Officer participated in a two-day trauma-informed engagement training session on September 22 and September 23, 2021. The training was hosted by Narratives Inc., the author of Sagkeeng's Psychosocial Impact Assessment Report, and took place in Winnipeg. The training in trauma-informed principles and methods of engagement included overview of the types of trauma(s). This included an understanding of the types of traumas, the symptoms of trauma, the impacts of trauma, the relationship between trauma and neurobiology, and responding to expressions of trauma. The training also highlighted the importance of being trauma-informed as well as trauma-informed principles, tools, and strategies. The training was customized to the unique needs of CNL, AECL, CNSC, and Sagkeeng. By taking this training, CNL, AECL, and the CNSC broadened their lens of what trauma means, gained a deeper understanding of the prevalence of trauma and its impact on Indigenous Nations, as well as understanding the importance of being trauma-informed and its relevance in organizational policies and procedures. Eleven participants from CNL, four participants from AECL, one participant from the CNSC, and Sagkeeng's Liaison officer participated in the training. Participants included Senior Site Officials, Engagement and Communication Officers, Managers, and Directors.

Afterwards, CNL hosted a debrief (November 1, 2021) on the trauma-informed engagement training with Sagkeeng, and the trainer and principle from Narratives Inc. After Narratives Inc. provided an overview of the training, CNL and Sagkeeng discussed how to use these teachings to develop a Healing and Resiliency Action Plan.

On September 29, 2021, Sagkeeng recommended, via e-mail, that CNL proceed with submitting the revised draft EIS with this version of the summary of interests and concerns table assuming CNL incorporated Sagkeeng's last feedback of the table. On October 6, 2021, CNL sent final copies for the summary of interest and concerns table and the list of VCs to Sagkeeng's leadership for their information and thanked Sagkeeng for their participation in validating CNL had accurately documented Sagkeeng's interest and concerns and list of VCs.

Through the months of October through December, CNL continued to verify information in the EIS related to Sagkeeng was adequately documented and a path forward is clearly defined. On October 13, 2021, Sagkeeng's consultation team confirmed that the latest version of CNL's write-up of Sagkeeng's Psychosocial Impact Assessment adequately captured Sagkeeng's position to the extent possible at this time. Sagkeeng confirmed that their findings and suggestions were incorporated. On the same day, CNL provided Sagkeeng and consultation with a final version of EIS Section 11.0 for their review. Sagkeeng provided their feedback on Section 6.7 and Section 11.0 on November 1, 2021.

General engagement and outreach activities continued with Sagkeeng. On October 14, 2021, CNL provided Sagkeeng's Liaison Officer with a copy of a Sagkeeng's fall engagement newsletter for review prior to sending it to Sagkeeng leadership. In addition, CNL provided Sagkeeng with a revised version of EIS Section 6.7 for review and verification that CNL had adequately incorporated Sagkeeng's interests and concerns related to environmental and human health.

During this time, CNL, AECL, and Sagkeeng began discussing and developing a Technical Working Group; a mechanism where the parties can discuss and resolve issues of mutual interest and concern. On October 20, 2021, CNL provided Sagkeeng with a copy of the Contribution Agreement that was developed to support the Technical Working Group, for their review and feedback. CNL also sent Sagkeeng's leadership a fall engagement update newsletter on October 20, 2021.

On November 3, 2021, CNL provided Sagkeeng with a copy of the revised Section 2.0 to show how CNL had incorporated Sagkeeng's feedback. Where integration was not possible, CNL provided a detailed explanation for why CNL was not able to incorporate Sagkeeng's comment. On November 4, 2021, CNL received confirmation from Sagkeeng to proceed with incorporating Section 2.0 into CNL's submission package. For the record, Sagkeeng has not endorsed all of Section 2.0 and has indicated that Sagkeeng will review and comment overall refiled EIS, including on the adequacy of incorporation of Sagkeeng inputs, when it comes out formally, and report Sagkeeng's findings to the Federal-Provincial Indigenous Review Team.

A meeting of the Technical Working Group was convened on Nov 10, 2021 and the focus was on environmental monitoring. CNL delivered a presentation on the site's environmental protection program and Sagkeeng delivered a presentation on the proposed CEMP.

The EIS review continued through this period. On November 15, 2021, Sagkeeng and CNL met with the EIS subcommittee of the Technical Working Group to discuss Sagkeeng's comments on Section 6.7 and Section 11.0. On November 18, 2021, CNL asked Sagkeeng to review Section 6.8 to make sure that CNL had documented Sagkeeng's information correctly. CNL sent Section 4.0 on November 26, 2021 and requested that Sagkeeng

review to confirm CNL had documented Sagkeeng's interests and concerns correctly. CNL provided Sagkeeng with Section 6.9 on November 30, 2021 and requested Sagkeeng review to confirm CNL had documented Sagkeeng's information correctly.

On November 30, 2021, CNL, AECL, and Sagkeeng signed an MOU, which supported the development of a liaison committee, the development of scopes of work for a CEMP, a Healing and Resiliency Action Plan, and a leadership table.

December focused on receipt of EIS feedback and further discussion and exploration of an independent Sagkeeng Guardianship Program. On December 8, 2021, Sagkeeng provided feedback on Section 6.8 and on December 14, 2021, CNL received feedback from Sagkeeng on Section 6.9. On December 15, 2021, Sagkeeng presented on the Guardianship Programs and how CNL and Sagkeeng could incorporate similar elements into monitoring at the WL site.

A teleconference held by CNL on January 5, 2022 to go over Sagkeeng's comments on Section 4.0 and to confirm that the list of interests and concerns was complete. On January 31, 2022, CNL sent Sagkeeng a revised copy of Section 4.0 and Section 6.7. Both copies were provided in track changes with detailed responses to each of Sagkeeng's comments.

CNL sent the Indigenous Advisory Committee terms of reference to Sagkeeng's consultation team for their review and input. On that same day, Sagkeeng provided CNL with drafts of Sagkeeng's independent CEMP and their Healing and Resiliency Action Plan. The development of the CEMP would become a priority for CNL and Sagkeeng for coming months. On February 22, 2022, the Technical Working Group discussed Sagkeeng's scope of work for a Sagkeeng-led CEMP and on March 2, 2022, Sagkeeng provided an overview of the Healing and Resiliency Action Plan. On March 3, 2022, CNL and AECL provided Sagkeeng with written feedback on the CEMP scope of work.

On March 9, 2022, CNL, AECL, and Sagkeeng held further discussions on Sagkeeng's scope of work for the CEMP. CNL and AECL provided Sagkeeng with formal written feedback on the scope of the CEMP on March 15, 2022. Meanwhile, on March 22, 2022, two CNL representatives met with Sagkeeng's community liaison committee to get to know each other and learn a bit more about the Project.

The period of April, May, and June 2022 focused on EIS updates to the interests and concerns tables and further understanding and development of the Sagkeeng's independent CEMP. On April 6, 2022, CNL and Sagkeeng discussed Sagkeeng's scope for the CEMP and repackaging of Sagkeeng's interest and concerns table. On April 11, 2022, CNL sent Sagkeeng their repackaged interests and concerns table for review. On May 10, 2022, CNL and Sagkeeng went through Sagkeeng's revised interest and concerns table and discussed the upcoming in-person workshop (CEMP). On May 20, 2022, CNL and Sagkeeng met to discuss the logistics of the CEMP workshop. On June 9, 2022, CNL and Sagkeeng discussed the interest and concerns table as well as the agenda for the CEMP workshop. On June 13, 2022, CNL asked Sagkeeng to confirm that they have reviewed and verified their interest and concerns table.

The efforts to develop a collaborative CEMP were further explored in a workshop held on June 15 and16, 2022, in Winnipeg. CNL and Sagkeeng representatives met in-person to negotiate a CEMP that would increase Sagkeeng's role (and the role of Anicinabe Traditional Knowledge) in the monitoring of the WL site and surrounding areas, supporting the reduction of fear and stigma at the site. The two-day meeting culminated with an agreement in principle to support the development and execution of an independent Sagkeeng CEMP over the next 5 years.

The parties determined that they would implement workshop action items and reconvene the Technical Working Group in the fall. On June 16, 2022, Sagkeeng confirmed during the workshop, that the interests and concerns table reflects the community's interest and concerns, as well as the status of those concerns.

On July 11, 2022, CNL provided a draft copy of the Contribution Agreement for the Sagkeeng CEMP and Olthuis Kleer Townshend LLP, Sagkeeng's lawyers, provided a revised copy of the draft Contribution Agreement for CNL and AECL's review. CNL continued to develop their relationship with Sagkeeng's Community Liaison Committee by hosting an on-site tour of the WR-1 facility and the WL site, lunch, and a general discussion. CNL followed up with material requested by the Committee. Subsequently, the parties continue to refine the Contribution Agreement for the Sagkeeng CEMP.

In August and early September, CNL held teleconferences with Sagkeeng to discuss the renewal of the Technical Working Group budget and develop a path forward for invoicing. On August 20, 2022, Sagkeeng asked CNL if they would have any objections to Sagkeeng communicating to community members that an agreement in principle has been reached on the Sagkeeng CEMP. CNL responded that day, supporting sharing this news with the community. On August 25, CNL met with Sagkeeng representatives to discuss Sagkeeng's revised Technical Working Group budget and specifically the Line Item 9 the Negotiation of a Healing and Resiliency Action Plan. At that time CNL expressed an interest to defer discussions until it was better understood and instead, focus efforts on the Sagkeeng CEMP. Sagkeeng representatives believed that this was a community priority. The parties agreed to discuss the earlier provided Healing and Resiliency Plan with at an upcoming Technical Working Group meeting. CNL sent a copy of CNL's environmental monitoring program schedule on August 30, 2022, and requested Sagkeeng to identify any potential activities they want to participate in.

CNL held teleconferences with Sagkeeng in August and September 2022 to discuss the renewal of the Technical Working Group budget and develop a path forward for invoicing. CNL and Sagkeeng discussed invoicing at the Technical Working Group meeting on September 7, 2022, and agreed that CNL would provide seed funding to support execution of the Contribution Agreements, and that Sagkeeng would invoice subsequently. On a phone call on September 27, 2022, CNL and Sagkeeng resolved finance/invoicing concerns. CNL would provide upfront payments, with follow-up invoices submitted from Sagkeeng triggering further payments. The parties went through a discussion of outstanding agreement payments.

September focused on finalizing Sagkeeng's Independent CEMP. On September 6, 2022, CNL sent Sagkeeng the revised Contribution Agreement to support Sagkeeng's Independent CEMP for their review and feedback. Discussion of the CEMP Budget and supporting scope of work document also occurred at the Technical Working Group meeting on September 7, 2022, where clauses of the agreement and funding structure were discussed. On September 13, 2022, CNL transmitted their final comments and changes to Sagkeeng on the scope of work and a Contribution Agreement for Sagkeeng's CEMP. On September 20, 2022, CNL received an e-mail from Sagkeeng indicating their acceptance of CNL tracked changes and providing notification that the document will be forwarded to Chief and Council for execution. As of September 30, 2022, the parties are preparing a joint 3-party press release to announce this exciting initiative. The CEMP was initiated to help reduce Sagkeeng's fear and the stigma associated with the WL site.

4.2.4.1.2 Interests and Concerns

Sagkeeng and CNL have been engaging on the Project since 2016, which has led to the identification of the interests and concerns held by Sagkeeng. This subsection is a summary of the interests and concerns and describes CNL's understanding based on written submissions and oral discussions with Sagkeeng. Sagkeeng

provided 38 formal comments on the 2017 and 2020 draft EIS. Sagkeeng also provided feedback during engagements including the Technical Working Group where Sagkeeng has shared their position on topics related to the Project and the Whiteshell Laboratories Closure Project and through the subcommittee where Sagkeeng shared feedback on sections of the EIS. Sagkeeng has also provided feedback via their Traditional Knowledge and Land Use and Occupancy Study (Firelight 2018), the harvester consumption survey (CNL 2018), their Alternative Means Assessment Report (Sagkeeng Anicinabe and Firelight 2018), and their Psychosocial Impact Assessment Report (Narratives 2020). CNL has made its best efforts to document and verify Sagkeeng's interests, concerns and perspectives.

Relationship Building

Sagkeeng and CNL are working together to develop a positive and lasting relationship.

Sagkeeng requested a meeting with CNL and AECL leadership to discuss concerns regarding CNL's response to Sagkeeng's Psychosocial Impact Assessment Report. This meeting took place on April 6, 2021. During the call, CNL offered a sincere apology for its approach and response to the report. CNL and AECL recognized the findings of Sagkeeng's Psychosocial Impact Assessment Report and the trauma experienced by Sagkeeng members in relation to the historical siting and operations of the WL site. CNL and AECL also recognized Sagkeeng as stewards of the land and waters and committed to working with Sagkeeng to develop and implement recommendations arising from the report and the April 6, 2021 dialogue.

CNL received a follow-up letter from Chief Henderson on April 22, 2021, stating the leadership meeting was productive, and the apology and acknowledgements provided in the meeting were meaningful to Sagkeeng. The letter reiterated Sagkeeng's preferred path forward for working together with CNL and AECL. This included establishing a Technical Working Group between AECL, CNL, and Sagkeeng to implement the following initiatives:

- Development of a community advisory committee;
- Development of a healing and resiliency action plan;
- Development of a leadership table among Sagkeeng, AECL and CNL; and
- Development of a meaningful Sagkeeng Indigenous monitoring program at and around the WL site.

The Technical Working Group meets monthly to support ongoing, constructive dialogue to develop and implement the above initiatives. The Technical Working Group has also formalized a Contribution Agreement to provide funding for the first year of activities that will form the basis of a long-term relationship agreement.

CNL expects that the relationship will continue to grow and improve after the submission of the EIS and implementation of Sagkeeng's CEMP and other initiatives.

Site Management Structure/Roles and Responsibilities

In their review on the 2017 and 2020 draft EIS, Sagkeeng requested CNL provide information on the nature of the contractual relationship between Canada and Canadian National Energy Alliance (CNEA), and the financial terms between Canada and CNEA, with emphasis on any incentives or penalties related to the schedule and budget of the proposed undertaking. Sagkeeng also requested information on the respective responsibilities of Canada, CNL, CNEA, and other parties for the environmental liabilities at the WL site, both now and in the future, and the respective responsibilities of Canada, CNL, CNEA, and other parties to fulfill the fiduciary obligations of Canada to Sagkeeng as they pertain to the proposed undertaking.

Sagkeeng expressed the position that the current application fails to meet both of these requirements and is inconsistent with the federal government's commitment to meaningful reconciliation with Indigenous peoples. Sagkeeng indicated that Canada cannot waive its fiduciary duties to: a) honour its prior commitment to remove the radioactive wastes from Sagkeeng lands; and b) ensure Indigenous interests and Aboriginal and Treaty rights are fully considered and protected. Sagkeeng expressed an interest in the history of CNL and how CNL relates to AECL and the WL site.

CNL has shared formal responses to these questions and concerns in January 2020, October 2020, and January 2021. In those responses, CNL explained that information on the financial terms of the CNEA contract could not be shared, as it is commercially sensitive. At this time, Sagkeeng does not accept CNL's position that the financial terms of the CNEA contract cannot be disclosed.

CNL provided an overview of the history of the site and explained that Whiteshell Laboratories is a government-owned and contractor-operated facility. The WL site, including all assets and liabilities, is owned by AECL, a federal government Crown corporation. AECL contracted CNL to operate the facility and perform the decommissioning work. While the ownership of CNL may change (CNEA is the current owner of CNL), CNL will remain the operator and licensee for all AECL sites. For questions related to the duty to consult and reconciliation, CNL referred Sagkeeng to the CNSC and Crown who hold the duty to consult.

CNL has taken steps to address this area of interest to the extent it believes is possible. Should this matter remain a priority area of concern for Sagkeeng, CNL would be prepared to re-engage to provide any further clarifications on their perspective.

Engagement

Sagkeeng had expressed concerns with the lack of meaningful and responsive engagement by CNL in January 2018 and requested a greater role in reviewing draft documentation related to the EIS. Sagkeeng also requested greater involvement in the implementation of the decommissioning plans for WR-1 and into the institutional control period. The community noted that technical results are difficult to understand and that CNL should consider methods to ensure that future updates about the Project will be understandable to community members. Sagkeeng suggested that CNL work with the Chief and Council to promote future engagement activities with the community. In addition, it would make sense to invite on-reserve members by going door to door.

Sagkeeng requested CNL commit funding to support the development and implementation of an Indigenous-led risk communication program designed to improve Indigenous understanding of the site and vicinity risk to the health and edibility of country food and water sources (including radiation, impact pathway identification, monitoring results, and plain language reporting about the safety of country food and water sources), as well as sharing CNL's annual reports with the community.

To help facilitate greater engagement with Sagkeeng, CNL, Sagkeeng, and AECL have established a Technical Working Group to resolve outstanding concerns and work collaboratively on areas of interest by developing and implementing initiatives that will help address Sagkeeng's concerns on the Project. An agreement was drafted to support Sagkeeng's continued engagement on the Project. CNL will continue to engage meaningfully with Sagkeeng Chief and Council, community members, their engagement team, and their Liaison through the lifecycle of this Project.

During the COVID-19 pandemic, CNL continued to engage Sagkeeng through their consultation team using teleconferences. As circumstances permit, CNL has expanded its engagement focusing on engaging with more

of Sagkeeng's membership. CNL and Sagkeeng have also engaged through a subcommittee focused on verifying that EIS documentation accurately reflects Sagkeeng's interests and position.

Sagkeeng acknowledges that CNL has substantively and meaningfully engaged with it on the WR-1 Project and expects that engagement to continue.

Historical Siting and Operations of the Whiteshell Laboratories Site

Sagkeeng identified concerns regarding the lack of engagement during the siting and operations of the WL site. Sagkeeng has also expressed concern that CNL does not adequately consider associated cumulative effects in the EIS. More specifically, Sagkeeng has asked CNL to integrate into the baseline, information on the pre-existing cumulative effects context, especially for Sagkeeng rights, cultural practices, and traditional land and resource use, Sagkeeng believes that cumulative effects should include historical changes to their territory and potential impacts to Sagkeeng's rights.

CNL and Sagkeeng are working through a subcommittee to review EIS documentation to incorporate Sagkeeng's feedback as much as possible. Regarding Sagkeeng's concern on historical cumulative effects, the issue remains outstanding and unresolved as Sagkeeng disagrees that adequate steps have been taken on this issue. From CNL's perspective, this concern is out of scope of the environmental assessment but commits to supporting a dialogue on historical siting of the WL site between AECL and Sagkeeng, through the Technical Working Group.

Free Prior and Informed Consent (FPIC)

Sagkeeng's view is that the Project must adhere to FPIC and requested that CNL agree to incorporate community consent into the Project, which could be provided in the form of a community vote or other form of consent provision process to be determined by the Sagkeeng community. Sagkeeng's position is that Article 29(2) of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) creates a legally binding requirement to secure Sagkeeng's free, prior and informed consent prior to proceeding with the proposed Project, which will convert the WR-1 site to a permanent hazardous waste disposal facility.

In February 2021, AECL hosted a leadership teleconference with representatives from Sagkeeng, CNL and the CNSC to discuss the principle of FPIC in relation to the Project. During the meeting, CNL and AECL acknowledged Sagkeeng's perspective and indicated their willingness to work collaboratively with Sagkeeng, understanding that while consent is the preferred outcome, the Project will benefit from greater collaboration even where consent is not achieved. CNL and AECL believe that meaningful engagement and participation in decisions that affect Sagkeeng members, their community, and territory is critical to fostering understanding and identifying mutually acceptable opportunities in respect of the Project. The meeting led to further discussions between CNL and Sagkeeng in March 2021 regarding capacity funding to support more direct engagement with Sagkeeng members.

CNL shared with Sagkeeng that while their consent is not required, CNL is working towards achievement of that principle to the extent possible. CNL and Sagkeeng have signed a Contribution Agreement to support Sagkeeng's engagement in the environmental assessment process. CNL continues to seek direction from the community, and work closely with the Liaison, to strengthen engagement with Sagkeeng community members. CNL has made efforts to address this area of interest to the extent possible. CNL is prepared to continue discussing and responding to Sagkeeng's concerns on this issue.

This issue remains outstanding as Sagkeeng continues to maintain its position that Article 29(2) of UNDRIP creates a requirement to secure Sagkeeng's free, prior and informed consent prior to proceeding with the proposed Project.

Rights Impact Assessment

Sagkeeng expressed concern that there was a lack of assessment of potential impacts on Aboriginal and Treaty rights, and their ability to practice their rights in the future. CNL has documented Sagkeeng's concerns and preferred method of decommissioning the WR-1 and defers to the results of CNSC's rights impact assessment for a conclusion on whether Aboriginal and Treaty rights are impacted by this Project. The next step is to engage with Sagkeeng through the Technical Working Group to resolve outstanding concerns and work collaboratively on areas of interest.

Sagkeeng's position remains that the EIS and the approach to engagement should be held to the highest current standard of impact assessment, which is now the *Impact Assessment Act*.

Psychosocial Impact Assessment

Sagkeeng has expressed in their Psychosocial Impact Assessment Report (Narratives Inc. 2020) that the WR-1 ISD option is likely to have incremental adverse psychosocial effects on Sagkeeng's membership, greater than those from other alternative decommissioning means. Sagkeeng's Psychosocial Impact Assessment Report states that CNL must address impacts resulting from past trauma, including the 1960s construction of the WL site, the perception of environmental effects, and the perception that illnesses may be connected with environmental effects.

CNL's leadership held a teleconference with leadership from Sagkeeng and AECL to discuss Sagkeeng's Psychosocial Impact Assessment Report. During the call, CNL offered a sincere apology for its approach and response to the report. CNL and AECL recognized the findings of Sagkeeng's Psychosocial Impact Assessment Report; more specifically, that the current proposal for ISD is Sagkeeng's least preferred option from a psychosocial impact perspective. In addition, both parties recognized the trauma experienced by Sagkeeng members in relation to the historical siting and ongoing presence of the WL site. Finally, CNL and AECL recognized and acknowledged Sagkeeng as stewards of the land and waters and committed to working with Sagkeeng to develop and implement recommendations arising from the report and the April 6 dialogue. CNL has summarized the psychosocial impact assessment write-up in Section 4.2.4.1.4.

CNL is committed to working collaboratively with Sagkeeng on developing and implementing the initiatives that will help address Sagkeeng's concerns. These initiatives include the development of a healing and resiliency action plan, which can include or be closely tied to a community-driven risk communication program focused on the health of country foods and waters; an independent Sagkeeng CEMP; a community liaison committee; and a leadership table. CNL, AECL, and Sagkeeng have an agreement in place to support the development of these initiatives. CNL, AECL, the CNSC, and Sagkeeng's Liaison Officer took trauma-informed engagement training as a precursor to developing a Healing and Resiliency Action Plan. The next step is to engage with Sagkeeng through the Technical Working Group to discuss the Healing and Resiliency Action Plan and what is within scope to resolve outstanding concerns and work collaboratively on areas of interest.

Sagkeeng remains concerned that the results of the Psychosocial Impact Assessment Report have not been adequately integrated into the effects assessment for human health, well-being and current use of lands and resources for traditional purposes.

Valued Components

Sagkeeng suggests that the draft EIS has neglected to consider the full scope of Sagkeeng's VCs within its assessment, which are necessary for the continued practice of Sagkeeng culture and livelihoods.

The VCs identified within the Sagkeeng Traditional Knowledge and Land Use Study (TKLUS; Firelight 2018) are: water; medicine, berries and other food plants; hunting and trapping; and Anicinabe Pimatiziwin. As detailed in the TKLUS in Section 3.1 (p. 22), "the VCs were chosen to represent the critical conditions or elements that must be present for the continued practice of Sagkeeng culture and livelihoods, and that may be impacted by the Project. As such, VCs can range from the direct presence of traditionally hunted animals and gathered plants, to continued habitation, travel, and cultural activities on the land."

CNL collected Sagkeeng species and topics of interest from their TKLUS, Alternative Means Assessment, Psychosocial Impact Assessment, general engagement, and verification discussions. The collected information regarding VCs helped CNL assess whether they had considered the effect pathway to those specific VCs in the assessment for the Project. CNL worked with Sagkeeng to verify the list of VCs below accurately captures, to the extent possible, Sagkeeng's species and topics of interest. Sagkeeng provided two rounds of feedback and met with CNL on July 28 and August 24, 2021 to revise the list based on Sagkeeng's feedback. CNL will engage with the Sagkeeng Community Liaison Committee once established on Sagkeeng's list of related species and topics of interests. Any revisions to this table will be reported in the IER for the public record.

The following list is CNL's understanding of related Sagkeeng species and topics of interest:

- grouse, geese;
- food (e.g., wild rice, wild ginger, blueberries, plums, raspberries, strawberries, pin cherries, Saskatoon berries, low-bush cranberries, gooseberries, chokecherries) and Traditional Medicines (names not included at Sagkeeng's request);
- furbearers, marten, rabbit, squirrel, weasel;
- white-tailed deer, moose, elk;
- sturgeon and sturgeon spawning grounds, sucker, catfish, pickerel, goldeye, sunfish, whitefish, perch, carp, pike, bass, and fish habitat including the Winnipeg River;
- water resources and the Winnipeg River;
- beaver, muskrat, otter;
- groundwater and groundwater interaction with surface waters in the Winnipeg River;
- water resources; drinkable water (i.e., Sagkeeng willingness to drink water directly from the land); Winnipeg River;
- employment and business opportunities; community psychological well-being; environmental and community safety; sense of safety and security on the lands and waters; risk perception regarding the consumption of country foods;
- hunting and trapping; Sagkeeng Anicinabe governance and stewardship, including in relation to protecting and monitoring the land, land tenure and future use; culture and archaeological sites; Anicinabe Pimatiziwin (a complex value which includes tangible, semi-tangible and intangible elements including but not limited to

connectedness to land and waters; spirit and spiritual practices/ceremony, knowledge of Sagkeeng territory, inter-generational knowledge transfer, among other cultural continuity factors); Winnipeg River; traditional harvesting of country foods; and

- traditional harvesting of country foods.

CNL has revised subsection of Section 6.0 to clearly reflect how VCs from First Nations and the Manitoba Métis Federation were considered for each effects assessment, where applicable.

Business and Employment Opportunities

Sagkeeng expressed an interest to know more about CNL's procurement policies and potential economic participation opportunities associated with the Whiteshell Laboratories Closure Project, including qualifications. Priority employment and contracts were identified as an important concern and area of interest for Sagkeeng. Sagkeeng also raised the possibility of a certain percentage of the work going to Indigenous companies.

Sagkeeng requested first preference for new or vacant positions and requested a commitment for training to enhance the skills of community members.

CNL adjusted the evaluation criteria for competitive bids to encourage economic participation by contractors that are Indigenous owned or have Indigenous employees or subcontractors. CNL has also sent job postings to Sagkeeng since approximately the mid-1990s. Sagkeeng has provided new contact information (December 12, 2019) and this has been provided to CNL Human Resources for use effective immediately. CNL would welcome applicants from Sagkeeng and will work with Sagkeeng to see how CNL can improve interest and success in recruiting. CNL sent a listing of current and potential future external vacancies as well as criteria for security clearances to Sagkeeng. To help facilitate information sharing, capabilities and opportunities, CNL also supported three "Industry Days" events to connect businesses with invited First Nations and the Manitoba Métis Federation. The industry days were held in Winnipeg, another at the WL site, and a third at the Sagkeeng First Nation Arena. CNL is developing an Indigenous Procurement Strategy to support and enable Indigenous owned business to economically participate in the Whiteshell Laboratories Closure Project.

CNL remains open to procuring Indigenous owned businesses for Project supply chain and enabling involvement in Project work by Indigenous companies. CNL and Sagkeeng will also discuss the current evaluation criteria once Sagkeeng has had an opportunity to review the information. CNL, Sagkeeng, and AECL have established a Technical Working Group to resolve outstanding concerns and work collaboratively on areas of interest such as Business and Employment Opportunities.

Future Land Use and Tenure (End State Planning for the Whiteshell Laboratories Site)

Sagkeeng requested more information regarding future compensation for the Local Government District of Pinawa and the First Nation since portions of the WL site is in Treaty 1 territory. Sagkeeng also requested that all site clean-up and release criteria and deviation of the desired end-state(s) for the Whiteshell Reactor Disposal Facility be developed collaboratively with Sagkeeng. Sagkeeng confirmed their interest in participating in a WL end-state workshop. Sagkeeng asked what impact small modular reactors might have on the site. Sagkeeng reinforced the importance of an Indigenous Liaison or Monitor to provide information back to the community on what will remain in the trenches.

In addition, Sagkeeng requested to be more involved in the drafting and implementation of plans for the duration of decommissioning and into the institutional control period, including the participation in the development and/or

review of documents such as the Environmental Risk Assessment, Detailed Decommissioning Plans and final safety assessment for the remediation of the trenches, as well as an appropriate institutional control framework.

CNL explained that the liability and land remain under the ownership of AECL. CNL and AECL will engage Sagkeeng to discuss potential future uses of the WL site.

CNL also provided information on the community regeneration partnership that was formed to develop both nuclear and non-nuclear opportunities for the WL site after the site is decommissioned. CNL participates in and supports the partnership and has invited Indigenous communities to join. Sagkeeng began sending representatives to these meetings.

CNL committed to engaging bilaterally with Sagkeeng and other First Nations, the Manitoba Métis Federation, local communities and stakeholders to co-develop future land use objectives, as well as engage on the end-state of the WL site as part of Whiteshell Laboratories Closure Project. CNL, Sagkeeng, and AECL have established a Technical Working Group to resolve outstanding concerns and work collaboratively on areas of interest. CNL will continue to engage meaningfully with Sagkeeng Chief and Council, community members, their engagement team, and their Liaison through the lifecycle of this Project.

Waste Management

Sagkeeng raised concerns and questions regarding how much radioactive waste would remain on the WL site and where and how that radioactive waste was being transported off-site. In response, CNL informed Sagkeeng that all waste materials (radioactive and non-radioactive) are sorted, verified, and transported using licensed containers, depending on the waste type, to a licensed hazardous waste management facility. CNL expects that approximately 2000 truckloads will need to be shipped throughout the Whiteshell Laboratories Closure Project. CNL explained that the used fuel baskets contained in the concrete canisters will be placed in a transportation flask and transported by truck. CNL also explained that radioactive material has been transported between CNL's WL site and Chalk River Laboratories site for many decades without a single radiological incident. Transportation of radioactive materials is a highly regulated activity that must meet the stringent requirements of both Transport Canada (Transportation of Dangerous Goods) and the Canadian Nuclear Safety Commission (Packaging and Transport of Nuclear Substances Regulations) prior to approval. CNL's approved Radioactive Material Transportation Program (CNL 2021) is in place to protect persons, property, and the environment from the effects of radiation during the transport of radioactive material. CNL also provided details on site waste management and waste characterization in response to Sagkeeng's comments on the 2017 and 2020 draft EIS.

Sagkeeng expressed that it would be best if all waste from WR-1 were removed from the WL site. In general, Sagkeeng expressed substantial and consistent concerns regarding deviation from the Comprehensive Study Report (AECL 2001), which proposed full removal of WR-1.

CNL has taken steps to address this area of interest to the extent possible. Sagkeeng and CNL disagree on the preferred approach to decommissioning for WR-1, based on the findings of their respective Alternative Means Assessments. CNL, Sagkeeng, and AECL have established a Technical Working Group to resolve outstanding concerns and work collaboratively on areas of interest. CNL will continue to engage meaningfully with Sagkeeng Chief and Council, community members, their engagement team, and their Liaison through the lifecycle of this Project.

Future Monitoring

Sagkeeng expressed an interest in learning about future monitoring of the site, including the duration of monitoring activities and where monitoring would occur. In particular, Sagkeeng thought that there should be monitoring at locations where members fish, and monitoring locations closer to the community. Sagkeeng also expressed concern that a lack of Traditional knowledge informed environmental monitoring and explained that Indigenous environmental monitoring was a critical element of Sagkeeng stewardship and Indigenous-led risk communication with members. Sagkeeng requested a commitment from CNL regarding an independent, long-term future monitoring program to be designed and led by Sagkeeng (a Community Environmental Monitoring Program).

CNL and Sagkeeng have both agreed that Sagkeeng's involvement in monitoring could help address other concerns including reducing fear and stigma of the site regarding the proposed ISD for WR-1 and improved faith in country foods and understanding of the environment and effects from the WL site, through collection of baseline and trend-over-time Traditional Knowledge in a dedicated, continuous fashion. CNL committed to establishing a Community Environmental Monitoring Program with Sagkeeng. CNL has agreed to work with Sagkeeng through a Technical Working Group to establish a CEMP that will include Indigenous-led risk communication and country foods monitoring with Sagkeeng members. These commitments are also referenced in Section 11.4 'Indigenous Engagement and Participation in Environmental Monitoring'.

In addition, CNL sent Sagkeeng CNL's 2020 summer and fall monitoring schedule and supported Sagkeeng's Liaison Officer's participation in on-site environmental monitoring activities. In June 2022, Sagkeeng, CNL and AECL agreed in principle to support Sagkeeng's Independent CEMP . The parties have developed a budget and agreed on a scope of work, and in the fall of 2022, Sagkeeng will begin execution of the monitoring work plan.

Fish, Fish Habitat, and the Winnipeg River

Sagkeeng expressed concern about the perceived deterioration of fish quality in the Winnipeg River. This included the observation of unusual sores on some fish. Sagkeeng also expressed an interest in being more involved in water quality and fish monitoring on site.

In late 1994, the Winnipeg River Task Force was created. Representatives from Indian and Northern Affairs Canada, Environment Canada, Health Canada, and Sagkeeng took part in the Task Force. The objective of the Task Force was to look at potential sources of Winnipeg River water quality degradation near the community of Sagkeeng. The Task Force report concluded that the drinking water quality met Canadian guidelines and that it was unlikely that the WL site had ever posed or would pose a significant threat to the health of Sagkeeng community members.

CNL has committed to the development and execution of an independent CEMP with Sagkeeng. CNL has agreed to work with Sagkeeng through a Technical Working Group to establish this CEMP that will include Indigenous-led risk communication and country foods monitoring with Sagkeeng members. These commitments are outlined in Section 11.4.

Regulatory Process

Sagkeeng expressed concern regarding limited funding provided by CNSC for review and participation in the Project. In addition, Sagkeeng expressed an interest in further opportunities for involvement in the Project.

In order to ensure meaningful engagement on the Project, CNL provided capacity funding and support to Sagkeeng beyond the funding provided by CNSC and committed to providing funding to Sagkeeng as needed throughout the environmental assessment process.

CNL considers this concern addressed to the extent possible at this time and will work with Sagkeeng should funding concerns arise.

In Situ Disposal Design of WR-1

Sagkeeng expressed that they are not confident that the proposed decommissioning method for the Project is adequate or preferable. Sagkeeng's position is that WR-1 should be dismantled as described in the 2001 Comprehensive Study Report (AECL 2021). Sagkeeng expressed an interest in understanding how the grouted encapsulation would maintain its integrity into the future. Topics of interest to Sagkeeng included the potential for climate change and natural disasters to affect the integrity of the grouted encapsulation and how it would be constructed to ensure that it is safe. Participants at the community open house were interested in various aspects of the Project. Questions were asked regarding the existence of similar projects, the differences in costs between the original removal decommissioning plan and the ISD and the safety of ISD in connection with the environment. CNL discusses the cost of all the alternatives in more detail in Section 2.6.2 (Economic Feasibility).

CNL provided a detailed response on how the different barriers of the in situ design ensure the waste is properly contained and isolated from the environment. This was done through written responses, in January 2020, October 2020, and January 2021, to Sagkeeng's draft EIS comments, through presentations to community members and consultants, and through dialogue at community and leadership meetings. CNL also provided additional information on the safety case as well as the grout formulation and process.

This issue remains outstanding. CNL respects that Sagkeeng has a different opinion on the most suitable decommissioning approach for WR-1. CNL will continue to submit the EIS for the Project through the environmental assessment process while supporting Sagkeeng's continued participation in the environmental assessment process. CNL and Sagkeeng recognize this difference of perspectives, and have committed to work collaboratively with each other to mitigate outstanding concerns related to this topic, to the extent possible.

Traditional Knowledge and Land Use and Cultural Heritage

Sagkeeng expressed an interest in conducting a traditional use study as they identified specific traditional uses in proximity to the Project study area and the larger WL site. Specifically, Sagkeeng identified that wild rice and medicinal plants are collected by Sagkeeng members in the area near the WL site. CNL and CNSC agree that a Traditional Knowledge study is an important input to the EIS and the Rights Impact Assessment (led by CNSC and Sagkeeng). Therefore, CNL supported Sagkeeng's TKLUS and incorporated findings into the revised draft EIS. CNL also partnered with Sagkeeng to complete a traditional food consumption study, of which 35 members of the community responded, helping CNL confirm that the Harvester model is a conservative model for modern day Indigenous people that rely on harvesting for some of their food.

Sagkeeng suggested that the draft EIS was inadequate based on a lack of meaningful engagement with Sagkeeng in establishing a baseline or conducting an effects assessment or in considering Sagkeeng VCs. Sagkeeng noted that the way the draft EIS was completed was not in keeping with the expectations for acceptable practice established by the Crown in the manner of assessing traditional land use and the assessment should have considered historic/cumulative issues. Sagkeeng expressed the position that the spatial boundaries of the assessment are inappropriate for assessing potential impacts to the current use of lands and resources for

traditional purposes). Sagkeeng expressed the position that CNL effectively ignored critical factors that influence decisions by land users, relying entirely on biophysical factors while ignoring Indigenous observations and perceptions critical to use (and loss of use) of areas of traditional territory.

In response to Sagkeeng's above feedback, CNL collected Sagkeeng species and topics of interest from their TKLUS (Firelight Research and Sagkeeng 2018), Alternative Means Assessment (Sagkeeng and Firelight 2020), Psychosocial Impact Assessment (Narratives 2020), general engagement and verification discussion. The collected information regarding VCs helped CNL assess whether they had considered the impact pathway to those specific VCs in the assessment for the Project. CNL worked with Sagkeeng to verify the list of VCs accurately captures, to the extent possible, Sagkeeng's species and topics of interest. Sagkeeng provided two rounds of feedback and met with CNL on July 28 and August 24, 2021, to revise the list based on Sagkeeng's feedback. CNL will engage with the Sagkeeng Community Liaison Committee once established on Sagkeeng's list of related species and topics of interests. Any revisions to Sagkeeng's VCs will be reported in future updates for the public record. CNL has revised each subsection of Section 6.0 to clearly reflect how VCs from Indigenous communities were considered for each effects assessment. CNL has also revised Section 6.8 to include information from Sagkeeng's TKLUS.

In Sagkeeng's review of Section 6.8 (Land and Resource Use), Sagkeeng stated the use of a "Base Case" tied to current damaged conditions rather than prior conditions or a desired condition set for decommissioning, led CNL to find no adverse effects pathways. Sagkeeng also is concerned in regard to Section 6.7 (Human and Ecological Health) stating the use of a damaged baseline and the lack of any reference to the proper base case to compare the Project against, which is the commitment made by Canada to remove all the radioactive components from WR-1, as per the Comprehensive Study Report (AECL 2001). In Sagkeeng's review of section 6.9 (Socio economic Environment), Sagkeeng raised concerns regarding the socio-economic assessment including but not limited to how CNL defines community well-being in a way that leaves out quite a number of elements that Sagkeeng use to characterize community well-being.

Sagkeeng also noted that CNL defined spatial areas by administrative boundaries as opposed to where impacts are expected; the clearest example of this is that the people of Fort Alexander are among the populations most likely to be subject to adverse socio-economic effects, and most deserving (through the principle of impact equity) of benefits from the Project, but Sagkeeng is put only in the regional study area for the socio-economic assessment, not the local study area. Sagkeeng stated this is inappropriate as the distance of residence is not the sole defining element of local and regional study areas for socio-economic assessment, especially for Indigenous peoples with Treaty rights in the immediate Project affected area. Indigenous peoples have the right to travel to, through and use, all areas of their traditional territories. Specifically, CNL's assessment does not disaggregate down into sub-populations and/or differential effects on different groups within communities. Sagkeeng expressed concern that CNL only consider Sagkeeng members in Fort Alexander, not off-reserve populations.

Sagkeeng stated that CNL's baseline on Sagkeeng perspective and observations lacks depth and that CNL's assessment on the socioeconomic environment does not capture Sagkeeng's psychosocial concerns or the results of Sagkeeng's psychosocial impact assessment. For more information on Sagkeeng's psychosocial impact assessment report refer to Section 4.2.4.1.4. More specifically Sagkeeng stated the absence of Indigenous indicators of well-being, even when some of those factors were clearly mapped in the Sagkeeng Psycho-social impact assessment, is highly problematic.

Sagkeeng expressed concern that the absence of trend-over-time data for a variety of indicators makes it impossible to determine whether the "health" of an indicator is getting better or worse over time in CNL's

socioeconomic environment assessment. Sagkeeng did not find it acceptable for CNL not to have identified Indigenous determinants of health and verified them with Sagkeeng.

In response to Sagkeeng's feedback on the sections of the EIS, CNL revised the sections of the EIS to incorporate Sagkeeng's feedback, prior to submission of the draft EIS. CNL provided detailed responses to each of Sagkeeng's comments and provided an explanation if their comments were not incorporated into the EIS.

This issue remains outstanding as Sagkeeng has indicated that CNL's EIS does not adequately capture all impact pathways (primary and secondary) on Sagkeeng traditional use and cultural values in the environmental assessment.

Alternative Means Assessment

Sagkeeng continues to have strong reservations with ISD and the way in which CNL conducted its Alternative Means Assessment. Sagkeeng states that ISD is not preferred over the previous full removal plan and has called for CNL to re-engage Sagkeeng on Alternative Means Assessment in a collaborative forum. This concern remains outstanding. Sagkeeng's most preferred decommissioning method for WR-1 is immediate full removal and Sagkeeng's least preferred decommissioning method is ISD, based on community input and the findings of Sagkeeng's Alternatives Means Assessment (Sagkeeng and Firelight 2020) and Psychosocial Impact Assessment (Narratives 2020). Sagkeeng's position is that as a result of Article 29(2) of UNDRIP and customary international law, the Project is not permitted to go forward without Sagkeeng's free, prior and informed consent.

CNL, Sagkeeng, and AECL have established a Technical Working Group to resolve outstanding concerns and work collaboratively on areas of interest. CNL will continue to engage meaningfully with Sagkeeng Chief and Council, community members, their engagement team, and their Liaison through the lifecycle of this Project.

4.2.4.1.3 Sagkeeng's Alternative Means Assessment

Below is a brief summary of CNL's engagement with Sagkeeng with respect to Sagkeeng's Alternative Means Assessment. A complete description of CNL's considerations of Sagkeeng's Alternative Means Assessment is included in Section 2.8 of the EIS.

Sagkeeng submitted 22 comments on the draft EIS on the Alternative Means Assessment conducted by CNL and has indicated the importance of engaging on Project alternatives in a meaningful way. Additional comments were submitted at the Sagkeeng Alternative Means workshop in February 2019, in a letter in June 2019, a letter from Sagkeeng in February 2020, and reinforced during a meeting in March 2020. Sagkeeng remains critical of the approach taken under CEAA, 2012 by CNL to evaluate Project alternatives, particularly concerning a lack of Sagkeeng's perspectives included in the Alternative Means Assessment. CNL respects the importance of this issue to Sagkeeng and subsequently supported Sagkeeng to undertake their own Alternative Means Assessment; one that assessed and measured the alternatives based on Sagkeeng values.

On October 19, 2020, Sagkeeng provided a copy of their Alternative Means Assessment (Sagkeeng and Firelight 2020). The Sagkeeng assessment draws the conclusion that based on results of their assessment, the ISD option ranked lower than the other alternatives for 7.5 of the 8 tests they conducted, and that it "…brings into question the appropriateness of CNL's preferred alternative for remediation of WR-1". In the document, Sagkeeng is calling for CNSC to "reject the proposal to change the decommissioning plan to ISD". CNL respects the independent view of Sagkeeng on potential alternatives for the Project.

A copy of the Alternative Means Assessment is included as a separate attachment to the EIS package submitted to the CNSC. For more information on Sagkeeng's Alternative Means Assessment see Section 2.8 of the draft EIS.

4.2.4.1.4 Sagkeeng First Nation's Psychosocial Impact Assessment

This subsection provides an overview of CNL's understanding and considerations of Sagkeeng First Nation's Psychosocial Impact Assessment (Narratives 2020). For details on CNL's engagement with Sagkeeng refer to Section 4.2.4.1 of the EIS and Section 4 in CNL's Indigenous Engagement Report (CNL 2022).

4.2.4.1.4.1 Introduction and Context

An important element of the EIS submission is documenting feedback and information supplied by Sagkeeng that is relevant to the proposed Project. While CNL defers to the results of the rights impact assessment process for a conclusion on whether Aboriginal and Treaty rights are impacted by this Project, Sagkeeng's Psychosocial Impact Assessment report is an important contribution of technical data and Traditional knowledge that contributes to the overall body of information of interests and concerns that Sagkeeng has expressed through engagement.

To better understand Sagkeeng's concerns regarding the psychosocial impacts that Sagkeeng associates with the WL site and predicts may result from the Project, the CNSC supported Sagkeeng's preparation of a psychosocial impact assessment. Sagkeeng commissioned Narratives Inc. to conduct the Psychosocial Impact Assessment of the Project (Narratives 2020). The study includes an account of experienced historical impacts, psychosocial impacts from WL's presence in the area, and psychosocial impacts expected to occur from each alternative[5] currently in consideration. The four alternatives considered as decommissioning options for WR-1 include the four identified by CNL as technically and economically feasible: *Alternative #1 – Deferred Dismantling and Removal*; *Alternative #2 – Dismantling and Removal; Alternative #3 – In Situ Disposal; and Alternative*; *#4 – Partial Dismantling and Removal with In Situ of the Remainder.* Sagkeeng's psychosocial impact assessment gathered information through a literature review and twenty-six semi-structured interviews with community members. In addition, thirteen Sagkeeng members participated in a psychological assessment conducted by a clinical psychologist.

The interviews conducted included prompting questions about the WL site. The overwhelming sentiment shared was regarding the confusion and fear related to nuclear in general; the expressed concerns about the use of a nuclear reactor and waste in Sagkeeng's territory; and the lack of engagement with Sagkeeng on the siting and operations of the WL site (Narratives 2020). One community member succinctly drew the connection between the secrecy and historic lack of consultation or engagement surrounding the WL site on the one hand, and negative feelings of self-worth, family cohesion, and traditional lifestyle on the other (Narratives 2020).

The study recommended that addressing psychosocial impacts of any of the Project Alternatives should focus not only on mitigating past harm but also on preventing future harm. It was assessed that Alternatives #1, #3, and #4 neither mitigate past harm nor prevent future harm, and thus sustain the status quo. If appropriate measures were in place and the fear associated with potential risks during the process of dismantling was addressed, Alternative #2 offers an opportunity to prevent further harm, and allow the community to start healing. Alternative #3 does offer some immediate waste removal action that would be beneficial from a psychosocial perspective, but the presence of radioactive material in the long term will continue to be a source of significant

[5] For more information on CNL's Alternative Means Assessment and each of the four alternatives considered technically and economically feasible, please refer to Chapter 2.0 of the EIS.

distress. Similar sentiments were expressed in the report for Alternative #4. Overall, the study found that Alternative #3 (In-Situ Disposal) was the least preferable option from a future trauma reduction perspective.

The study recommended that the following actions would contribute to a reduction in Sagkeeng's psychosocial impacts:

1. building a trauma-informed decision-making model;
2. building a Healing and Resiliency Plan;
3. building a long-term monitoring program with "extensive involvement" for Sagkeeng members;
4. providing capacity and access to independent expertise on an ongoing basis; and
5. actively investing in improving the psychological wellbeing of Sagkeeng members.

4.2.4.1.4.2 CNL's Considerations of the Report

CNL has engaged Sagkeeng's leadership, consultation team, and the psychosocial impact assessment author as well as carefully reviewed the findings of Sagkeeng's Psychosocial Impact Assessment (Narratives 2020). CNL's understanding of potential impacts of the Project and understanding of Sagkeeng's perspectives has evolved over time with support and guidance from Sagkeeng.

Sagkeeng's concerns include the potential for ongoing fear and avoidance for land use if in situ decommissioning is conducted instead of full dismantling and complete removal of all waste from the land.

CNL acknowledges and accepts the findings in the report and recognizes that Sagkeeng community members have experienced psychosocial impacts that stem from the presence of the WL site in Sagkeeng's traditional territory and other sources of trauma. Based on the study and the separate findings of Sagkeeng's Alternative Means Assessment (Sagkeeng and Firelight 2020), Sagkeeng believes that the best option for community healing arises from complete and immediate removal of all waste from the site and that the proposed ISD option for WR-1 is likely to continue to contribute to psychosocial trauma for Sagkeeng members.

CNL recognizes that members of Sagkeeng are stewards of the lands and waters of their traditional territory, which includes the area now covered by the WL site, which was established by the federal government in the early 1960s. Sagkeeng states this alteration to the land reduced access and created alienation effects at and around the WL site, reducing Sagkeeng's access to and enjoyment of portions of its traditional territory up to the present day, and impacting Sagkeeng's Treaty and aboriginal rights. CNL also recognizes that the establishment of the WL site, while compliant with regulatory standards at that time, would not meet the engagement and consultation standards that exist today. Sagkeeng has stated this process disconnected Sagkeeng from its traditional territory and the lack of engagement throughout the operations of the site, particularly around spills into the river, perpetuated fear and stigma around the WL site. This resulted in a mistrust in the management of the site.

CNL is committed to building trust and maintaining open, transparent communication with Sagkeeng's leadership and members, particularly around issues that arise on the WL site that may influence the water quality of the river. CNL understands that ceremony is a very important part of Anicinabe way of life and is seeking guidance from Turtle Lodge and the Sagkeeng Anincinabe First Nation on how best to incorporate ceremony into the decommissioning and engagement plans for WR-1 and for the WL site.

The study recommends that addressing psychosocial impacts of any of the alternatives for WR-1 should focus not only on mitigating past harm, but also on preventing future harm. CNL recognizes that the proposed in situ option for decommissioning WR-1 does not support optimum healing, and that additional support to Sagkeeng is required to adequately address their concerns regarding the Project.

CNL acknowledges that its actions and engagement alone may not improve perceptions of the proposed Project and WL site, and remains committed to ongoing engagement, cultural training and learning from Sagkeeng about how best to reduce fear and stigma and address any potential impacts from the site. CNL recognizes the role it needs to play in supporting the reduction of fear and stigma associated with the nuclear industry, the WL site, and helping Sagkeeng reduce any potential trauma among its members in relation to the proposed in situ decommissioning of WR-1.

4.2.4.1.4.3 Addressing Sagkeeng Psychosocial Impacts

The Psychosocial Impact Assessment Report (Narratives 2020) attributes psychological trauma with each alternative, with the least amount of trauma associated with Alternatives #1 and #2. As stated above, the report indicates that Alternative #3 offers some immediate removal action that would be beneficial from a psychosocial perspective, however according to the report the presence of radioactive material in the long term would continue to be a source of significant distress. CNL believes Alternative #3 is the best option from a technological, practicable, safety to workers, and economic perspective; and provides protection to the public and the environment. Recognizing Alternative #3 is the least favoured option from Sagkeeng's perspective; CNL is committed to working collaboratively with Sagkeeng to develop and implement mitigation measures that are meaningful to Sagkeeng and will help to address Sagkeeng's concerns and ongoing/residual trauma.

As a starting place, Sagkeeng's consultation team, CNL, and AECL have established a Technical Working Group to work together to develop and implement initiatives that will help address Sagkeeng's concerns regarding the Project. The Technical Working Group has agreed to move forward on the following initiatives to help address Sagkeeng's concerns: a Healing and Resiliency Action Plan; a community liaison committee; a leadership table between Sagkeeng, AECL, and CNL; and development and execution of Sagkeeng's CEMPthat will include country foods monitoring and a community-led risk communications program that is co-developed by Sagkeeng, CNL, and AECL.

In September 2021, CNL coordinated trauma informed engagement training for Sagkeeng, CNL, AECL and CNSC representatives to support the development of a Healing and Resiliency Action Plan. Following the training, CNL shared trauma informed training materials with Sagkeeng representatives. Through the development of an independent Sagkeeng CEMP, Sagkeeng acknowledged that the CEMP is part of a recommended approach to addressing fear and stigma.

4.2.4.1.5 Verification

CNL incorporated feedback through engagements with Sagkeeng on the Project, their TKLUS, Psychosocial Impact Assessment Report, Alternative Means Assessment Report, and country foods harvest survey. To confirm CNL has adequately captured Sagkeeng's interests and concerns, position, and knowledge, CNL and Sagkeeng underwent a verification process whereby CNL provided EIS documentation, which included a summary of interests and concerns table, a list of Sagkeeng's Valued Components, and sections of the EIS, to Sagkeeng for their review and feedback. Upon receiving feedback on a document, CNL and Sagkeeng's Consultation Team met to confirm CNL's understanding of Sagkeeng's feedback, seek clarification where needed, and review CNL's proposed responses. Through this process, Sagkeeng has reviewed and provided feedback from their summary of interests and concerns table, list of VCs, Alternative Means Assessment write-up, psychosocial impact assessment write-up, Section 2.0, Section 4.0, Section 6.0, and Section 11.0. While not all of Sagkeeng's concerns were addressed by this process, CNL made every effort to verify that Sagkeeng's position, interests, and concerns were adequately characterized.

CNL received a letter from the CNSC on August 24, 2022, indicating that three Information requests remained outstanding, including updating the Indigenous engagement narrative and tables. Further verification efforts were made to updates to the EIS. Community specific portions of Section 4.0, Engagement Logs, and Interests and Concerns Tables were sent to Sagkeeng on October 20, 2022, to review for accuracy. On November 12, 2022, Sagkeeng provided written feedback on the updates. With CNL's acknowledgement that Sagkeeng edits were incorporated, Sagkeeng provided an e-mail to CNL on November 18, 2022, confirming that they had no further comments at this time.

Sagkeeng has indicated that it will further review the EIS when filed against comments made by Sagkeeng during this pre-filing period and will report to the CNSC thereafter. CNL continues to work with Sagkeeng to address their concerns through the Technical Working Group.

For specific engagement related information on the verification process, see Section 4.2.4.1.1 Engagement, or see Appendix 4.0-1.

4.2.4.1.6 Next Steps

CNL values how the relationship between Sagkeeng and CNL has grown and believes CNL's collective engagement efforts and collaboration through the Technical Working Group table and subcommittee have contributed positively to the environmental assessment of WR-1 and the Whiteshell Laboratories Closure Project more broadly.

CNL will continue to work with Sagkeeng on the environmental assessment for WR-1 to address their concerns in a way that is meaningful to Sagkeeng. As determined through the leadership meeting with Chief Henderson in April, 2021, this included establishing a Technical Working Group between AECL, CNL, and Sagkeeng to implement the following initiatives:

- Development of a community advisory committee;
- Development of a Healing and Resiliency Action Plan;
- Development of a leadership table among Sagkeeng, AECL and CNL; and
- Development of a meaningful Sagkeeng Indigenous monitoring program at and around the WL site.

Through the persistent efforts of the Technical Working Group, CNL, AECL, and Sagkeeng have made significant progress towards successful implementation of three of the four initiatives listed above. CNL has supported the development of the Community Liaison Committee and has now moved into moved into a support role. On July 18, 2022, CNL hosted Sagkeeng's Community Liaison Committee for an on-site tour of the WR-1 and the WL site. CNL and Sagkeeng have agreed to coordinate leadership tables as necessary and when key relationship milestones are reached. In September 2022, CNL and AECL agreed to provide funding support for the development and execution of an independent Sagkeeng CEMP, to the development of a meaningful Sagkeeng community driven monitoring program at and around the WL site.

CNL, AECL are convening a meeting in October to further discuss the Healing and Resiliency plan, and where AECL and CNL may fit within the scope of what is proposed.

Next steps in engagement on the Project include developing a list of commitments that will be submitted to the CNSC, and re-engaging on the 2017 and 2020 EIS comments and responses table to update responses to reflect recent engagements and commitments. Once the commitments list is completed, CNL will work with Sagkeeng to also complete the final columns of the summary of interest and concerns table.

CNL will continue engagement with Sagkeeng to address or resolve outstanding issues or concerns to the extent possible regarding the Project and has demonstrated its commitment to ongoing engagement and relationship-building to support discussions regarding the future land use of the WL site.

4.2.4.2 Manitoba Métis Federation

The Manitoba Métis Federation is the democratically elected self-government representative of the Manitoba Métis also known as the Red River Métis, an "Aboriginal peoples" under Section 35 of the Constitution Act, 1982 and currently includes the Manitoba Métis Federation Inc., a non-share corporation incorporated pursuant to the laws of Manitoba. Founded in 1967, the Federation has over 650 staff across the province (MMF 2018).

The Manitoba Métis Federation represents and advances the interests of the Red River Métis and uses an electoral process where all formal positions are elected by Federation members in each designated Region or Local. Governance includes: a President, Board of Directors, regional associations or "Regions" and community-level "Locals".

A map of the Manitoba Métis Federation is provided in Appendix D of the IER (CNL 2022).

The President functions as the Federation leader, and spokesperson and Chief Executive Officer. This position oversees day-to-day Federation operations and is elected through a province-wide election every four years. A Board of Directors, comprised of 23 democratically elected members, provides guidance, leadership and management toward Federation (and its subsidiaries) policies, objectives and strategic direction. Seven Regions across Manitoba are administered by a vice-president and two executive officers, who are also of the Federation's Board of Directors, and who administer programs and services independently to their specific geographic area. Each Region comprises various Locals. These are administered by a chairperson, a vice-chairperson and a secretary-treasurer, and have a minimum of nine members that meet at least four times a year. Each Red River Métis citizen belongs to a Local. Specific Locals determine the timing of election of their respective Local representatives, while Regional officers are elected every four years (MMF 2018).

Since 2016 when CNL started engaging Manitoba Métis Federation on the proposed ISD of WR-1, Manitoba Métis Federation's position has remained that complete removal and remediation (i.e., CNL's Alternative #2) of WR-1 should be selected as the decommissioning method for WR-1.

CNL has committed to involving the Manitoba Métis Federation and its citizens in the environmental monitoring for the long-term at the WL site. CNL will be collaborating with the Manitoba Métis Federation and other Indigenous nations to ensure it aligns with the Nation's expectations and interests. CNL and the Manitoba Métis Federation held a teleconference on March 23, 2021, to discuss a relationship agreement including funding a Liaison position, and participation in annual environmental monitoring. CNL committed to developing a relationship agreement with the Manitoba Métis Federation.

Throughout the environmental assessment process for WR-1, CNL has engaged with the Manitoba Métis Federation to share information and build awareness about the proposed ISD of WR-1, understand the Manitoba Métis Federation's Aboriginal and Treaty rights and main concerns and interests regarding the Project to determine how CNL and the Manitoba Métis Federation can work collaboratively to address the Manitoba Métis Federation's concerns.

Overtime, CNL has strengthened its relationship with the Manitoba Métis Federation, which has led to more engagements on the broader Whiteshell Laboratories Closure Project and better understanding of the Manitoba Métis Federation's concerns, potential impacts, and collaborate on ways to help address these concerns of the Project. In 2021, the Manitoba Métis Federation and CNL participated in a series of technical workshops on specific areas of interest to the Manitoba Métis Federation on the Project. Workshops included an overview of the in situ design, proposed groundwater monitoring program, the broader site's environmental protection program, the WR-1, Alternative Means Assessment, and opportunity for collaboration. The workshops facilitated greater understanding of the concerns and interest of the Manitoba Métis Federation. As a result of the workshops, CNL committed to incorporating an additional ground monitoring station between WR-1 and the river as part of their post-closure monitoring program.

CNL and the Manitoba Métis Federation have also identified initiatives that would help address the Manitoba Métis Federation's concerns of the Project and are working toward finalizing a relationship agreement to support the development and implementation of these initiatives. These initiatives include the development of a Liaison position and a discussion table that will meet regularly until the decommissioning of the Project is complete, and the WL site is closed. Other initiatives include a leadership table between the Manitoba Métis Federation and CNL, Support to meaningfully participate in onsite monitoring, and the establishment of a communication protocol to notify the Manitoba Métis Federation of any reportable event at the WL site that may have off site impacts.

CNL and the Manitoba Métis Federation have been working collaboratively to develop and implement these initiatives as well as to continue to strengthen their relationship. At the time of submission, CNL and the Manitoba Métis Federation are near executing a relationship agreement that will support the resolution of outstanding Manitoba Métis Federation concerns.

4.2.4.2.1 Engagement

CNL first reached out directly to the Manitoba Métis Federation in November 2016 after sending a formal letter requesting their government's input on the WR-1 Decommissioning Project. The Manitoba Métis Federation and CNL had an introductory meeting in November where CNL provided an overview of their proposed change to the decommissioning of WR-1.

In 2017, CNL and the Manitoba Métis Federation continued to engage in discussions about WR-1 via teleconferences, site tours, and attending Manitoba Métis Federation's Annual General Assembly. CNL set up a booth at Manitoba Métis Federation's Annual General Assembly and spoke directly to Red River Métis citizens about the Project. CNL sent notification of the public comment period on the draft EIS and invited the Manitoba Métis Federation to engage. The Manitoba Métis Federation participated in a site tour and discussion on WR-1 decommissioning, and environmental risk assessment.

In September 2017, CNL provided an opportunity for five members from each First Nation community and the Manitoba Métis Federation to attend a full day workshop to both learn and share on how CNL and the First Nation communities collectively protect and care for the environment. The goal was to provide some hands-on experience coupled with ample discussion, learning and dialogue on opportunities moving forward both as a career option and as a relationship between the site and the First Nations and the Manitoba Métis Federation. On October 31, 2017, CNL's Annual Safety Reports were distributed to each First Nation community including the "Environmental Monitoring in 2016 at Whiteshell Laboratories" report (CNL 2017a), and the "2016 Progress Report on the Environmental Assessment Follow-up Program for Whiteshell Laboratories" (CNL 2017b). CNL also provided an invitation to engage on these documents.

In 2018, the Manitoba Métis Federation, CNL, and CNSC set up a monthly recurring meeting to provide updates and discuss topics of interest. In 2018, there were seven update meetings. The Manitoba Métis Federation also participated in the Benchmarking trip to Hallam, Nebraska, to learn more about ISD. In March 2018, CNL and the Manitoba Métis Federation signed a Contribution Agreement to further support the Manitoba Métis Federation's' continued engagement in the environmental assessment process of the Project. At the end of 2018, the Manitoba Métis Federation participated in a tour of WR-1.

In 2019, the Manitoba Métis Federation completed their Traditional Knowledge, Land Use, and Occupancy Study (TKLUOS; SVS 2019). Also in 2019, CNL, CNSC, and the Manitoba Métis Federation met eight times as part of their monthly meeting updates. In March, CNL and the Manitoba Métis Federation discussed actions identified in the TKLUOS. In August 2019, the Manitoba Métis Federation and CNL signed a Contribution Agreement for the Manitoba Métis Federation to observe environmental monitoring activities. One of the Manitoba Métis Federation' recommendations on CNL's environmental protection program were to include mushroom collection into their sampling program. CNL has since adjusted its environmental protection program to include mushroom collection and CNL continues to look for additional ways to improve their monitoring program. The Manitoba Métis Federation also participated in fall monitoring activities. At the Manitoba Métis Federation's 2019 Annual General Assembly, Minister Park, the Manitoba Métis Federation Minister of Energy & Infrastructure, spoke about CNL and indicated that it was an example of a positive relationship with the Manitoba Métis Federation and acknowledged CNL's work with the Manitoba Métis Federation on environmental monitoring.

In 2020, the Manitoba Métis Federation, CNL, and CNSC participated in six monthly update meetings at the start of the year, discussing interests in participating in an Indigenous Advisory Committee, environmental monitoring, and developing a long-term relationship agreement. In July, the Manitoba Métis Federation observed a waste shipment from pre-job to completion of loading. In August 2020, CNL provided responses to the Manitoba Métis Federation's comments on the draft 2017 and 2020 EIS. The Manitoba Métis Federation and CNL also met that month to introduce CNL's new Indigenous Engagement Officer and discuss the Manitoba Métis Federation's comments on the Indigenous Advisory Committee Participation Agreement. In September, CNL provided a list of all fall monitoring activities and invited the Manitoba Métis Federation to participate. Following this e-mail, the Manitoba Métis Federation participated in mushroom sampling on site alongside CNL's environmental technicians.

On October 14, 2020, CNL received Métis Cultural Awareness Training provided by the Louis Riel Institute. While this was not a direct engagement with the Red River Métis , the training increased CNL, AECL and CNSC participants' knowledge on Métis history, culture, and the role of the Métis in the formation of Manitoba. Later that month, a Red River Métis representative visited the WL site and observed CNL's environmental technicians process fish. CNL's environmental specialist also provided an overview of CNL's environmental protection program.

At the end of the month on October 26, 2020, CNL hosted a teleconference with the Manitoba Métis Federation to discuss their comments on the draft EIS. The purpose of the meeting was to seek clarification on the Manitoba Métis Federation's comments and have a discussion on how CNL can address their concerns. During the meeting, a number of technical and non-technical workshops were suggested. The purpose of these workshops was to try to resolve outstanding concerns presented in the Manitoba Métis Federation's EIS comments. In the meeting notes, CNL provided draft agendas for each proposed workshop including draft participant lists, tentative dates, suggested background reading, and draft purpose statements for each workshop. Over the course of the next several months, CNL and the Manitoba Métis Federation planned a series of four workshops and one technical wrap-up meeting. The workshops focused on topics such as exploring opportunities for collaboration, in situ design and Alternative Means Assessment, ground water flow and ground water well placement, and CNL's environmental protection program. They created space for an open dialogue between the Project's technical team and the Manitoba Métis Federation's technical team to ask questions and support a greater understanding of the decisions CNL made in consideration of the in-situ design.

During a teleconference on November 12, 2020, the Manitoba Métis Federation made a few suggested edits to the workshops following which CNL sent out the revised draft agendas and scheduled a follow-up meeting to verify the changes made to the agenda. Due to scheduling issues with the Manitoba Métis Federation, the meeting was cancelled. CNL and the Manitoba Métis Federation held the first workshop to discuss the environmental initiatives and identify possible areas for collaboration, by teleconference on October 26, 2020. During this meeting, the Manitoba Métis Federation and CNL also discussed CNL's proposed communication protocol and the Manitoba Métis Federation's Resolution #8 (MMF n.d.a.).

On November 25, 2020, CNL invited the Manitoba Métis Federation to participate in CNL's 2020 virtual industry day being held December 9, 2020. The event was in partnership with the Organization of Canadian Nuclear Industries. On November 26, 2020, CNL and the Manitoba Métis Federation met via teleconference for the first workshop that was identified as an action item out of the October 26 meeting. The purpose of this workshop was to identify areas of collaboration and mutual interest. The majority of the discussion was on the Manitoba Métis Federation's environmental and monitoring initiatives.

On December 17, 2020, CNL sent the Manitoba Métis Federation a final round of responses to their EIS comments, which clearly identified any comment or concern that was out of the scope of the EIS and proposed clear next steps to help address the Manitoba Métis Federation's concerns.

On January 13 and 14, 2021, CNL had teleconferences with the Manitoba Métis Federation to plan for the upcoming workshops. On January 25, CNL sent the Manitoba Métis Federation an advanced copy of the draft EIS.

CNL had two additional planning meetings on January 27 and February 2, 2021, to discuss the goals, objectives, and agendas for the workshop which were pushed back due to scheduling issues. The ground water and ground monitoring wells workshop with the Manitoba Métis Federation was held on February 9, 2021. The main topics of

this workshop include surface water and ground water movement over the WL site and the placement and number of the planned ground monitoring wells around WR-1. As a result of feedback from the Manitoba Métis Federation during the workshop, CNL included one additional ground monitoring well into their proposed follow-up monitoring program. CNL and the Manitoba Métis Federation held a follow-up teleconference on February 15 to discuss action items for the meeting and the outcomes of the workshop. CNL affirmed their commitment to adjusting the follow-up monitoring program to include an additional well closer to the reactor.

As a follow-up to the workshop held on October 26, 2020, to discuss opportunities for collaboration, CNL and the Manitoba Métis Federation met via teleconference on February 18, 2021, to explore opportunities for collaboration in areas of similar interest including environmental monitoring and environmental sustainability. During the meeting, CNL learning about the multiple green initiatives the Manitoba Métis Federation was developing and leading. CNL and the Manitoba Métis Federation created a list of long-term opportunities for collaboration specifically in site-wide tree planning, river erosion protection, and future land use. CNL and the Manitoba Métis Federation also created a list of possible short-term objectives to be completed by the end of the fiscal year. These included supporting one of Manitoba Métis Federation’s green initiatives such as the Red River Métis' commitment to plant 2 million trees, their environmental monitoring program, and citizen science program. Both CNL and the Manitoba Métis Federation took away the list to discuss internally.

In the meantime, the series of technical workshops continued with a workshop on the Project’s Alternative Means Assessment and methodology for choosing VCs on March 2, 2021. Most of the questions posed by the Manitoba Métis Federation's technical team during the meeting centered on international and federal regulations, oversight, and guidance and how the Project considered and adhered to those documents.

On March 9, 2021, CNL and the Manitoba Métis Federation met via teleconference to discuss the development of the relationship agreement and liaison position for the Project. CNL and the Manitoba Métis Federation held a final workshop to discuss CNL’s environmental protection program and opportunities to incorporate Traditional Knowledge into CNL’s current environmental monitoring practices. As a result of the workshop, the Manitoba Métis Federation has a better understanding of the rigorous practices CNL takes to protect the environment, and CNL and the Manitoba Métis Federation created action items to discuss further opportunities for participation of Métis citizens in environmental monitoring on site and to discuss supporting the Manitoba Métis Federation's green initiatives.

As a result of all the engagement that took place over the past few months, CNL created an engagement infographic to illustrate the engagement that took place over the past few months. The infographic included a list of engagements plus a brief description about each engagement. CNL sent the infographic to the Manitoba Métis Federation on April 12, 2021.

On May 11, 2021, CNL, the Manitoba Métis Federation, and their respective technical team held a teleconference to have a wrap-up workshop. The purpose of the wrap-up workshop was to review the four technical workshops (i.e., topics covered, associated comments/concerns, action items, current commitments); discuss the status of comments/ concerns, associated commitments, and appropriate ways to address any outstanding concerns and how the information will be reflected in the EIS; and chart a path forward on remaining environmental assessment reviews and next steps. The commitments to address the Manitoba Métis Federation's concerns involved having the Manitoba Métis Federation involved in all aspects of current and future environmental monitoring on site. These include participation in CNL’s annual environmental monitoring activities, the Manitoba Métis Federation's involvement in the development, implementation, and participation in post closure environmental monitoring, and additional placement of a groundwater well in closer proximity to the Project.

As a follow-up to the technical wrap-up meeting, CNL and the Manitoba Métis Federation met on May 25, 2021, to discuss their involvement in the 2021 environmental monitoring field season. During the meeting, the Manitoba Métis Federation expressed which field monitoring they would be interested in participating in and which they would want to include Métis citizen scientists as participants. CNL and the Manitoba Métis Federation also briefly discussed the types of support the Manitoba Métis Federation would need to participate in on site monitoring.

With the technical workshops complete, the Manitoba Métis Federation and CNL met on June 2, 2021, to discuss the relationship agreement. The Manitoba Métis Federation and CNL developed the main elements the Manitoba Métis Federation and CNL want included in the relationship agreement and discussed the process to help develop and implement the relationship agreement in a timely manner that was mutually beneficial for the Manitoba Métis Federation and CNL. On June 2, 2021, CNL sent the Manitoba Métis Federation a letter requesting their review of the summary table of interests and concerns CNL had developed based on engagements and the Manitoba Métis Federation's Traditional Knowledge, Land Use and Occupancy Study (TKLUOS; SVS 2019). CNL also developed a list of VCs for the Manitoba Métis Federation based on feedback from past engagement, the Manitoba Métis Federation's harvester consumption survey, and the Manitoba Métis Federation's TKLUOS. CNL asked the Manitoba Métis Federation to verify whether CNL had adequately characterized the Manitoba Métis Federation's interests and concerns. In the letter, CNL offered to provide capacity funding and to meet with the Manitoba Métis Federation to discuss the table and list of VCs.

With almost all of the engagement focused on the Project, CNL and the Manitoba Métis Federation felt it was timely to discuss the progress made for the site decommissioning. Therefore, on June 3, 2021, CNL provided the Manitoba Métis Federation with an overview of building decommissioning that had been completed to date and planned decommissioning for the next fiscal year. During the meeting, CNL asked the Manitoba Métis Federation whether they had reviewed the summary table of interests and concerns and list of VCs and whether they required any capacity support. The Manitoba Métis Federation stated they need to have an internal discussion first and would get back to CNL.

On June 8, 2021, CNL and the Manitoba Métis Federation held a teleconference to continue their discussion on their participation in CNL's environmental monitoring. The Manitoba Métis Federation identified which activities they wanted to participate in and which they would like their citizen scientists to participate in. To kick off the environmental monitoring season, on June 14, 2021, the Manitoba Métis Federation staff participated in ground water monitoring, a turtle search along the plant road, and a songbird survey. The Manitoba Métis Federation staff suggested setting up trail cameras along the plant road to better assess whether turtles were in the area. On June 22 and 23, and July 13 and 14, 2021, the Manitoba Métis Federation staff and Métis citizen scientists participated in evening bat surveying for Building 100 that houses WR-1. The purpose of the survey was to help assess whether bats were roosting in the building. On June 29, 2021, the Manitoba Métis Federation and CNL signed an MOU to support the Manitoba Métis Federation's involvement in environmental monitoring on site.

On June 23, 2021, CNL and the Manitoba Métis Federation continued their progress on developing a relationship agreement focusing on fine tuning the language for the main initiatives identified that would help to address the Manitoba Métis Federation's concerns on the Project. During the meeting, CNL also asked whether the Manitoba Métis Federation had reviewed the interests and concerns table for the Manitoba Métis Federation and the list of VCs. CNL asked whether the Manitoba Métis Federation required capacity support to have consultants review the document. On July 6, 2021, CNL and the Manitoba Métis Federation met via teleconference to confirm the language in the revised relationship agreement and discuss specific edits required to move forward. On July 12, 2021, the Manitoba Métis Federation provided feedback on the relationship agreement.

On July 26, 2021, the Manitoba Métis Federation sent CNL feedback on the summary of interests and concerns table and list of VCs for the Red River Métis. On the same day, CNL and the Manitoba Métis Federation signed an MOU to support the Red River Métis' technical review of the summary of interests and concerns and list of VCs. CNL accepted all track changes for both documents from the Manitoba Métis Federation and sent back the revised two documents on August 19, 2021. CNL sent a final thank you letter to the Manitoba Métis Federation on August 24, 2021, thanking the Manitoba Métis Federation for their participation in verifying CNL had adequately captured their summary of interests and concerns and their list of VCs.

On August 9, 2021, CNL sent a revised copy of the relationship agreement to the Manitoba Métis Federation for their review and feedback. On August 12, 2021, the Manitoba Métis Federation participated in a tour of WR-1 and the waste management area. On August 16, 2021, the Manitoba Métis Federation came to site and observed river sediment, soil, and vegetation sampling.

On August 19, 2021, the Manitoba Métis Federation, the CNSC, and CNL participated in a trilateral meeting to discuss that status of interests and concerns and the relationship agreement. The Manitoba Métis Federation and the CNSC were going to meet and do a cross reference between the CNSC table of concerns and the table that CNL had developed. After submission of the revised draft EIS, CNL would assess the summary of interests and concerns and clearly state the responsible party to address the Red River Métis' concerns. On that same day, CNL and the Manitoba Métis Federation met to discuss the relationship agreement. CNL and the Manitoba Métis Federation finalized the major initiatives and then turned to discuss the budget for each item. CNL also met with the Manitoba Métis Federation on August 19, 2021, to discuss support for the Red River Métis' green initiative and begin to identify which green initiative project required the most support. It was identified that the Red River Métis' initiative to plant 2 million trees needed the most support and after the meeting CNL held internal discussions on how to best support the initiative.

On August 30, 2021, CNL sent the Manitoba Métis Federation a revised budget for the relationship agreement for their review and feedback.

After a few follow-up e-mails between the Manitoba Métis Federation and CNL, the Manitoba Métis Federation and CNL signed a MOU on September 8, 2021, to support the Red River Métis' purchase of 5,000 tree saplings. On September 9, 2021, the Manitoba Métis Federation staff came to site to participate in mushroom collection on site and in the surrounding area. The Manitoba Métis Federation recommended CNL cut the mushrooms at the stem when they collect the mushrooms so that the mushroom has an opportunity to grow up. CNL has adopted this method into their environmental practices.

On September 21, 2021, CNL and the Manitoba Métis Federation held a teleconference to discuss the draft budget, and economic participation and opportunities section in the relationship agreement. CNL sent a revised draft budget and relationship agreement to the Manitoba Métis Federation on September 29, 2021. CNL reached out to the Manitoba Métis Federation on September 29, 2021, to provide and confirm the updates made to the budget of the Relationship Agreement based on the previous meeting.

The month of November of 2021, saw many discussions and engagement activities with the Manitoba Métis Federation. On November 15, 2021, the Manitoba Métis Federation completed a technical review of CNL’s annual compliance monitoring reports for the WL site and provided CNL with a copy. CNL hosted a teleconference with Manitoba Métis Federation on November 17, 2021, to discuss CNL’s alpha targeted therapy project, which was an action from the Manitoba Métis Federation, CNL, and AECL Leadership Meeting. Active discussions on the Relationship Agreement occurred in November. On November 18, 2021, CNL revised the Relationship Agreement

to include both the Manitoba Métis Federation's and CNL's legal review and sent the revised Agreement to the Manitoba Métis Federation. On November 22, 2021, CNL met by teleconference with the Manitoba Métis Federation to review the changes recommend by both party's legal counsel. CNL and the Manitoba Métis Federation discussed additional revisions that were still required related to the topic of procurement.

Verification activities continued in November 2021. CNL sent the Manitoba Métis Federation Section 4.0, Section 6.7, Section 6.8, and Section 11.0 on November 26, 2021, with the request for Manitoba Métis Federation review of these sections and confirmation that CNL has adequately addressed the Manitoba Métis Federation's concerns and correctly captured the Manitoba Métis Federation's information. CNL sent Section 6.9 to the Manitoba Métis Federation on November 30, 2021 and asked the Manitoba Métis Federation to review to confirm CNL had documented the Manitoba Métis Federation's information correctly.

On December 7, 2021, CNL sent a revised copy of the Relationship Agreement to the Manitoba Métis Federation. This included additional revisions from the teleconference and further revisions on the procurement language.

CNL sent the Manitoba Métis Federation a signed copy of an MOU on December 13, 2021, to support the Manitoba Métis Federation's technical review of the EIS sections. The Manitoba Métis Federation returned feedback on Sections 4.0, Section 6.7, Section 6.8, and Section 11.0 on December 19, 2021. On December 28, 2021, Manitoba Métis Federation sent feedback on the draft Relationship Agreement.

A meeting with the Manitoba Métis Federation was held on January 6, 2022 to discuss the Relationship Agreement, where feedback was provided, and revisions were discussed. On February 17, 2022, CNL sent a revised copy of the Relationship Agreement to the Manitoba Métis Federation for review and feedback. On the same day, CNL sent the Manitoba Métis Federation revised copies of the sections of the EIS that the Manitoba Métis Federation reviewed and highlighted where any changes were made based on their feedback. CNL also provided a table to show how CNL addressed each of the Manitoba Métis Federation's concerns. Additional sections of the EIS were provided if they were referenced in CNL's responses. CNL highlighted specific passages in these sections to help the Manitoba Métis Federation in their review of this information.

There was much engagement completed in March 2022 with the Manitoba Métis Federation. On March 2, 2022, with a meeting between CNL and the Manitoba Métis Federation's communication director to discuss co-developing an infographic in preparation for the Manitoba Métis Federation's Annual General Assembly. On March 15, 2022, CNL informed the Manitoba Métis Federation that CNL would be repackaging their interests and concerns table and on March 16, 2022, the Manitoba Métis Federation confirmed they would review the repackaged table. On March 29, 2022, CNL held a teleconference and walked the Manitoba Métis Federation and their consultants through the repackaged interests and concerns table and discussed their review and timeline. CNL and the Manitoba Métis Federation also discussed Red River Métis rights, claims, and interests. CNL sent the Manitoba Métis Federation the repackaged interests and concerns table on March 31, 2022, for the Manitoba Métis Federation's review and feedback.

On April 16, 2022, CNL received the Manitoba Métis Federation's revised relationship agreement for CNL's consideration. CNL held a teleconference on April 25, 2022, with the Manitoba Métis Federation and their technical consultants to go over the Manitoba Métis Federation's repackaged interests and concerns table before their review.

On May 18, 2022, CNL walked through the Manitoba Métis Federation's interests and concerns table and the Manitoba Métis Federation's feedback on the table. CNL focused on items where they would need to revise the Manitoba Métis Federation's proposed language and provided an explanation. Later in May on May 25, 2022, CNL

and the Manitoba Métis Federation discussed the relationship agreement and Indigenous economic participation. On May 27, 2022, the Manitoba Métis Federation provided an additional round of feedback on the interests and concerns table. CNL sent back the revised interests and concerns table on May 30, 2022, to show that the Manitoba Métis Federation's revisions were incorporated.

On June 7, 2022, the Manitoba Métis Federation's new coordinator was welcomed to the WL site to collect mushrooms with CNL's environmental team. CNL asked the Manitoba Métis Federation on June 13, 2022, to confirm that they have completed the verification of their interests and concerns table. On June 16, 2022, the Manitoba Métis Federation provided confirmation that the table was reflective of their interests and concerns.

CNL met with the Manitoba Métis Federation on July 6, 2022, to discuss the status of the relationship agreement, environmental monitoring activities on site, and future engagement activities. CNL sent the revised relationship agreement back to the Manitoba Métis Federation on July 13, 2022, for their review and feedback. Also in July on July 28, 2022, CNL hosted the Manitoba Métis Federation on-site to participate in ground water sampling around the main campus.

August 2022 saw further focus on the relationship agreement. At the monthly meeting on August 8, 2022, the discussion between CNL and the Manitoba Métis Federation focused on the Relationship Agreement. CNL presented at the Manitoba Métis Federation Community Consult Meeting in Lac du Bonnet on August 10, 2022. CNL shared information on their environmental monitoring program and answered questions from the citizens. Red River Métis citizens participated in a bat survey at the WL site in the evening of August 17, 2022. On August 30, 2022, CNL sent a copy of CNL's environmental monitoring program schedule and requested the Manitoba Métis Federation to identify any activities of interest.

On September 7, 2022, at the monthly meeting, CNL and the Manitoba Métis Federation discussed the status of the Relationship Agreement, environmental monitoring and future engagement activities on the Project. CNL provided revisions to the Relationship Agreement for the Manitoba Métis Federation's review and feedback on September 9, 2022; these revisions are believed to have addressed any outstanding issues or concerns. On September 11, 2022, CNL confirmed with the Manitoba Métis Federation that CNL will proceed with an "al la Carte sponsorship" and will participate in the trade show at the Manitoba Métis Federation Annual General Assembly from October 14-16, 2022. September 16, 2022, CNL provided formal written responses to the Manitoba Métis Federation's comments on CNL's 2020 Compliance Reports for the WL site.

On September 22, 2022, there were e-mails between the parties regarding the participation in scheduled CNL monitoring activities. On September 26, 2022, CNL sent an email to the Manitoba Métis Federation inquiring on the status of the Relationship Agreement.

CNL continues to engage with the Manitoba Métis Federation to address their comments on the draft EIS, and to begin execution of the Relationship Agreement.

4.2.4.2.2 Interests and Concerns

The Manitoba Métis Federation and CNL have had extensive engagement on the Project. Through a variety of engagement forums including technical workshops, webinars, and meetings, the Manitoba Métis Federation has raised issues, concerns and questions that were initially focused on the 2017 and 2020 draft EIS. These engagements have led to the development of the interests and concerns table. This subsection is taken from the tables of interests and concerns from Appendix 4.0-1, and describes CNL's understanding based on written submissions and oral discussions with the Red River Métis. CNL continues to disposition the Red River Métis' 24

formal comments and feedback on the draft EIS; to date the Manitoba Métis Federation has fully accepted 14 comments and considers 9 to be partially addressed. See Appendix 4.0-1 Tables of Interests and Concerns for a list the Red River Métis' concerns. The Manitoba Métis Federation have also provided feedback during engagements including the technical workshops where the Manitoba Métis Federation and CNL and their technical experts discussed key topics of interest related to the Project including the in situ design, Alternative Means Assessment, and post closure follow-up monitoring. The Manitoba Métis Federation has also provided feedback through their Traditional Knowledge and Land Use and Occupancy Study and the harvester consumption survey. CNL has made its best efforts to document and verify the position the Manitoba Métis Federation has taken on each interest/concern. See Section 4.4 for a summary of issues raised during engagement activities that influenced the scope of the environmental assessment.

The topics in the Table of Interests and Concerns are briefly summarized below:

Long Term Relationship

The Manitoba Métis Federation and CNL have invested in the development of a positive and collaborative relationship since 2017. A relationship agreement will support implementation of commitments to address the Red River Métis' interests and concerns, including providing appropriate capacity.

CNL and the Manitoba Métis Federation held a teleconference on March 23, 2021, to discuss the relationship agreement including funding a liaison position, participation in annual environmental monitoring, and participation in CNL's Indigenous Advisory Committee. CNL provided a revised draft of the relationship agreement for the Red River Métis' review and feedback on April 22, 2021. CNL and the Manitoba Métis Federation held a technical wrap-up meeting on May 11, 2021, to review outstanding concerns with the Project. During the meeting, CNL committed to funding and implementing a Manitoba Métis Federation wildlife and environmental monitoring program, recommitted to funding a liaison position and supported the Red River Métis' participation in the Indigenous Advisory Committee to address this concern. It was agreed that these initiatives would be funded through a relationship agreement. Throughout the summer and fall of 2021, CNL and the Manitoba Métis Federation have been working together to develop the draft multi-year relationship agreement that will help to mitigate the Red River Métis' concerns on the Project and ensure the Manitoba Métis Federation is involved in environmental monitoring, communication initiatives, and other key initiatives. At the time of this submission of the draft EIS, CNL and the Manitoba Métis Federation were close to finalizing the draft relationship agreement.

CNL and the Manitoba Métis Federation still need to finalize the list of binding commitments and submit that list to the CNSC, and the Manitoba Métis Federation and CNL need to complete an assessment to confirm the implemented commitments adequately address the Manitoba Métis Federation's concerns.

The Health of the Winnipeg River and Confidence in Métis Harvesting near the Whiteshell Laboratories Site

The Manitoba Métis Federation indicated that the health of the environment, plants, and wildlife relied on for harvesting activities as well as the risk to people in the area of the Project site are of great concern to the Manitoba Métis Community. The Manitoba Métis Federation also had a series of questions on the WL site's discharge to the Winnipeg River, including the potential for their discharge licence to trigger an environmental assessment and if the site's discharge has any effects on Manitoba Hydro operations. The Manitoba Métis Federation have indicated they want to be able to share factual and timely information about the WL site with Métis harvesters so they have confidence to conduct their Métis Harvest Rights. The Manitoba Métis Federation also raised concerns

that the Manitoba Métis Federation be notified within 21 days of construction activities so Métis harvester's rights would not be affected as a result of construction related activities, which may disturb or displaced wildlife.

During the 2020 Regulatory Oversight Report meeting, the Manitoba Métis Federation provided recommendations on how CNL can continue to progress its relationship with the Manitoba Métis Federation through more active involvement in environmental monitoring activities on site. The Manitoba Métis Federation would like to see more opportunities for participation in environmental monitoring program development and implementation, beyond simply observation.

To help to address these concerns, CNL has committed to collaborating on a Manitoba Métis Federation wildlife and environmental monitoring program for the WL site, during a technical wrap up meeting on May 11, 2021, to address concerns regarding the health of the environment. CNL also committed (May 2021) to funding a liaison position and supported the Red River Métis' participation in the Indigenous Advisory Committee. These initiatives will improve communication about site activities and support alleviating concerns about the Project. In addition, CNL has committed to establishing a communication protocol for reportable events with the Manitoba Métis Federation so that Métis harvesters are notified in the unlikely event of any off-site effects such as noise or other activities that may impact harvesting activities. This commitment was affirmed during a workshop in November 2020.

CNL's view is that the steps CNL has taken adequately addresses this area of interest to the extent possible. The next steps are to develop a relationship agreement to implement these commitments, and work with the Manitoba Métis Federation to develop communication materials to mitigate fear, anxiety, and stigma associated with the WR-Project. Engagement with the Manitoba Métis Federation is on-going, and monitoring with the Manitoba Métis Federation will continue throughout the environmental assessment process and afterwards.

The parties will consider these concerns to be fully addressed once the Manitoba Métis Federation and CNL assess the success of the implemented commitments and confirm they address the Manitoba Métis Federation's concerns.

Regulatory Process

The Manitoba Métis Federation expressed the concern that participant funding from the CNSC was lower than anticipated and covers activities following EIS submission and not before. They requested clarification on Red River Métis' opportunities to comment on the EIS. In addition, the Manitoba Métis Federation requested a list of VCs for the Project and asked if Indigenous rights would be included as a VC. CNL has committed to and provided capacity funding to Manitoba Métis Federation beyond the funding provided by CNSC. In general, this has included reimbursement of some out-of-pocket expenses to participate in engagement activities such as site visits, tours, regional community open houses; and basic costs to support open houses. In addition, CNL funded a food intake study by Manitoba Métis Federation citizens regarding collection and eating of harvested country foods. CNL also provided a list of VCs as requested and asked for Manitoba Métis Federation feedback.

CNL's view is that the steps CNL has taken adequately addresses this area of interest to the extent possible. The next steps to support ongoing participation in the environmental assessment process include support for, and consideration of, any additional technical comments raised during the review process for the revised EIS to be submitted to CNSC in fall 2021; the finalizing and implementation of a relationship agreement; and the development and implementation of a monitoring protocol agreement for the involvement of Métis monitors in monitoring activities at the site.

In Situ Disposal Option

The Manitoba Métis Federation raised concerns about the ISD approach and have stated their preference for complete removal of the WR-1 facility from the site. The Manitoba Métis Federation has stated that the risks from ISD will still be present and would have the potential to adversely impact the Manitoba Métis Federation and their ability to exercise their rights.

CNL recognizes that the Red River Métis' preferred decommissioning approach for WR-1 is full removal. CNL's view is that the steps CNL has taken adequately addresses this area of interest to the extent possible at this time. While CNL and the Manitoba Métis Federation do not agree on the method of decommissioning, the parties have agreed to continue to work collaboratively to ensure any outstanding concerns are resolved to the extent possible.

Traditional Land Use

The Manitoba Métis Federation noted that regulators may notice and flag the absence of Traditional Knowledge in the EIS. The Manitoba Métis Federation has a catalogue of Traditional Knowledge but does not have the capacity to analyze it for gaps and relevance to the WL site. The Manitoba Métis Federation notes that a TKLUOS should be undertaken as neither the previous Comprehensive Study Report nor the current monitoring reports consider Métis harvesting. The Manitoba Métis Federation indicates that CNL should also include monitoring and follow-up programs for potential effects to culturally important terrestrial species. The Manitoba Métis Federation recommends that CNL complete a thorough effects assessment on species of traditional importance to the Manitoba Métis Federation identified in a Project-specific TKLUOS.

To help address this concern, CNL drafted the EIS to clearly state that Red River Métis citizens conduct traditional activities and land use near the WL site. CNL funded a traditional food consumption study of which 21 citizens of the community responded. The Manitoba Métis Federation carried out the survey and the data was provided back in the community feedback report. CNL has used the data to confirm that the Harvester model is a conservative model for modern day Indigenous people that rely on harvesting for some of their food. The results confirmed that the intake rates assumed in the Harvester model in the EIS are conservative compared to the Manitoba Métis Federation survey and the post closure safety assessment is also conservative.

CNL undertook research on Red River Métis traditional land use when preparing the draft EIS, however, the Manitoba Métis Federation indicated in meetings with CNL and CNSC, Métis specific knowledge of the region does not necessarily exist in written documents and needed to be obtained first-hand. As such CNL, with support from the CNSC, funded the Whiteshell Reactor #1 Decommissioning: Manitoba Métis TKLUOS (SVS 2019). CNL has incorporated information from the TKLUOS into the draft EIS. CNL has subsequently revised the draft EIS and included elements of the TKLUOS in Section 6.8.1.5.2.2 Traditional Land and Resource Use by Indigenous Peoples. CNL's view is that the steps CNL has taken adequately addresses this area of interest to the extent possible.

CNL has also used the TKLUOS to verify the Project's VCs and created a list of VCs for Red River Métis. The Manitoba Métis Federation has verified that these VCs adequately capture the species and areas of interest and concern to the Red River Métis. The following list is CNL's understanding of related species and topics of interest to the Manitoba Métis Federation:

- food and medicines;
- furbearers;
- marten;

- rabbit, squirrel;
- weasel;
- white-tailed deer;
- moose;
- pike, walleye, other fish;
- grouse, geese, ducks, waterfowl;
- groundwater and groundwater interaction;
- Winnipeg River;
- land tenure and future use;
- cultural and archaeological sites;
- traditional harvesting of country foods;
- psychosocial and perceptions-based health and rights impacts; and
- employment and business opportunity, community well-being, and environmental and community safety.

CNL has partially addressed this matter within the Project context and will continue to ensure the Manitoba Métis Federation and Red River Métis values, interests, and traditional knowledge are meaningfully incorporated into the Project. The sincerity of CNL is demonstrated through the Relationship Agreement. The Manitoba Métis Federation will review and comment on this commitment when it is included as a formal commitment submitted to the CNSC.

Monitoring and Control of the Proposed WR-1 Disposal Facility and the Decommissioned WL Site

The Manitoba Métis Federation raised a concern about monitoring and control of the WL site over the long-term. Specifically, they raised issue that the rationale for ISD relies on maintenance and monitoring of the installation for 300 years and that “control” will last “indefinitely”. The Manitoba Métis Federation indicates that it is not clear how CNL is prepared to make this commitment for the post-closure phase after 2126 or, in particular, after 2326. The Manitoba Métis Federation notes that environmental regulations change with each government, and it is possible that future governments may choose not to allocate funding to maintaining and monitoring the WL site. The Manitoba Métis Federation argues that there is no way to guarantee future commitment of resources. The Manitoba Métis Federation has raised concerns about the containment of waste in the disposal facility, monitoring of the ground water in the vicinity of WR 1 and the Winnipeg River, overall. The Manitoba Métis Federation stressed the importance of ongoing monitoring and accountability for the WR-1. The Manitoba Métis Federation requested the opportunity to work alongside CNL in the development a wildlife mortality monitoring and adaptive management program to address impacts to wildlife important to the Manitoba Métis Federation.

CNL has committed to supporting the Manitoba Métis Federation’s participation in environmental monitoring and will be collaborating with the Manitoba Métis Federation to ensure CNL aligns with the Manitoba Métis Federation’s expectations and interests. CNL and the Manitoba Métis Federation held a teleconference on March 23, 2021, to discuss a relationship agreement including funding a Liaison position, and participation in annual environmental monitoring. CNL committed to developing a relationship agreement with the Manitoba Métis Federation and provided a revised draft of the relationship agreement for the Manitoba Métis Federation’s review and feedback on April 22, 2021. The relationship agreement would help support the Manitoba Métis Federation’s continued

engagement on the reactor decommissioning and site environmental monitoring activities. CNL and the Manitoba Métis Federation hosted a workshop and discussed post closure ground water monitoring February 9, 2021, and a workshop on the site wide environmental protection program. Following the workshops, CNL provided the Manitoba Métis Federation with additional information on upcoming monitoring activities at CNL and invited them to participate.

On May 11, 2021, CNL committed to establishing a Manitoba Métis Federation wildlife and environmental monitoring program on the WL site. CNL and the Manitoba Métis Federation agreed to fund this initiative through signing a relationship agreement. During the meeting, the Manitoba Métis Federation confirmed the implementation of this initiative would address this area of interest. CNL will also use adaptive management practices in the post closure monitoring program from WR-1.

CNL's view is that the steps CNL has taken adequately addresses this area of interest to the extent possible, pending the funding and implementation of the wildlife and environmental monitoring program initiative.

Whiteshell Site Environmental Remediation and incorporation of Métis Information

The Manitoba Métis Federation has expressed interest in providing Métis input into the grass seed mix proposed for site remediation areas, to ensure species of importance to the Métis are considered and to avoid species that may conflict with Métis harvest practices. The Manitoba Métis Federation expressed interest in site remediation with respect to bush and tree planting. The Manitoba Métis Federation would like to see species of importance to the Métis used on site.

To help address Red River Métis' concerns in this area, CNL shared the current seed mix with the Manitoba Métis Federation to seek their feedback on it. CNL committed to providing the Manitoba Métis Federation with the detailed site revegetation plan once it has been drafted. CNL committed to only using native seeds in our revegetation efforts. CNL held discussions in fall 2020 with the Manitoba Métis Federation on input to tree species for site re-forestation. CNL held discussions with the Manitoba Métis Federation on potentially procuring trees and bush plants from the Red River Métis. The Manitoba Métis Federation is currently exploring the establishment of a tree nursery business.

In addition, CNL and the Manitoba Métis Federation participated in a workshop on CNL's environmental protection program on March 17, 2021. Afterwards, CNL also provided a list of environmental monitoring activities and invited the Manitoba Métis Federation to participate in monitoring. A workshop that included tree planting on site was held in late 2020. CNL will continue to engage with the Manitoba Métis Federation on input to and potential sourcing of seeds, bushes, and trees for site re-vegetation activities. During a teleconference on May 11, 2021, CNL committed to establishing a Manitoba Métis Federation wildlife and environmental monitoring program for the WL site.

CNL's view is that the steps CNL has taken adequately address this area of interest to the extent possible.

Next steps are for CNL and the Manitoba Métis Federation to finalize and begin execution of the relationship agreement to support the implementation of CNL's commitments.

Economic Opportunities

The Manitoba Métis Federation raised an interest in capacity building for its citizens and participating in the economics of the Project. The Manitoba Métis Federation expressed a desire for Métis businesses to be involved in contract work on the Project. In addition, the Manitoba Métis Federation recommends that CNL provide

opportunities to the Manitoba Métis Federation to build capacity and knowledge in decommissioning activities and reclamation of project components. CNL hosted three industry days to facilitate a dialogue with interested Métis contractors. CNL worked to enhance options to better match Métis businesses' capabilities with their contracting needs, including adding provisions to its procurement process that encourages the use of Indigenous and local small and medium sized businesses. CNL introduced Métis N4 Construction to Golder Associates to provide the possibility of the organizations forming a teaming agreement to support contracting opportunities. CNL exhibited at the 2018 and 2019 Manitoba Métis Federation Annual General Assembly in order to meet Métis businesses and share employment and contracting opportunities with the Whiteshell Laboratories Closure Project.

CNL integrated these socio-economic VC considerations into the updated EIS and provided Manitoba Métis Federation with a copy for their review and feedback to verify these concerns were addressed in the EIS. Implementation of the Relationship Agreement should result in increased economic participation in the Project by Red River Métis citizens.

4.2.4.2.3 Verification

CNL incorporated feedback through engagements with the Manitoba Métis Federation on the Project, their TKLUOS, and Country Foods Harvest Survey. To confirm CNL has adequately captured the Red River Métis' interests and concerns, position, and knowledge, CNL and the Manitoba Métis Federation underwent a verification process whereby CNL provided EIS documentation to the Manitoba Métis Federation for their review and feedback. Through this process, the Manitoba Métis Federation has reviewed and provided feedback from their summary of interests and concerns table, list of VCs, and Section 4.0 Indigenous Engagement. While not all of the Red River Métis' concerns were mitigated by this process, CNL made every effort to verify that the Red River Métis' position, interests, and concerns were adequately characterized. CNL continues to work with the Manitoba Métis Federation to address their concerns through on-going discussions. And as stated above, CNL and Manitoba Métis Federation continue to work towards having a relationship agreement in place in the near term.

On June 2, 2021, CNL sent the Manitoba Métis Federation a letter requesting their review of the summary of interests and concerns CNL had developed based on engagements and Red River Métis' TKLUOS (SVS 2019). CNL also developed a list of VCs for the Manitoba Métis Federation based on feedback from past engagement, Red River Métis' harvester consumption survey, and Red River Métis' TKLUOS. CNL asked the Manitoba Métis Federation to verify whether CNL had adequately characterized Red River Métis' interests and concerns. In the letter, CNL offered to provide capacity funding and to meet with Manitoba Métis Federation to discuss the table and list of VCs.

On July 26, 2021, the Manitoba Métis Federation sent CNL feedback on the summary of interests and concerns table and list of VCs. On the same day, CNL and the Manitoba Métis Federation signed an MOU to support Red River Métis' technical review of the summary of interests and concerns and list of VCs. CNL accepted all track changes for both documents from the Manitoba Métis Federation and sent back the revised two documents on August 19, 2021. CNL sent a final thank you letter to the Manitoba Métis Federation on August 24, 2021, thanking the Manitoba Métis Federation for their participation in verifying CNL had adequately captured their summary of interests and concerns table and list of VCs.

CNL received a letter from the CNSC on August 24, 2022, indicating that three Information requests remained outstanding, including updating the Indigenous engagement narrative and tables. Further verification efforts were made to updates to the EIS. Community specific portions of Section 4.0, Engagement Logs, and Interests and Concerns Tables were sent to the Manitoba Métis Federation to review for accuracy. On November 22, 2022, CNL met with the Manitoba Métis Federation to review EIS updates. The Manitoba Métis Federation expressed concern

for CNL to ensure they are referencing Manitoba Métis Federation and Red River Métis. The Manitoba Métis Federation confirmed in an e-mail to CNL on December 7, 2022, that they have no further comments on EIS updates.

Further verification of the EIS occurred in October 2022 where material changes to the EIS as a result of necessary CNSC required updates were sent to the Manitoba Métis Federation to review for accuracy. On November 3, 2022, Manitoba Métis Federation confirmed that changes to the EIS reflected current discussions and understandings.

For specific engagement related information on the verification process, please see Section 4.2.4.1.1 and Appendix 4.0-1.

4.2.4.2.4 Next Steps

During past engagements, the Manitoba Métis Federation has expressed an interest in developing a formal communications protocol between CNL and the Manitoba Métis Federation in the event there are activities/an event that has the potential to impact their rights. CNL and the Manitoba Métis Federation are working to formalize CNL's commitment to support a communication protocol and other initiatives through a relationship agreement between CNL and the Red River Métis. The relationship agreement will support key initiatives that will help to address the Red River Métis' interests and concern on the Project. Once the Long-Term Relationship Agreement is finalized, CNL will work with the Manitoba Métis Federation on a work plan to develop the communication protocol, along with other initiatives under the Long-Term Relationship Agreement.

CNL has committed supporting Manitoba Métis Federation's involvement in long-term environmental monitoring at the WL site.

CNL has committed to establishing an Indigenous Advisory Committee, which will provide Indigenous advice and guidance on matters of mutual interest, but not replace Indigenous bi-lateral engagement. In addition, CNL has committed to supporting the Manitoba Métis Federation's participation in long-term environmental monitoring at the WL site. CNL plans to have further discussions to establish these initiatives. As a result of engagement with the Manitoba Métis Federation, CNL has made the following commitments:

- Establish a surface water monitoring location in closer proximity to the release point in the Winnipeg River;
- Include a ground monitoring station closer to the reactor; and
- Incorporate a water sample collection in final post-closure monitoring plan.

CNL will be compiling a list of all commitments and recommended next steps proposed in the comments and responses table and from recent engagements, and work with the Manitoba Métis Federation to finalize the list. Some of these commitments will include supporting the Manitoba Métis Federation's participation in long-term environmental monitoring at the WL site. CNL will work with the Manitoba Métis Federation to complete CNL's final responses to their comments on the EIS. CNL will also work with the Manitoba Métis Federation to complete the final columns of the summary of interests and concerns table.

CNL committed to executing and implementing the Relationship Agreement with the Manitoba Métis Federation to support key initiatives that will help to address the Red River Métis' concerns on the Project.

4.2.4.3 Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation

Black River First Nation, Hollow Water First Nation, and Brokenhead Ojibway Nation are three very unique First Nations that all have asserted or established Aboriginal and Treaty rights in the vicinity of the Project. Their reserves are also within proximity to the WR-1 site, and the communities have expressed an interest in the Project. The three First Nation communities have worked together to submit a joint TKLUS report and have worked together to submit questions on the 2017 draft of the EIS and it is for those reasons CNL has put these communities in one section.

See the IER (CNL 2022) for more background information on each First Nation community.

The Black River First Nation is an Anishinaabe community and signatory to Treaty No. 5. The Black River First Nation primarily speak Ojibwe (Black River First Nation 2009) and occupy one area of reserve lands: Black River 9 Reserve No. 06360. The Reserve is situated approximately 75 km north of the WR-1 site, and along the eastern shore of Lake Winnipeg. The reserve covers an area of 809.3 ha. Band Membership is under Section 10 of the *Indian Act* (INAC 2019b).

A map of the Black River First Nation is provided in Appendix D of the IER (CNL 2022).

The Hollow Water First Nation is an Anishinaabe (Ojibwa) First Nation and signatory to Treaty No. 5, with land cessions within the settlement boundary identified in the IER. The First Nation has potential, asserted, and/or established Aboriginal and Treaty rights in the vicinity of the Project.

A map of Hollow Water First Nation is provided in Appendix D of the IER (CNL 2022).

The Brokenhead Ojibway Nation is an Anishinaabe (Saulteaux/Ojibwa) First Nation. The First Nation is a signatory to Treaty 1. The Brokenhead Ojibway Nation occupies three areas of reserve lands. Brokenhead 4 Reserve No. 06361 is the largest and is situated approximately 44 km northwest of the WL site. This main reserve is largely surrounded by the Rural Municipality of St. Clements and contains the settlement of Scanterbury. The land base for this reserve is 5,412.8 ha. One of two additional smaller reserves is the Birch Landing Reserve No. 09800 (272 ha) to the north of Brokenhead 4 Reserve, and 55 km northwest of the WL site.

A map of Brokenhead Ojibway First Nation is provided in Appendix D of the IER (CNL 2022).

CNL, Black River First Nation, and Hollow Water First Nation have worked collaboratively since 2016. CNL and the two Nations have entered into a relationship agreement, as of April 2021, to support engagement with the broader community members. Key initiatives in the relationship agreement include establishing a core engagement team made up of community members from each Nation, holding community events and activities such as barbeques and community open house events. The relationship agreement also includes funding for a part-time Liaison position to support greater engagement with the two communities. In fall of 2020, CNL received verbal confirmation from Brokenhead Ojibway Nation that they no longer had interest in further engagement on the Project with CNL at this time. CNL respects this position and remains interested in future engagement with Brokenhead if the community chooses to re-engage. CNL continues to send project updates to Brokenhead Ojibway Nation to keep the community informed.

In October, 2022, at the further urging of CNL, the Brokenhead Ojibway Nation has re-engaged with CNL. CNL will work with the Brokenhead Ojibway Nation to ensure they have the information and support necessary for their further participation.

4.2.4.3.1 Engagement

In August 2016, CNL sent the Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation each a letter to introduce the proposed Project, which included a request for community input on any potential adverse impacts from Project activities. In December 2016, CNL invited all three communities to meet and discuss the Project. CNL met with Black River First Nation and Brokenhead Ojibway Nation to discuss how they would like to be engaged and to provide an overview of the proposed alternative to ISD.

In early February 2017, CNL and AECL held a two-day meeting with the three communities to discuss the WR-1 ISD Project and reviewed a proposed student job description. On the second day, community representatives were given a tour of WR-1 and of the WL site. CNL HR staff were also present to discuss job advertising. In June, CNL and the Brokenhead Ojibway Nation had a follow-up meeting where CNL presented their proposed ISD and addressed community concerns. In fall 2017, CNL sent a letter to all Indigenous communities notifying them of the public comment period on the draft EIS and invited them to engage. CNL also mailed hard copies of the draft EIS executive summary.

In September 2017, CNL provided an opportunity for five members from each First Nation and the Manitoba Métis Federation to attend a full day workshop to both learn and share on how CNL and Indigenous Nations collectively protect and care for the environment. The goal was to provide some hands-on experience coupled with ample discussion, learning and dialogue on opportunities moving forward both as a career option and as a relationship between the site and the First Nation and the Red River Métis.

On October 31, 2017, CNL's Annual Safety Reports were distributed to each First Nation community including the "Environmental Monitoring in 2016 at Whiteshell Laboratories" report, and the "2016 Progress Report on the Environmental Assessment Follow-up Program for Whiteshell Laboratories". CNL also provided an invitation to engage on these documents.

In 2018, CNL organized a trip to Hallam, Nebraska with engaged Indigenous communities to visit a site that had implemented ISD. Collectively, Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation sent representatives from Black River First Nation and Brokenhead Ojibway Nation. In September, CNL and Black River, Brokenhead and Hollow Water First Nations had a follow-up meeting to discuss the Hallam trip and the communities' introduced Kevin Bird as Project coordinator for the three communities.

In February 2019, CNL provided a site tour to the Southeast Resource Development Council (SERDC) and have enabled a potential collaboration with a CNL supply chain contractor for the purpose of economic benefit resulting from the WL Closure Project. The SERDC, incorporated and recognized in 1978, represents the formal unification of eight (8) member First Nations in the southeastern portion of Manitoba, including Brokenhead, Hollow Water and Black River First Nations. The Tribal Council is accountable to approximately 12,000 members under the leadership of its eight First Nation Councils.

As a political and administrative organization, the SERDC is designed and mandated to facilitate the development of local control and responsibility of programs and services to member First Nations by:

- Providing a mechanism whereby the SERDC can develop the administrative and managerial skills necessary to assist each First Nation institute and deliver local services at its own pace and in tune with each First Nation's level of development.
- Providing a mechanism whereby the SERDC can ensure that services are equitably and effectively delivered to each First Nation.
- Providing a mechanism whereby the SERDC can assist the First Nations to develop a capacity for local services, making them less dependent on Aboriginal Affairs and Northern Development Canada (AANDC) or the Tribal Council in matters of local concern and responsibility.

In March 2019, CNL supported a Councillor from Black River First Nation to attend the Waste Management Symposia in Phoenix, Arizona. The symposia is a not-for-profit organization dedicated to providing education and information exchange on global radioactive waste management. This trip was intended to provide a cooperative learning opportunity for Black River First Nation. Councillor Johnson was able to attend conference presentations and interact with regulators, government representatives and contractors. Councillor Johnson also participated on a panel session regarding Indigenous engagement in nuclear projects.

CNL also hosted the three communities for a two-day meeting in June 2019. The first day, CNL provided a site tour. On the second day, CNL provided a Project update, followed by a Traditional Knowledge study workshop with the three communities held at Brokenhead Ojibway Nation. In September, the communities invited CNL to participate in a meeting to discuss the Traditional Knowledge study wrap-up. In December, CNL, AECL, the communities, and their consultants met to discuss roll-out of a TKLUS.

In March 2020, CNL and Black River First Nation had a teleconference to discuss next steps as well as setting up a meeting to review the communities' thoughts on CNL's responses to the communities' comments on the EIS. In April 2020, CNL provided an update to the communities and CNSC on the decommissioning activities. In August 2020, Brokenhead Ojibway Nation confirmed they did not want to participate in the Indigenous Advisory Committee nor did they want to have an Indigenous liaison position in their community, despite CNL's offer to provide them with capacity funding. Brokenhead stated they were content to continue to engage through the regulatory process and CNL continues to respect their decision. CNL also continues to send Brokenhead updates. In September 2020, CNL, Black River First Nation, Hollow Water First Nation and their consultant met by teleconference to discuss the Indigenous Advisory Committee and Black River and Hollow Water First Nations' engagement organizational framework.

In fall of 2020, CNL received verbal confirmation from Brokenhead Ojibway Nation that they no longer had interest in further engagement on the Project. CNL respects this position and remains interested in future engagement with Brokenhead if the community chooses to re-engage.

CNL hosted a multi-community event at the WL site on October 20, 2020. The purpose of the half-day site visit was to discuss CNL's environmental protection program and to observe CNL's fish processing, which is part of CNL's routine environmental monitoring program. Participants included Sagkeeng's Liaison Officer, a representative from the Red River Métis, and two representatives from Black River and Hollow Water First Nations. A presentation was provided by CNL's environmental specialist on CNL's environmental protection program. Participants also made a number of recommendations on how to incorporate species of interest to the communities

into CNL's monitoring program. Afterwards, CNL and the participants made their way to the environmental lab where participants observed CNL processing fish they had caught that morning. Participants asked CNL's environmental technicians a number of questions about where the fish were caught and the method for catching them. A workshop report was circulated to participants for review and comment. CNL did not receive any feedback on the report from the participants.

On October 27, 2020, HTFC, consultants supporting Black River and Hollow Water First Nations, met with CNL to discuss a 2-year engagement plan that would support engagement with both communities on the Project. CNL and HTFC met via teleconference again on November 2 and November 12, 2020, to discuss HTFC's revised proposal. On November 25, 2020, CNL invited Black River and Hollow Water First Nations to participate in CNL's 2020 virtual Industry Day held December 9, 2020.

On December 14, 2020, CNL hosted a teleconference with Black River and Hollow Water First Nations and their consultants, HTFC Planning and Design, to discuss funding needs for the two communities. On January 11, 2021, CNL provided CNL's final responses on their draft EIS comments and on January 19, CNL provide a copy of their proposed Contribution Agreement. CNL also provided an advanced copy of the IER.

In February 2021, CNL met with Black River and Hollow Water First Nations' consultants to review the communities' proposed changes to the Contribution Agreement. This Contribution Agreement will fund the communities' participation in the Indigenous Advisory Committee as well as a Community Liaison to support engagement between CNL and Black River and Hollow Water First Nations. On February 8, 2021, CNL sent out a letter to Brokenhead Ojibway Nation to notify Indigenous communities who had indicated they did not wish to engage of the status of the EIS submission and to offer to meet to discuss their interest and concerns in relation to the Project. On March 11, 2021, CNL reached out to Brokenhead Ojibway Nation via telephone asking to see whether they wanted to re-engage on the Project.

On April 6, 2021, Black River First Nation, Hollow Water First Nation, and CNL signed a 2-year relationship agreement to support the development of a community liaison position and a community advisory committee and participation in the environmental assessment process for the Project.

On April 12, 2021, CNL provided a list of environmental monitoring activities for the 2021 field season and invited the communities to set up a meeting to discuss which activities the communities wanted to participated in. On April 20, 2021, CNL invited the communities to participate in a public webinar to learn more about the Project.

On May 11, 2021, CNL sent a letter to the communities requesting verification of the draft table of interests and concerns as well as the VCs CNL had developed from past engagements and the communities' TKLUS (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019).

On May 13, 2021, CNL held a meeting to introduce the new liaison officer to the CNL team and provide some initial background information on the site and WR-1. During the meeting, the participants also discussed developing an onboarding program. On May 19, 2021, CNL met with Black River and Hollow Water First Nation's Liaison Officer to review and finalize the onboarding process and begin to schedule the site tours and presentations.

On May 20, 2021, at the request of Black River First Nation, CNL gave a presentation on the Project to members of the Lake Winnipeg Collective.

Black River First Nation and Hollow Water First Nation's Liaison Officer visited site and took a tour of WR-1 on May 25, 2021. On June 1, 2021, the Liaison Officer participated in a radiation 101 course.

In June 2021, CNL sent out invitations to communities to participate in the Indigenous Advisory Committee.

On June 23, 2021, CNL met via teleconference with Black River First Nation and Hollow Water First Nation to discuss how they would like to participate in environmental monitoring. On July 6, 2021, CNL and the communities had a follow-up discussion on which environmental monitoring activities the communities wanted to participate in.

On July 12, 2021, CNL received feedback from Black River First Nation and Hollow Water First Nation on their summary of interests and concerns and list of species and topics raised in the TKLUS (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019) and engagement.

On July 14, 2021, the communities' Liaison Officer participated in a bat survey for Building 100, which houses WR-1.

The communities' Liaison Officer visited site and participated in a WR-1 and Waste Management Area tour on August 11, 2021. On the following day, August 12, 2021, Hollow Water First Nation participated in an exploratory discussion on the formation of an Indigenous Advisory Committee for the WL site. During the meeting the participants worked on key elements of a terms of reference for the committee.

On August 16, 2021, the communities' Liaison Officer observed river sediment sampling, soil, and vegetation surveys on site.

CNL met with HTFC Planning & Design and lead representatives from each community on August 19, 2021, to go through the feedback received on the summary of interests and concerns table and list of species and topics raised in the TKLUS and engagement. CNL incorporated the feedback and on August 26, 2021, CNL provided a revised copy to the communities to show how their feedback was incorporated. The communities provided additional feedback on September 2, 2021. CNL incorporated the additional feedback and sent the final copy back the community on September 9, 2021, along with a thank you letter, thanking the communities for participating in the verification process for their summary table of interests and concerns and list of species and topics raised in the TKLUS and engagement. CNL provided the updated copies to Brokenhead Ojibway Nation and throughout the summer of 2021 reached out by phone, e-mail and fax. CNL has not heard from the community and while CNL sent an updated copy of the summary of interests and concerns table to include specific references with Brokenhead Ojibway Nation's technical review of the 2020 draft EIS on October 6, 2021, CNL has not received a response from the community. On September 30, 2022, CNL issued a letter to the Brokenhead Ojibway Nation informing them that CNL would be incorporating the table into the EIS and move forward with submission. In the letter, CNL informed Brokenhead Ojibway Nation that CNL would be proceeding with incorporating the summary of interests and concerns table and list of VCs but that there remained opportunities to review and provide feedback in the EIS and throughout the environmental assessment process.

On November 10, 2021, CNL, Black River First Nation, and Hollow Water First Nation held a teleconference to go over the budget for the Relationship Agreement and to set next milestones and target dates for key activities within the Relationship Agreement. On November 26, 2021, CNL asked Black River First Nation, Hollow Water First Nation, and Brokenhead Ojibway Nation to review Section 4.0 to confirm CNL had documented the information correctly. On November 30, 2021, CNL followed-up via e-mail to confirm Black River First Nation, Hollow Water First Nation, and Brokenhead Ojibway Nation had received Section 4.0 and were planning to review. Further, on December 1, 2021, CNL followed-up via phone to confirm Black River First Nation, Hollow Water First Nation, and

Brokenhead Ojibway Nation had received Section 4.0 and were planning to review the document. On December 8, 2021, CNL received feedback from Black River First Nation and Hollow Water First Nation on Section 4.0. In a phone conversation on December 13, 2021, Black River First Nation provided an update on the first Black River First Nation and Hollow Water First Nation Liaison Committee Meeting.

On February 8, 2022, CNL met with Black River First Nation to discuss the status of the EIS submission and next steps for engagement in the environmental assessment process. CNL also discussed priority engagement items for the community. Later, on February 16, 2022, CNL met with Black River First Nation to discuss the development of community-specific communications material. Black River First Nation provided a list of topics that they would like to communicate to the community.

On March 15, 2022, CNL informed the communities that CNL would be repackaging their interests and concerns table as a result of CNSC feedback on a similar CNL project. The communities confirmed they would like to review the table prior to submission. During a teleconference on April 13, 2022, CNL, Black River First Nation, and Hollow Water First Nation discussed setting up a site tour with the core engagement team and CNL's environmental monitoring team.

CNL met with Black River First Nation and Hollow Water First Nation on May 11, 2022, to discuss the status of the EIS submission, discuss their revised interests and concerns table, environmental assessment process, development of communication materials and other areas of interest.

On May 25, 2022, CNL, Black River First Nation, and Hollow Water First Nation discussed the logistics for the upcoming site tour, and on June 9, 2022. CNL hosted the Black River First Nation and Hollow Water First Nation Community Liaison Committee for their first site tour. Meanwhile on June 13, 2022, CNL requested confirmation from the communities that the table was reflective of their interests and concerns.

CNL, Black River First Nation, and Hollow Water First Nation discussed the upcoming Treaty days via teleconference on July 13, 2022, and how CNL could participate. On the same day, CNL sent out a letter of notice to Brokenhead Ojibway Nation's Chief informing them that CNL has submitted a draft EIS and requested a meeting to engage on the project. Later in July on July 28, 2022, Black River First Nation and Hollow Water First Nation participated in berry picking near the underground research laboratory site.

August 2022 focused on further discussions regarding the Project and involvement in environmental monitoring. The monthly meeting with CNL, Black River First Nation, and Hollow Water First Nation, on August 17, 2022, focused on upcoming engagements, exploring areas of interest, and updates on the decommissioning work. On August 30, 2022, CNL sent a sent a copy of CNL's monitoring program schedule and requested Black River First Nation and Hollow Water First Nation to identify any activities of interest.

On September 8, 2022, Black River First Nation and Hollow Water First Nation participated in mushroom collection from three locations around the WL site. At the September 14, 2022, monthly meeting, CNL, Black River First Nation, and Hollow Water First Nation discussed extending the existing Relationship Agreement and coordinating future environmental monitoring activities. There was also an invitation extended to Black River First Nation and Hollow Water First Nation to accompany CNL to the Waste Management Symposium in Phoenix in 2023, and be a panelist to discuss risk communication matters. CNL is currently developing a letter of extension to ensure the Contribution Agreement continues. CNL forwarded an invitation to Black River First Nation, Hollow Water First Nation and Brokenhead Ojibway Nation on September 20, 2022, to join a Webinar on September 28, 2022. There was much coordination and communication during the week of September 25, 2022, culminating in a fall medicinal

plant walk at the WL site with Elders and members from Black River and Hollow Water First Nations on September 29, 2022.

At the time of this submission, the relationship with Black River First Nation and Hollow Water First Nation is active and continuing to develop and grow. CNL will continue to make efforts to engage Brokenhead Ojibway Nation.

4.2.4.3.2 Interests and Concerns

Through a variety of engagement forums, including technical workshops, webinars, and meetings, Black River First Nation and Hollow Water First Nation have raised issues, concerns and questions that were initially focused on the 2017 and 2020 draft EIS. These engagements have led to the development of the interests and concerns table for Black River First Nation, Hollow Water First Nation, and Brokenhead Ojibway Nation. This subsection is taken from the tables of interest and concerns from Appendix 4.0-1 and describes CNL's understanding based on written submissions and oral discussions with the Nations. The Nations have also provided feedback through their TKLUS (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019) and Brokenhead Ojibway Nation provided addition comments through their technical review of the 2020 draft EIS (SVS 2020).

CNL has made its best efforts to document and verify the position the Nations have taken on each interest/concern. See Section 4.4 for a summary of issues raised during engagement activities that influenced the scope of the environmental assessment.

Business and Employment Opportunities

Brokenhead Ojibway Nation, Hollow Water First Nation and Black River First Nation raised the possibility of CNL using direct negotiated contracts with First Nations in decommissioning and overall closure processes and expressed an interest in learning more about CNL's Indigenous procurement requirements associated with the Project and employment opportunities that are currently available within the Whiteshell Laboratories Closure Project. The communities expressed concern that they would not be competitive with larger businesses in the tender process.

To help address this concern, CNL worked to enhance options to better match these First Nations capabilities with their contracting needs including adding provisions to its procurement process that encourages the use of Indigenous-owned businesses or businesses that employ Indigenous People. CNL discussed the need for better information sharing regarding the procurement and contracting opportunities and asked for specific capabilities that communities have related to the Project. CNL engaged with the SERDC as it was recommended as the best way to explore First Nation capabilities and CNL procurement opportunities. SERDC has subsequently partnered with Golder to increase their ability to contract to CNL. CNL, Black River First Nation, and Hollow Water First Nation also signed a comprehensive relationship agreement, on April 6, 2021, to support greater community involvement in the Project. The relationship agreement supports the establishment of a community committee, a community liaison position, support to participate in the Indigenous Advisory Committee and provide capacity support to ensure the communities can continue to participate in discussions on business development opportunities.

In Brokenhead Ojibway Nation's Technical Review of the Revised Environmental Impact Statement for the Project (SVS 2020), Brokenhead Ojibway Nation expressed concerns that CNL had not include data on Brokenhead Ojibway Nation labour force, employment, and income conditions into the regional baseline as well as community well-being as inherently linked to the land in the March 2020 draft of the EIS. On August 16, 2021, CNL provided

responses to questions from Brokenhead Ojibway Nation Technical Report of the Revised Environmental Impact Statement for the Project. In response to Brokenhead Ojibway Nation request, CNL is currently working to revise the EIS with more current data in Section 6.9.5.2.6 Community Well-being and will include data from Brokenhead Ojibway Nation, where available.

CNL will continue to engage on the matter of contracting and employment with the Nations through the Chiefs and Councils and the Black River First Nation and Hollow Water First Nation Community Liaison. CNL will continue to work to remove the barriers community members may face in applying for positions and seek opportunities to increase Indigenous participation in the Project.

Future Land Use and Tenure

Black River First Nation, Hollow Water First Nation, and Brokenhead Ojibway Nation were interested in knowing if the land currently occupied by the WL site would be available for other uses in the future. The communities also noted that the site occupies a large parcel of land that was removed from Treaty 1 territory without adequate consultation and there will need to be discussions with the Federal Government about the future of the WL site and potentially accommodation. There are discussions on using the WL site to build small modular reactors and the communities wanted to know more about small modular reactors and if there will be any First Nation and Manitoba Métis Federation engagement as part of the process.

CNL explained that the liability and land remain with the federal government (i.e., AECL). Decisions on future uses of the land are not under the scope of this environmental assessment and licence amendment. However, CNL and AECL plan to begin engagement on end state and future land use in 2022. The communities will be invited to participate in that process.

CNL shared that there is a community regeneration partnership that was formed to develop both nuclear and non-nuclear opportunities for the WL site after the site is decommissioned. CNL participates and supports the partnership. CNL invited Indigenous communities to join. Some communities have attended these meetings.

CNL explained that any new project on the WL site such as a small modular reactor would need to go through a licensing process that would include Indigenous engagement.

CNL, Black River First Nation, and Hollow Water First Nation signed a Comprehensive Relationship Agreement, on April 6, 2021, to support greater community involvement in the Project. The relationship agreement supports the establishment of a community committee, a community liaison position, support to participate in the Indigenous Advisory Committee and provide capacity support to ensure the communities are able to continue to participate in discussions on future land use of the WL site.

In their Technical Report, Brokenhead Ojibway Nation identified their rights and interests are to maintain a Seven Generations approach to stewardship of their lands and resources. As such, it is imperative that lands are available, healthy, and accessible to future generations. Brokenhead Ojibway Nation requested an engagement and consultation meeting with CNL and AECL to discuss future land use and tenure plans and agreements.

On August 16, 2021, CNL provided responses to questions from Brokenhead Ojibway Nation's Technical Report of the Revised Environmental Impact Statement for the Project (SVS 2020). In response to Brokenhead Ojibway Nation's request, CNL invited Brokenhead Ojibway Nation to participate in discussions on future land use and end state when they begin. In response to Brokenhead Ojibway Nation's comments in #51a and #52b, CNL has agreed to develop the post-closure monitoring programs in collaboration with each Indigenous Nation to support their

involvement in long-term monitoring. CNL updated Section 11.4 Indigenous Engagement and Participation in Environmental Monitoring of the EIS to reflect these commitments.

While future land use and tenure is out of scope for the assessment for WR-1, CNL will be contacting the communities to participate in discussions on site wide end state. CNL has acknowledged the historical lack of engagement on siting the WL site and will continue to facilitate dialogue between CNL, AECL, and the Black River First Nation, Hollow Water First Nation and Brokenhead Ojibway Nation in this regard. CNL will continue to engage the Nations on the Project and closure of the WL site.

Accidents and Malfunctions

The communities expressed concerns about past releases to the environment from the WL site and the potential for future releases of hazardous and radioactive material into the Winnipeg River. Brokenhead Ojibway Nation, Hollow Water First Nation and Black River First Nation were interested in how releases could be contained in the soil. They were also interested in how CNL detects spills.

The history of leaks at the site makes community members even more doubtful about the certainty of predictions related to potential groundwater and environmental contamination in the future.

The communities suggest in their TKLUS that groundwater health and the Winnipeg River are of primary concern. While CNL's scientific models do not predict the levels of these nuclides to be dangerous to human health, Anishinaabe Traditional Knowledge holders identified that they have seen that when predicting hundreds or thousands of years in the future, it is difficult to be confident in scientific predictions.

CNL provided information on the topic of accidents and malfunctions in writing and at two community meetings at Brokenhead Ojibway Nation. CNL explained that radioactivity levels in WR-1 are similar to other reactors that have gone through the ISD process. When the facility was shut down in 1985, all fuel and liquids were safely removed from the reactor, and what remains in place today are the structural components of the reactor, such as the metal vessel and piping. Radioactivity in the reactor is not easily mobilized. The vast majority is trapped in the walls of tanks and pipes. With respect to the rest of the WL site, all radioactive waste at the site is safely and securely stored in the site's Waste Management Area. Any events that occurred in the past were reported to the Canadian Nuclear Safety Commission (or previously the Atomic Energy Control Board). No employees or members of the public have been negatively affected by the operation emissions of the WL site.

In addition, CNL provided fact sheets of the Winnipeg River Task Force. Previously, an independent task force was created consisting of Sagkeeng, Indian and Northern Affairs, Health Canada, and Environment Canada. The Winnipeg River Task Force released its report in 1995. The task force concluded that "it is unlikely that the AECL WL site has ever posed a significant threat to the health of Sagkeeng residents, nor is there apparently any prospect of such a threat in the future". CNL explained to the communities during engagements that, as part of the application to the CNSC for a decommissioning licence in 2001, a Comprehensive Environmental Assessment was conducted. This included an investigation of the surrounding environment and the Winnipeg River sediments to look for any radioactive contamination that may have occurred over the history of the site. River sediments were surveyed for radioactivity at hundreds of locations. The assessment concluded that "using the most conservative dose estimation methods, doses to humans and non-human biota are below accepted guidelines." The analysis methodology and results were peer-reviewed, presented in public meetings and are available in the open publication of the Comprehensive Study Report (AECL 2001). CNL continues to monitor the river sediment near the site, and downstream. During tours of the site, CNL demonstrated how environmental monitoring detection tools work.

The CNSC conducted an independent monitoring campaign in 2017 with assistance from Sagkeeng. This independent program included collecting and analyzing fish caught near Sagkeeng. The results of the assessment conclude that the public and the environment in the vicinity of the WL site are protected and there are no expected health impacts. The results of this independent monitoring are publicly available at this link: https://nuclearsafety.gc.ca/eng/resources/maps-of-nuclear-facilities/iemp/whiteshell.cfm.

CNL, Black River First Nation, and Hollow Water First Nation signed a Comprehensive Relationship Agreement, on April 6, 2021, to support greater community involvement in the Project. The Comprehensive Relationship Agreement supports the establishment of a community committee, a community liaison position, support to participate in the Indigenous Advisory Committee, and contemplates the provision of capacity support to ensure the communities and CNL develop infographics specific to the needs of the communities.

Brokenhead Ojibway Nation expressed numerous concerns through their Technical Report pertaining to accidents and malfunctions (SVS 2020). Questions and comments ranged from the safety, condition, and integrity of the concrete barriers, to bank stabilization and permanent erosion control measures, to the validity of CNL computer models.

Additionally, in their Technical Report (SVS 2020), Brokenhead Ojibway Nation re-enforced the importance of water and protecting it, and shared many comments and recommendations pertaining to water. Key themes included: protection of water and ensuring the integrity of the Winnipeg River; interests in monitoring and sampling of water; the potential for future groundwater contamination; recommendation for more wells for groundwater testing; concerns about proper sealing of conduits; and that the Proponent develop closure-specific runoff control measures, as well as sediment and erosion control measures, to minimize site surface water and sediment entering the river.

On August 16, 2021, CNL provided responses to questions from Brokenhead Ojibway Nation's Technical Report of the Revised Environmental Impact Statement for the Project (SVS 2020). In response to Brokenhead Ojibway Nation's questions, CNL provide additional rational and clarity on specific topics under this theme. This did not result in any updates to the revised draft EIS.

Recognizing that accidents and malfunctions will continue to be an area of interest for the communities, with the relationship agreement in place, CNL has put in place a forum to discuss and further address this area of interest. Without close engagement within the communities since 2019, it is unlikely that most community members are aware of the new materials about the leaks that CNL has produced. Further work is needed to translate and share this information with community members. CNL will continue to engage the communities on this matter.

Waste Management

The communities were interested to know which material will be sent to Chalk River Laboratories for disposal and how it will be transported. The communities' TKLUS highlighted the tension that many of the community members felt about wanting the waste removed from the WL site while recognizing that this would mean moving it to the lands of other First Nations. One of the communities' questions was to find out more about what, if anything is being offered in compensation to other First Nations for storing nuclear waste material in their traditional territories.

CNL participated in community meetings where waste management was discussed and provided the following information that all waste materials are sorted, verified and transported using licensed containers, and depending on the waste type, to a licensed hazardous waste management facility. Radioactive materials will be shipped in licensed waste containers. Depending on what materials are being shipped, sometimes shielded cylinders are

used. CNL expects that about 2000 truckloads will need to be shipped for the entire Whiteshell Laboratories Closure Project. A dangerous goods transportation specialization may be required for trucking companies to move some of this waste. The used fuel baskets contained in the concrete silos will be placed in a transportation flask and transported by truck along the highway. CNL explained that radioactive materials are safely shipped around Canada regularly. CNL will be hiring transportation contractors who are qualified to undertake the work and have met the necessary qualifications and have the required safe driving hours logged.

The containers used to transport waste are designed to withstand considerable impact. CNL also has a mobile response unit that can be dispatched if an accident occurred. CNL has an emergency response plan that they are trained and drilled to implement.

CNL committed to asking the closest First Nation to the Chalk River Laboratories site, Algonquins of Pikwakanagan First Nation, about their interest in being contacted by Black River and Hollow Water First Nations to discuss their collective experience with the nuclear industry. CNL committed to sharing the results of their discussion with Pikwakanagan when it occurs. After receiving permission from Pikwakanagan, CNL shared Pikwakanagan's contact information with Black River First Nation and Hollow Water First Nation.

Future Communication

The communities expressed a desire for user friendly ongoing communication. CNL continues to send Project updates to the communities and is currently discussing the opportunity to establish an Indigenous Advisory Committee and have committed to fund a community liaison position to support a dialogue between community members and CNL.

CNL, Black River First Nation, and Hollow Water First Nation signed a Comprehensive Relationship Agreement, on April 6, 2021, to support greater community involvement on the Project. The relationship agreement supports the establishment of a community committee, a community liaison position, supports participation in the Indigenous Advisory Committee, and provides capacity support to ensure meaningful participation and engagement throughout the environmental assessment process.

Recognizing that matters regarding future communications will continue to be an area of interest for Hollow Water First Nation and Black River First Nation, the relationship agreement establishes a forum to support continuing dialogue on this area of interest, and the parties are seeking to extend this agreement. In September 2020, Brokenhead Ojibway Nation notified CNL via a teleconference on two occasions that they are no longer interested in engaging with CNL on the Project. CNL followed up in an e-mail to confirm. CNL will continue their engagement outreach to ensure Brokenhead Ojibway Nation is informed as the Project proceeds, or if their interest in the Project changes.

Monitoring

Brokenhead Ojibway Nation, Hollow Water First Nation and Black River First Nation requested more information about CNL's current monitoring activities, including activities related to the contamination in the riverbed of the Winnipeg River. More specifically, in their TKLUS, the communities identified an interest in further discussion related to the rationale for conducting river sediment sampling at 20-year intervals, believing that more frequent sampling is likely needed. Recommendation #2 of the TKLUS called for funding for the First Nations to contract and conduct independent monitoring of the site using technical and Traditional knowledge.

The communities also wanted further information and discussion about the vegetation, fish, and wildlife sampling taking place at the site, and specifically with respect to the Project. They expressed concern that plants, fish, and

wildlife would only be sampled if other parameters raise concern and would like to discuss this further. The communities would also like to be invited to participate in future testing events on the site so that they can ask questions while the testing is in progress.

The three communities expressed an interest in learning more about future monitoring activities that will occur after the WL site is fully decommissioned. Black River First Nation expressed interest in having students involved in monitoring activities.

CNL provided the communities with a list of upcoming monitoring activities and invited them to participate. CNL will continue to send upcoming environmental monitoring activities and seek to host a workshop to discuss CNL's current environmental monitoring programs. In addition, CNL has committed to work with these communities to better understand their monitoring interest, to incorporate Traditional knowledge into existing programs and develop approaches that encourage the building of trust in the monitoring activities. In addition, CNL has committed to developing an Indigenous environmental stewardship initiative.

Through their Technical Report, Brokenhead Ojibway Nation had multiple comments and recommendations related to environmental monitoring. These ranged from concern for how CNL will monitor the performance of the grouted structure and verify that it is operating as predicted, to requests for more detail on CNL pre- and post-closure monitoring programs, from challenges to the CNL monitoring approach, to requests for direct Indigenous involvement and participation in current and post-closure monitoring.

On August 16, 2021, CNL provided responses to questions from Brokenhead Ojibway Nation's Technical Report of the Revised Environmental Impact Statement for the Project (SVS 2020). In response to Brokenhead Ojibway Nation's questions and recommendations, CNL has updated Section 11.0 Summary of Monitoring and Follow-Up Programs of the revised draft EIS to include a list of monitoring activities proposed for the Project, which are above and beyond the current monitoring program. The list is provided in Table 11.0-1. CNL has also revised Section 11.4 to reference CNL's commitment to developing a post-closure monitoring program in collaboration with Indigenous Nations.

Recognizing that environmental monitoring will continue to be an area of interest for the communities, CNL is committed to ongoing Indigenous engagement, in the development and execution of its monitoring programs.

In Situ Disposal

Brokenhead Ojibway Nation, Hollow Water First Nation and Black River First Nation expressed interest in understanding how ISD was chosen as the preferred decommissioning method for WR-1 and wanted to know if nearby communities would have an opportunity to provide input on the chosen decommissioning method. The three communities also wanted to learn and discuss whether climate change or natural disasters could affect the integrity of the grouted encapsulation and how it would be constructed to ensure that it is safe.

The communities suggest in their TKLUS that groundwater health and the Winnipeg River are of primary concern. While CNL's scientific models do not predict the levels of these nuclides to be dangerous to human health, Anishinaabe Traditional Knowledge holders identified that they have seen that when predicting hundreds or thousands of years in the future, it is difficult to be confident in scientific predictions.

In their Technical Report, Brokenhead Ojibway Nation expressed an interest in re-evaluating decommissioning in favour of full removal of waste off-site. They also expressed concerns regarding climate change not being considered in the assessment, and the effects of climate change on VC populations now and in the future. Additionally, in their Technical Report (SVS 2020), Brokenhead Ojibway Nation re-enforced the importance of

water and protecting it, and shared many comments and recommendations pertaining to water. Key themes included: protection of water and ensuring the integrity of the Winnipeg River; interests in monitoring and sampling of water; the potential for future groundwater contamination; recommendation for more wells for groundwater testing; concerns about proper sealing of conduits; and that the Proponent develop closure-specific runoff control measures, as well as sediment and erosion control measures, to minimize site surface water and sediment entering the river.

On August 16, 2021, CNL provided responses to questions from Brokenhead Ojibway Nation's Technical Report of the Revised Environmental Impact Statement for the Project (SVS 2020). In response to Brokenhead Ojibway Nation's questions and recommendations, CNL provided additional information on studies and consideration given to the ISD design and climate change. This did not result in any updates to the revised draft EIS.

Recognizing that environmental protection and the integrity of the ISD design will continue to be an area of interest for the communities, with the relationship agreement in place, CNL has put in place a forum to discuss and make efforts to address residual areas of concern.

Consultation, Engagement and Regulatory Processes

Questions were raised about why communities had not been previously consulted when AECL originally chose the WL site. Specifically the communities identified that while this Project is not meant to address historical issues and that the primary duty to consult on this Project lies with the Crown (CNSC) and not CNL, that CNSC and CNL must acknowledge the history of this site, whereby a colonial government was able to establish a nuclear research facility without the permission, engagement, or knowledge of Indigenous communities; one which has created an environmental footprint and had unplanned releases to their traditional territories. They suggested that while the environmental licensing process addresses one project at a time, the dialogue and relationship with First Nations must take a broader temporal scope. The three communities also raised questions about the duty to consult. Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation expressed a concern about the small amount of participant funding available. The three communities were curious about the CEAA 2012 and its requirements for soliciting information from nearby communities, and Brokenhead Ojibway Nation wanted to understand how the regulator works, and how the independent commission is selected.

In response to the three communities' interests and concerns regarding consultation, engagement, and the regulatory process, CNL confirmed that while historical grievances are outside of the scope of this Project, CNL committed to supporting an open and transparent dialogue on historical concerns between the communities, CNL, and AECL. CNL also has committed to and provided capacity funding for regional Indigenous communities beyond the funding provided by CNSC. CNL also has responded to community requests for capacity and entered into MOUs and Contribution Agreements for specific scopes of work such as the TKLUS.

CNL coordinated, and hosted a community benchmarking trip to Hallam, Nebraska, to tour an in situ reactor and CNL provided support for a member of Black River First Nation to attend the Waste Management Symposia in 2019.

CNL, Black River First Nation, and Hollow Water First Nation signed a Comprehensive Relationship Agreement, on April 6, 2021, to support greater community involvement on the Project. The Comprehensive Relationship Agreement supports the establishment of a community committee and a community liaison position, provides support to participate in the Indigenous Advisory Committee, and provides capacity support to ensure meaningful participation and engagement throughout the environmental assessment process. Talks are currently underway between the parties to extend the agreement. The relationship agreement has created a forum to discuss and

work to continue to resolve and address residual concerns. CNL will continue to make efforts to re-engage Brokenhead Ojibway Nation.

Traditional Knowledge

The communities have identified through the TKLUS that, over time, they have seen changes to the health of the animals that they harvest. They have also seen that hunting and trapping are getting harder to do, as many traditional areas have been converted to other land uses over time. They suggest that the WL site is one piece of the cumulative effects of development that has slowly taken away their traditional way of life. While it is too late to change the fact that the WL site was built on this site within their traditional territory, it is not too late to continue to work with CNL and other partners to discuss their communities' interests in this area as well as the future health of the water, land, fish, and animals.

The communities also noted that some of the spiritual places they had may no longer exist because the land has changed. They emphasized that it is important to protect remaining spiritual places like the petroform sites in the Whiteshell area. Black River First Nation typically held ceremonies in the Whiteshell region in the fall around the period of the Harvest Moon. Here, they also picked wild rice, which was a dietary staple. Brokenhead Ojibway Nation and Hollow Water First Nation also noted the importance of traditional and cultural perspectives with regard to the Project. CNL has offered to Black River First Nation, Hollow Water First Nation and Brokenhead Ojibway Nation the opportunity to conduct ceremony on site in connection to the Project and the WL site.

CNL heard this feedback and ensured that the EIS properly considered wild rice. Berries were also included as part of the ecological and human health risk assessment, and their consumption, when combined with other activities such as harvesting, did not result in any adverse effects on health. CNL noted that when all of the potential pathways from the Project to traditional land and resource use were considered, such as changes to water quality, to fish, to wildlife, to vegetation, or to human health, there were no significant residual effects predicted. CNL supported the TKLUS that was conducted by the three communities and used the information from the TKLUS to revise sections of the EIS. CNL has also used the TKLUS to verify the Project's VCs and created a list of topics and species of interest and concern for the three communities. The plants, animals, and other species and topics identified below are not intended to be representative of all of the Nations' species and topics of interest but are generally representative of aspects of values that have been explicitly flagged through Traditional Knowledge Study and engagement in relation to the WR-1 Decommissioning Project. They may not reflect an exhaustive list of species and topics of interest. The following list is CNL's understanding of related species and topics of interest to the communities:

- food (e.g., blueberries, raspberries, chokecherries) and Traditional Medicines (e.g., muskeg tea, willow, seneca root, rose hips, cedar, poplar, weekay);
- rabbit, squirrel, porcupine, chipmunks;
- white-tailed deer, moose;
- fox, lynx, marten, fisher;
- sturgeon, pickerel, sunfish, catfish;
- geese, ducks, waterfowl;
- beaver, muskrat;
- wild rice;

- seagull eggs;
- groundwater and groundwater interaction;
- Winnipeg River;
- employment and business opportunity;
- community well-being;
- land tenure and future use;
- cultural and archaeological sites;
- traditional land use; traditional harvesting of country foods; and
- environmental and community safety.

In their Technical Report (SVS 2020), Brokenhead Ojibway Nation made numerous comments and recommendations pertaining to Traditional Knowledge, culture, and ceremony. Comments on methodology and the need to incorporate traditional values in consideration of seed mix, monitoring and testing on harvested species, and traditional diet considerations.

On August 16, 2021, CNL provided responses to questions from Brokenhead Ojibway Nation's Technical Report of the Revised Environmental Impact Statement for the WR-1 Project (SVS 2020). In response to Brokenhead Ojibway Nation's comments and feedback, CNL has revised Section 11.0 to reference CNL's commitment to use native grass species for the WR-1 cap and cover. To provide further clarity on land and resource use, CNL is revising Section 6.8.1.5.2.2 Traditional Land and Resource Use by Indigenous Peoples, as well as the other subsections of Section 6.0, to include up-front tables that explicitly list the interests and concerns of each community and identify exactly how that concern is captured and addressed within the section. These are separated by community so it should be very clear how Brokenhead Ojibway Nation feedback was included and distinguishes Indigenous Nation's feedback from public feedback.

Recognizing that Traditional knowledge, culture and ceremony will continue to be areas of interest for the communities, with the relationship agreement in place with Black River First Nation and Hollow Water First Nation, CNL has put in place a forum to discuss and address any residual concerns on these matters. CNL will continue to make efforts to engage with Brokenhead Ojibway Nation.

4.2.4.3.3 Verification

CNL incorporated feedback through engagements with the three communities on the Project and their TKLUS. To confirm CNL has adequately captured the communities' interests and concerns, position, and knowledge, CNL and Black River First Nation and Hollow Water First Nation underwent a verification process whereby CNL provided EIS documentation to the three communities for their review and feedback. CNL and Black River First Nation and Hollow Water First Nation met to discuss their feedback on the documents and to inform how CNL incorporated the feedback into the EIS. Due to the communities' limited capacity to respond during the COVID-19 Pandemic, the information in the summary of interests and concerns table, list of species and topics raised in the TKLUS and engagement, and Section 4.0 has been reviewed by Hollow Water First Nation and Black River First Nation's technical advisors and one Council representative from each community; however, they may not represent the view of the Nations as a whole. While not all of Black River and Hollow Water First Nations' concerns were mitigated by this process, CNL made every effort to verify that the communities' position, interests and concerns were adequately characterized. CNL continues to work with the communities to address their concerns.

On July 7, 2021, technical advisors and lead representatives from Black River First Nation and Hollow Water First Nation provided feedback on the summary of interests and concerns table and list of species and topics raised in the TKLUS and engagement. CNL met with representatives and technical advisors from Black River First Nation and Hollow Water First Nation on August 19, 2021, to go through the feedback received on the summary of interests and concerns table and list of species and topics raised in the TKLUS and engagement. CNL incorporated their feedback and on August 26, 2021, CNL provided a revised copy to the communities to show how their feedback was incorporated. The representatives and technical advisors for the communities provided additional feedback on September 2, 2021. CNL incorporated the additional feedback and sent the final copy back to the communities on September 9, 2021, along with a thank you letter, thanking the communities for participating in the verification process for their summary table of interests and concerns list of species and topics raised in the TKLUS and engagement. CNL provided the updated copies to Brokenhead Ojibway Nation and throughout the summer of 2021 reached out by phone, e-mail and fax. CNL has not heard from the community and while CNL sent an updated copy of the summary of interests and concerns table to include specific references with Brokenhead Ojibway Nation's technical review of the 2020 draft EIS on October 6, 2021, CNL has not received a response from the community. On September 30, 2022, CNL issued a letter to the Brokenhead Ojibway Nation informing them that CNL would be incorporating the table into the EIS and move forward with submission.

In addition to verifying information in the EIS with the three communities, CNL has also worked on verifying their responses to the three communities' comments on the draft EIS. CNL sent their responses to the communities' draft EIS comments on September 15, 2020, to each individual community and their consultants. In October 2020, the consultant for Black River and Hollow Water First Nations acknowledged receipt of responses to community comments on the draft EIS and provided additional comments. Prior to submitting additional responses to the communities, CNL met with the communities and their consultants to better understand their concerns and test CNL's proposed responses and next steps. Afterwards, CNL revised its responses based on the feedback received from the communities. CNL sent its responses to each of the communities.

CNL received a letter from the CNSC on August 24, 2022, indicating that three Information requests remained outstanding, including updating the Indigenous engagement narrative and tables. Community specific portions of Section 4.0, Engagement Logs and Interests and Concerns Tables were sent to Black River First Nation, Hollow Water First Nation and Brokenhead Ojibway Nation on October 20, 2022. On November 3, 2022, Black River First Nation and Hollow Water First Nation returned an e-mail confirming that changes to the EIS reflected current discussions and understandings. While all efforts were made to communicate changes to the EIS to the Brokenhead Ojibway Nation, CNL did not receive any feedback on these latest EIS updates.

Further verification of the EIS occurred in October 2022 where material changes to the EIS, as a result of necessary CNSC required updates, were sent to Black River First Nation, Hollow Water First Nation and Brokenhead Ojibway Nation. On November 3, 2022, Black River and Hollow Water First Nations returned an e-mail confirming that changes to the EIS reflected current discussions and understandings.

4.2.4.3.4 Next Steps

CNL will work with the communities to compile a list of all commitments and recommended next steps and will be reviewing all previous documents and tables to ensure all outstanding issues, concerns or commitments are brought forward. Black River and Hollow Water First Nations have been observing and participating in some of CNL's on-site monitoring activities. The parties have discussed putting an annual monitoring plan in place to coordinate these activities.

CNL will also continue engagement with the three communities with the objective of addressing or resolving any outstanding issues or concerns with the Project. CNL, Black River First Nation and Hollow Water First Nation signed a relationship agreement that will help increase the communities' capacity and allow for greater participation in the environmental assessment process. The relationship agreement supports a liaison position and the creation of a community liaison committee (the "Core Engagement Team"), among other things. As mentioned, the parties are in talks to extend this agreement.

4.2.4.4 Wabaseemoong Independent Nations

The Wabaseemoong Independent Nations (also known as Wabaseemoong Independent Nations of One Man Lake, Swan Lake, and White Dog) are signatories to Treaty No. 3. The Wabaseemoong Independent Nations have potential, asserted and/or established Aboriginal and Treaty rights in the vicinity of the Project.

A map of Wabaseemoong Independent Nations is provided in Appendix D of the IER (CNL 2022). See the IER (CNL 2022) for more background information on Wabaseemoong Independent Nations.

The Wabaseemoong Independent Nations have a total registered population of 1,989 (as of September 2018). Approximately half of the community (1,012) reside off reserve lands.

The Wabaseemoong Independent Nations occupy four areas of reserve lands, all within north-western Ontario. Wabaseemoong Reserve No. 06268 has a land base of 8,480 ha. The largest of the four reserves, it is situated approximately 8 km east of the Manitoba/Ontario border and approximately 80 km east of the WR-1 site. At its southern perimeter, the reserve encompasses the community of Whitedog. To the south is Swan Lake 29 Reserve No. 06270 with the second largest land area (2,237 ha), located on the east shore of Swan Lake and approximately 85 km east of the WR-1 site. One Man Lake 29 Reserve No. 06269 is located to the northeast of Wabaseemoong Reserve, on the north shore of One Man Lake and 95 km east of the WR-1 site. This reserve has a land base of 1,117.3 ha. Agency 30 Reserve No. 06240 is the fourth reserve (379 ha), well to the south of the other reserves, and situated in Lake of the Woods, approximately 140 km southeast of the WR-1 site. This reserve is shared with twelve other First Nations, including Shoal Lake No. 40 First Nation, Northwest Angle No. 33 First Nation, and Iskatewizaagegan #39 Independent First Nation.

4.2.4.4.1 Engagement

In August 2016, CNL sent a letter to Wabaseemoong Independent Nations introducing the WR-1 Decommissioning Project and inviting them to engage on this Project. In May 2017, CNL, AECL, and the CNSC met with Wabaseemoong to discuss the Project. One month later, in June, Wabaseemoong representatives participated in a site tour at the WL site and had a follow-up discussion on the Project. CNL, CNSC, and AECL also met with Wabaseemoong in August 2017 to continue discussions on WR-1. In October, CNL sent a letter to Wabaseemoong notifying them of the public comment period for the draft EIS and invited them to review and submit comments. In November, CNL sent a hard copy of the draft EIS executive summary to the community. The same month, CNL invited the community to participate in a site tour.

In September 2017, CNL provided an opportunity for five members from each First Nation community and the Manitoba Métis Federation to attend a full day workshop to both learn and share on how CNL and the First Nations and the Manitoba Métis Federation collectively protect and care for the environment. The goal was to provide some hands-on experience coupled with ample discussion, learning and dialogue on opportunities moving forward both as a career option and as a relationship between the site and the First Nations and the Manitoba Métis Federation.

On October 31, 2017, CNL's Annual Safety Reports were distributed to each First Nation community including the "Environmental Monitoring in 2016 at Whiteshell Laboratories" report, and the "2016 Progress Report on the Environmental Assessment Follow-up Program for Whiteshell Laboratories". CNL also provided an invitation to engage on these documents.

In 2018, Wabaseemoong Independent Nations participated in the Hallam, Nebraska, benchmarking trip. The purpose of the trip was to provide First Nations and the Manitoba Métis Federation the opportunity to see firsthand what an in-situ disposed site looks like post-closure and to provide more information about ISD. Wabaseemoong also submitted a Traditional Knowledge and Environmental Impact Assessment (WIN 2018), which was submitted to the CNSC on January 8, 2018.

In August 2020, CNL submitted CNL's responses to Wabaseemoong's comments on the EIS. CNL followed up several times via e-mail and phone requesting an opportunity to discuss CNL's responses and invited them to participate in a site tour. Although Wabaseemoong indicated interest in attending a tour no answer was given for whether the community would like to discuss CNL's responses to their comments. In September, CNL sent an invitation to Wabaseemoong inviting them to participate in CNL's fall monitoring activities. This invitation was sent out to all communities. CNL also sent Wabaseemoong an invitation to participate in CNL's final breakfast session. This was also sent to the First Nations and the Manitoba Métis Federation. CNL did not receive a response for either invitation.

In October 2020, CNL reached out to Wabaseemoong on a weekly basis requesting to meet to discuss CNL's responses to their comments. The purpose of the meeting would be to determine whether CNL's responses adequately addressed their comments and discuss next steps. Wabaseemoong did not respond to CNL's calls or e-mails.

On February 8, 2021, CNL sent a formal letter to the community, stating CNL was getting ready to resubmit their draft EIS for the decommissioning of WR-1 and offering to provide a Project update.

On May 11, 2021, CNL sent a letter to Wabaseemoong' s leadership asking for their verification on whether CNL had documented the community's interest and concerns and list of VCs correctly. On June 6, 2021, CNL sent the community an invitation to participate in an exploratory discussion on developing an Indigenous Advisory Committee at Whiteshell Laboratories. On July 20, 2021, CNL and a representative from Wabaseemoong Independent Nations held a teleconference to go through the table to ensure CNL had addressed their interests and concerns. During the meeting, CNL revised the summary of interests and concerns table and sent back a copy on July 22, 2021, and the revised list of VCs on July 23, 2021. On September 9, 2021, CNL sent a thank you letter to Wabaseemoong, thanking them for verifying that CNL had adequately captured their interests and concerns.

A representative from Wabaseemoong Independent Nations participated in the two exploratory discussions on developing an Indigenous Advisory Committee for the WL site. The two sessions were held on August 12, 2021 and September 28, 2021.

On May 16, 2022, CNL held a teleconference with Wabaseemoong Independent Nations and walked through the revisions to the interests and concerns table and made changes based on Wabaseemoong Independent Nations feedback during the meeting. On June 13, 2022, CNL asked Wabaseemoong Independent Nations to confirm they have completed verification of their interests and concerns table. On July 12, 2022, CNL and Wabaseemoong Independent Nations had a phone conversation and discussed current events and upcoming availability for a site tour. CNL also confirmed the contact information for the Chief. On the following day, July 13, 2022, CNL sent a

letter to Wabaseemoong Independent Nations Chief notifying him that CNL had submitted the draft EIS to the CNSC to determine completeness.

On August 26, 2022, CNL and Wabaseemoong Independent Nations discussed setting up a date for a tour. Wabaseemoong Independent Nations suggested calling in a few weeks to confirm interest in attending a tour. CNL sent a copy of CNL's monitoring program schedule on August 30, 2022 and requested Wabaseemoong Independent Nations to identify any activities of interest. CNL followed up with an e-mail on September 23, 2022, regarding recent discussions about meeting with the Wabaseemoong Independent Nations leadership team and doing a site tour. CNL reaffirmed their interest to meet and coordinate those activities. CNL also requested Wabaseemoong Independent Nations identify any specific monitoring activities that they wish to be involved with, from the list provided to them on August 30, 2022.

4.2.4.4.2 Interests and Concerns

Wabaseemoong Independent Nations submitted three formal comments on the 2017 draft EIS.

Through a variety of engagement forums, including webinars, meetings, and teleconferences, Wabaseemoong Independent Nations has raised a number of issues, concerns and questions that were initially focused on the 2017 and 2020 draft EIS. These engagements have led to the development of the interests and concerns table for Wabaseemoong Independent Nations. This subsection is taken from the tables of interests and concerns from Appendix 4.0-1 and describes CNL's understanding based on written submissions and oral discussions with the Nations. The Nations have also provided feedback through their TKLUS (WIN 2018). CNL has made its best efforts to document and verify the position the Nations have taken on each interest/concern. See Section 4.4 for a summary of issues raised during engagement activities that influenced the scope of the environmental assessment.

The topics in the table of interests and concerns are briefly summarized below:

Regulatory Process

Wabaseemoong Independent Nations expressed concern with the communication methods used by the CNSC, noting that they were not aware of the Project until Chief Henderson from Sagkeeng mentioned it. They also wanted to understand why they were only recently contacted since the WL site was established and began operations in the 1960s. CNL responded directly to community comments and concerns about the timing and communications on the Project. CNL held an information session in the community to provide information on the Project and answer any questions directly from the community members. CNL continues to send updates on the Project. CNL will continue to notify Wabaseemoong Independent Nations about the Project and make itself available to discuss topics of interest to the community.

CNL has adequately addressed this area of interest, based on the steps taken to address this concern with the community and the attempts made to verify this area of interest.

Engaging the Community

Wabaseemoong Independent Nations expressed interest in having an engagement event in their home community with CNL, AECL and CNSC which subsequently occurred August 21, 2017. CNL has invited Wabaseemoong for a site tour and offered capacity funding to support their review of CNL's responses to the community's comments on the draft EIS. CNL continues to look for ways to engage with the community. CNL has adequately addressed this request and area of interest.

Business and Employment Opportunities

Wabaseemoong Independent Nations requested more details about employment opportunities at the WL site, including the availability of seasonal employment and the proportion of the workforce that is Indigenous. Wabaseemoong Independent Nations noted that employment at the WL site may be difficult for members because it is not located within commuting distance of the community. CNL hosted an Indigenous industry day to share information about employment and contracting opportunities with communities. CNL recognized that the commute from Wabaseemoong Independent Nations was long but offered to help any job candidates find appropriate housing in the region.

CNL's procurement department also added provisions to its procurement process that encourages the use of Indigenous and local small and medium sized businesses and has reached out to engage with communities on procurement. CNL believes they have adequately addressed this area of interest, based on the steps taken to address this concern with the community and the attempts made to verify this area of interest.

Traditional Knowledge

Wabaseemoong Independent Nations noted that animals do not obey the same sort of boundaries as humans and could come into contact with hazardous materials. They expressed an interest in conducting a traditional use study. Wabaseemoong submitted a CNSC funded traditional use study to the CNSC on January 18, 2018. CNL acknowledged this and explained that there were no Project activities or outcomes that would result in a residual adverse effect to wildlife, so species of importance to traditional land and resources use will not be affected.

CNL provided responses to community comments about animals within CNL boundaries limits, and incorporated elements of the traditional use study in Section 6.8.1.5.2.2 Traditional Land and Resource Use by Indigenous Peoples of the EIS to the extent possible.

By incorporating Traditional knowledge from Wabaseemoong Independent Nations into the draft EIS, CNL has adequately addressed this area of interest, recognizing that engagement is ongoing and CNL will continue to invite Wabaseemoong to be involved in environmental monitoring on site.

CNL has also used the TKLUS to verify the Project's VCs and created a list of VCs for the community. Wabaseemoong Independent Nations verified that these VCs adequately capture the species and areas of interest and concern to the community to the best of their knowledge at this time. The following list is CNL's understanding of related species and topics of interest:

- Partridge;
- Food and traditional medicines;
- Rabbit, squirrel, porcupine, chipmunk;
- White-tailed deer, moose;
- Bear, wolf;
- Fish (sturgeon, whitefish, walleye, bass);
- Benthic invertebrate;
- Heron;
- Mallards, teal, geese;

- Mink, beaver, muskrat, otter;
- Winnipeg River; and
- Employment and business opportunity; community well-being; environmental and community safety; land tenure and future use; cultural and archaeological sites; traditional land.

Environmental Monitoring

Wabaseemoong Independent Nations expressed an interest in knowing more about monitoring fish, including how fish are tested and if contaminants can accumulate over time. In addition, they asked about air emissions monitoring practices. The community expressed an interest in learning more about CNL's long-term monitoring plan for WR-1 due to the long-term nature of the Project.

CNL environmental protection staff engaged and presented on the Whiteshell Laboratories environmental protection program, explaining, among many other aspects, the annual monitoring campaign that has been underway since the inception of the site. This included information on fish sampling and air emissions. CNL explained where air monitoring occurs, both on and off site. CNL explained the results and the low impact. CNL pointed to where the results are available annually on their website.

CNL sent Wabaseemoong a list of environmental monitoring activities and invited the community to participate. CNL continues to look for ways to improve its environmental monitoring program. CNL will continue to invite Wabaseemoong to participate in CNL's monitoring activities. CNL has also committed to engagement with each Indigenous community on the development and implementation of a post-closure monitoring plan that will include an Indigenous-led monitoring program.

Recognizing that this is an area of ongoing interest for the community, and CNL's commitment to continued engagement on this topic, CNL believes it has adequately addressed this area of interest.

Future Land Use and Tenure

Wabaseemoong expressed questions about future land use of the WL site, specifically on the proportion of land that would be available post-closure of the WL site. CNL plans to engage with First Nations and the Manitoba Métis Federation on future land use and end state in 2021. CNL explained and provided information on the size and location of the site. This included posters that had a map and aerial pictures of the site. While out of scope of the environmental assessment for the Project, CNL has adequately addressed this area of interest, recognizing that engagement on future land use for the site is forth coming.

Governance Structure of the Canadian Nuclear Laboratories

Wabaseemoong Independent Nations were interested in the history of the WL site and the functional relationship between CNL and AECL. CNL provided information explaining CNL's governing structure and their relationship with AECL. AECL, CNL, and CNSC have presented on their individual roles in the regulatory process. CNL has adequately addressed this area of interest, based on the steps taken to address this concern with the community and the attempts made to verify this area of interest.

Waste Management

Wabaseemoong Independent Nations were interested in more detailed information about how much radioactive waste would remain on the WL site, where the radioactive waste would be stored, and how it was to be transported off-site. Wabaseemoong Independent Nations also asked about the methods used to transport waste and how it

will be communicated to potentially affected communities. CNL hosted Wabaseemoong for a tour of their waste management facilities and answered questions about waste management and transportation of waste. CNL provided information to the community on waste management at the site and proposed plans for waste transportation. CNL has adequately addressed this area of interest, based on the steps taken to address this concern with the community and the attempts made to verify this area of interest.

Accidents and Malfunctions

Wabaseemoong Independent Nations were interested in past releases and the potential for future releases of hazardous and radioactive material into the Winnipeg River. In addition, they were interested in how releases could be contained in the soil, and information on spill detection. As stewards of the land, members of Wabaseemoong Independent Nations have a responsibility to protect ecosystems and ensure ecosystem function including trophic impacts of contamination. Wabaseemoong Independent Nations expressed the view that potential adverse impacts on fisheries from the Project would negatively impact the ability of Wabaseemoong Independent Nations members to collect these fisheries resources and damage their relationship with them. Moreover, changes to concentrations of contaminants (e.g., nuclear spills) in fish tissues could have negative consequences on human health. CNL has provided updates on the decommissioning activities to the community and will continue to seek opportunity to discuss the Project with the community.

CNL responded to Wabaseemoong's questions regarding CNL's detection systems, past spills, and prevention of future spills. CNL developed plain language materials to support their communication of past spills. CNL has committed to involving First Nations and the Manitoba Métis Federation in the development and implementation of an Indigenous post-closure monitoring program.

CNL has adequately addressed this area of interest, based on the steps taken to address this concern with the community and the attempts made to verify this area of interest.

Project Description

Wabaseemoong Independent Nations expressed a concern about the longevity of the nuclides and the long-term nature of the Project. There was discussion about whether climate change or natural disasters could affect the integrity of the grouted encapsulation and how it would be constructed to ensure that it is safe.

CNL indicated that climate change may have an impact on the site and that potential effects are being studied and reported on in the EIS. CNL also mentioned that extreme events are also being considered including flooding. Wabaseemoong was told that the site is located in an area that isn't prone to earthquakes. Seismic activity is extremely low in the Project area and is not expected to result in any damage to the facility. CNL will be examining potential accidents and disruptive scenarios such as a plane crash, animal intrusion, or glaciation.

CNL has adequately addressed this area of interest, based on the steps taken to address this concern with the community and the attempts made to verify this area of interest.

4.2.4.4.3 Verification

CNL incorporated feedback through engagements with Wabaseemoong Independent Nations on the Project and their TKLUS. To confirm CNL has adequately captured the community's interests and concerns, position, and knowledge, CNL and Wabaseemoong Independent Nations underwent a verification process whereby CNL provided EIS documentation to the community for their review and feedback. CNL and Wabaseemoong Independent Nations met to discuss the community's feedback on the documents to inform how CNL incorporated

the feedback into the EIS. Through this process, the community has reviewed and provided feedback from their summary of interests and concerns table, list of VCs, and Section 4.0. CNL made every effort to verify that the community's interests and concerns were adequately characterized. CNL continues to work with Wabaseemoong Independent Nation to address their concerns.

In September 2020, Wabaseemoong acknowledged receipt of CNL's responses to their community's comments on the draft EIS. CNL has requested to meet with Wabaseemoong to discuss CNL's responses to their comments, however the community has not yet indicated whether they intend to review CNL's responses. CNL has also offered to provide capacity funding and to host Wabaseemoong for a site tour. Wabaseemoong showed interest in participating in a tour on site, however, no date has been set despite multiple follow-ups. CNL understands that communities have a number of other pressing concerns and priorities on their plate and will continue to patiently and respectfully invite them for a tour and to discuss the WR-1 decommissioning. A final notice for submitting additional comments was sent via e-mail to Wabaseemoong. CNL will continue to seek guidance on how best to engage Wabaseemoong in the environmental assessment process. CNL will continue to send invites and general information about the Project to Wabaseemoong.

On May 11, 2021, CNL sent a letter to Wabaseemoong' s leadership asking for their verification on whether CNL had documented the community's interests and concerns and list of VCs correctly. On June 6, 2021, CNL sent the community an invitation to participate in an exploratory discussion on developing an Indigenous Advisory Committee at Whiteshell Laboratories. On July 20, 2021, CNL and a representative from Wabaseemoong Independent Nations held a teleconference to go through the table to ensure CNL had addressed their interests and concerns. During the meeting, CNL revised the summary of interests and concerns table and sent back a copy on July 22, 2021, and the revised list of VCs on July 23, 2021. On September 9, 2021, CNL sent a thank you letter to Wabaseemoong, thanking them for verifying that CNL had adequately captured their interests and concerns.

CNL received a letter from the CNSC on August 24, 2022, indicating that three Information requests remained outstanding, including updating the Indigenous engagement narrative and tables. Community specific portions of Section 4.0, Engagement Logs, and Interests and Concerns Tables were sent to Wabaseemoong Independent Nations on October 20, 2022, to review for accuracy. While all efforts were made to communicate changes to the EIS to the Wabaseemoong Independent Nations, CNL did not receive any feedback on these updates. CNL will continue to make efforts to engage with Wabaseemoong Independent Nations.

Further verification of the EIS occurred in October 2022 where material changes to the EIS, as a result of necessary CNSC required updates, were sent to Wabaseemoong Independent Nations. On November 3, 2022, Wabaseemoong Independent Nations returned an e-mail confirming that changes to the EIS reflected current discussions and understandings.

4.2.4.4.4 Next Steps

CNL will continue engagement with the Wabaseemoong Independent Nations with the objective of addressing or resolving any outstanding issues or concerns with the Project. CNL will continue to reach out in the interest of improving the relationship between CNL and Wabaseemoong Independent Nations.

CNL has committed to establishing an Indigenous Advisory Committee and supporting Indigenous participation in environmental monitoring at the WL site. CNL plans to continue to involve Wabaseemoong Independent Nations in the further establishment of this initiative.

4.2.4.5 Shoal Lake #40 First Nation

In August 2016, CNL sent Shoal Lake #40 First Nation a Project introductory letter and requested the community's input on any potential adverse impacts from the Project activities. CNL did not receive any response from the community. In addition to sending the letter, CNL phoned Shoal Lake multiple times in 2016 to determine whether the community was interested in engaging on the Project. CNL followed up with the Chief who confirmed he had received CNL's letter. In 2017, CNL followed up multiple times with the Lands and Resource Manager and in October 2017, CNL sent a letter to the Chief notifying the community that CNL had submitted the draft EIS. Until recently, February 2021, CNL did not reach out to the community; since we had not heard back after multiple attempts to communicate, we assumed the community was not interested in engaging on the Project.

Since 2017, CNL has learned a great deal from engaging with First Nations and the Manitoba Métis Federation on the Project. CNL recognizes the importance of making ongoing efforts to meaningfully engage with communities and has resumed communications with the Shoal Lake #40 First Nation. CNL sent a formal letter in February 2021 to the community, stating CNL was getting ready to resubmit their draft EIS for the decommissioning of WR-1 and offering to provide a Project update.

On July 13, 2021, CNL sent out a letter of notice to Chief Redsky informing him that CNL has submitted a draft EIS and requesting a meeting to engage on the Project. On August 3, 2022, CNL followed up with a phone call and left a detailed message with reception for Chief Redsky regarding receipt of the letter and transmittal e-mail and regarding CNL's interest to discuss and meet

CNL sent a follow-up email on October 21, 2022, with a letter attachment, providing an update on the status of the WR-1 Project application. CNL will continue to provide regular project updates to Shoal Lake #40 First Nation.

While CNL has yet to receive a response from Shoal Lake #40 First Nation on the project, CNL will continue to make efforts to engage and provide regular Project updates.

A map of Shoal Lake #40 First Nation is provided in Appendix D of the IER (CNL 2022).

4.2.4.6 Iskatewizaagegan No. 39 Independent First Nation

In August 2016, CNL sent Iskatewizaagegan No. 39 Independent First Nation a Project introductory letter and requested the community's input on any potential adverse impacts from the Project activities. CNL did not receive any response from the community.

In October 2016, CNL called Iskatewizaagegan No. 39 Independent First Nation to gauge interest in the Whiteshell Laboratories Closure Project. CNL was forwarded to a community representative who requested CNL fax their introductory letter to their community. CNL sent the letter by fax in November 2016. Afterwards, CNL followed-up by phone multiple times with the community that year, with no responses.

In 2017, CNL followed-up multiple times with the community, inviting them to engage on the Project. In October 2017, CNL sent the chief a letter notifying them that CNL had submitted the draft EIS. CNL never received a response from the community and did not reach out again.

Since 2017, CNL has learned a great deal from engaging with the First Nations and the Manitoba Métis Federation on the Project. CNL recognizes the importance of making ongoing efforts to meaningfully engage with the First Nations and the Manitoba Métis Federation and has resumed communications with the Iskatewizaagegan #39

Independent First Nation. CNL sent a formal letter in February 2021, to the community, stating CNL was getting ready to resubmit their draft EIS for the decommissioning of WR-1 and offering to provide a Project update.

On July 13, 2022, CNL sent out a letter of notice to Chief Lewis informing him that CNL would be submitting a draft EIS and requested a meeting to engage on the Project. On August 3, 2022, CNL followed up with a phone call and left a detailed message with reception for Chief Lewis regarding receipt of the letter and transmittal e-mail and regarding CNL's interest to discuss and meet.

CNL sent a follow-up e-mail on October 21, 2022, with a letter attachment, providing an update on the status of the WR-1 Project application. CNL will continue to provide regular project updates to Iskatewizaagegan No. 39 Independent First Nation.While CNL has yet to receive a response from Iskatewizaagegan No. 39 Independent First Nation on the Project, CNL will continue to make efforts to engage and provide regular Project updates.

A map of Iskatewizaagegan No. 39 Independent First Nation is provided in Appendix D of the IER (CNL 2022).

4.2.4.7 Northwest Angle No. 33 First Nation (Treaty No. 3)

After CNL sent the introductory letter to Northwest Angle No. 33 First Nation, CNL followed up multiple times with the community in 2016 to determine if the community would like to engage CNL on the Project. A community representative informed CNL they had received the letter and that it was provided to Chief and Council, but noted the community recently had an election and people were still getting used to their positions. When CNL followed up they confirmed the letter had been distributed to the Chief and Council but cautioned that the Chief and Council were unlikely to review prior to end of December 2016.

In 2017, CNL notified the Chief of CNL's draft EIS submission and invited them to engage on the Project. After receiving no response on the initial letter or any subsequent follow-up, CNL did not attempt to reach out again. CNL recognizes the importance of making ongoing efforts to meaningfully engage with the First Nations and the Manitoba Métis Federation and has resumed communications with the Northwest Angle No. #33 First Nation. CNL sent a formal letter in February 2021, to the community stating CNL was getting ready to resubmit their draft EIS for the decommissioning of WR-1 and offering to provide a Project update.

On July 13, 2022, CNL sent out a letter of notice to Chief Comegan informing her that CNL would be submitting a draft EIS and requested a meeting to engage on the Project. On August 3, 2022, CNL followed up with a phone call and left a detailed message with reception for Chief Comegan regarding receipt of the letter and transmittal e-mail and regarding CNL's interest to discuss and meet.

CNL sent a follow-up e-mail on October 21, 2022, with a letter attachment, providing an update on the status of the WR-1 Project application.

While CNL has yet to receive a response from Northwest Angle No. 33 First Nation on the Project, CNL will continue to make efforts to engage and provide regular Project updates.A map of Northwest Angle No. 33 First Nation (Treaty No. 3) is provided in Appendix D of the IER (CNL 2022).

4.2.5 Future Engagement Activities Planned

Canadian Nuclear Laboratories will continue to engage with First Nations and the Manitoba Métis Federation after submission of the updated draft EIS, throughout the remaining environmental assessment steps, and during the remediation of the WL site. Future activities are expected to focus on continued relationship building addressing

ongoing interests and concerns, and monitoring of the site, all of which will be documented into updated revisions of the IER (CNL 2022).

Future engagement activities are broken into short-term initiatives that will take place between now and the final EIS submission, and longer-term initiatives, some of which are relevant to the Project's environmental assessment, and others that extend beyond the scope of the Project.

4.2.5.1 Short-term Initiatives and Engagements

The following list outlines short-term initiatives that apply to all First Nation and the Manitoba Métis Federation that CN will take between now and submitting the final EIS. For specific initiatives for each First Nation or the Red River Métis, see the subsection 'Next Steps' in Section 4.2.4.

- **Informational Webinars and Online Open Houses –** CNL has been, and will be, hosting informational webinars on various topics related to the Project including follow-up monitoring, end state of WR-1, baseline conditions, etc. Some of these will be designed to directly address misperceptions and stigma associated with the Project.
- **Commitments Dialogue –** Now that CNL has verified each Nation's interests and concerns on the Project, after submission of the EIS, CNL will work with each Nation to draft a list of commitments to support addressing their concerns related to the Project.
- **Sharing of Job Postings –** CNL will continue to share job postings and opportunities for employment as they become available.
- **Community Liaison and Associated Engagement Plans –** CNL will work with the community liaison officers to develop an engagement plan and other community-specific initiatives to support engagement with community members or citizens to elevate the level of awareness and knowledge about the Project within the community.
- **Community Specific Information Sessions –** Once CNL has submitted the revised EIS, CNL will send out invitations to the First Nations and the Manitoba Métis Federation to continue engagement on the key components of the EIS, including baseline studies, WR-1 end state, follow-up monitoring, and other items of importance to that Community.
- **Participation in Environmental Monitoring Activities –** CNL will continue to invite First Nations and the Manitoba Métis Federation to participate in monitoring activities during the upcoming field seasons.

4.2.5.2 Long-term Initiatives and Engagements

The following is a list of longer-term initiatives that while relevant to the Project's environmental assessment, extend beyond the scope of the Project to address WL site issues, concerns and interests:

- **Supporting Long-term Monitoring –** All the First Nations and the Manitoba Métis Federation have expressed an interest in being more involved in CNL's environmental protection program. Specifically, the Manitoba Métis Federation expressed an interest in actively participating in monitoring both in the environmental protection program and decommissioning activities (outside the scope of the environmental assessment). CNL will work closely with the First Nations and the Manitoba Métis Federation to support their involvement in environmental monitoring at the WL site. This initiative will extend beyond the timeline and

scope of the environmental assessment for WR-1 and will be a part of the larger site environmental remediation Project. CNL has agreed to a scope of work with Sagkeeng to develop and execute an independent Sagkeeng Monitoring Program. At the time of submission, the parties were moving the agreement in front of their respective leadership.

- **Indigenous Advisory Committee –** CNL has received interest from three First Nations and the Manitoba Métis Federation to move forward with the establishment of an Indigenous Advisory Committee. Two workshops were held to develop a draft term of reference and guide for the Indigenous Advisory Committee. The purpose of the Indigenous Advisory Committee includes but is not limited to foster a working relationship between Indigenous Nations, CNL, and AECL to collaborate and engage with CNL and AECL regarding the Whiteshell Laboratories Closure Project, and on other topics of mutual interest and concern. The Indigenous Advisory Committee will also provide advice and guidance, and amplify the voice of Indigenous Nations to CNL and/or AECL management, to influence organizational change, and add Indigenous input into areas of the project and company including procurement, communication and engagement, long-term legacy monitoring, integration of Traditional knowledge. CNL has taken steps to work with the First Nations and the Manitoba Métis Federation to move this initiative forward. The intent of this committee extends beyond the scope of the environmental assessment for the Project. CNL will continue to solicit interest and make efforts to put this committee in place should the Nations see value in it.
- **Relationship Agreements –** CNL will continue to discuss developing relationship agreements with each of the involved First Nations and the Manitoba Métis Federation. These relationship agreements will likely extend beyond the scope of the environmental assessment for the Project and include engagement, participation, and involvement in the Whiteshell Laboratories Closure Project. These relationship agreements can also include developing community risk-informed communication tools with direct input from community leaders and include reconnection to the land through access to the site for cultural and ceremony activities. CNL will also discuss implementing long-term relationship agreements between AECL, CNL and the Nations that will help to ensure the initiatives that are developed and implemented continue into the post-closure phase of the Project and that may also help to address broader concerns. At the time of submission, a Relationship Agreement is being discussed between the Manitoba Métis Federation and CNL.

4.3 Influence of Traditional Knowledge on the Environmental Assessment

Four Traditional Knowledge, Land Use and Occupancy Studies (TKLUOS) for the WL site have been completed. These studies are intended to document traditional use around the Project, local, and regional study areas.

The Manitoba Métis Federation study, titled “Whiteshell Reactor #1 Decommissioning: Manitoba Métis Traditional Knowledge, Land Use and Occupancy Study” (SVS 2019), was provided to CNL in January 2019 while the Sagkeeng First Nation study, titled “Sagkeeng Anicinabe Land Use and Occupancy Study Specific to Canadian Nuclear Laboratories’ Proposed In Situ Decommissioning of the WR-1 Reactor at Whiteshell Laboratories” (Firelight Research Inc. and Sagkeeng Anicinabe 2018), was provided in December 2018.

The study done jointly by Black River First Nation, Brokenhead Ojibway Nation, and Hollow Water First Nation, titled “api migizik pii pa gilot – When Eagles Call Traditional Knowledge and Land Use Study for the WR-1 Nuclear Reactor In Situ Decommissioning Project” (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019), was provided to CNL in November 2019. The study by Wabaseemoong Independent Nations,

titled “Traditional Knowledge and Environmental Impact Assessment - Decommissioning of Whiteshell Nuclear Reactor #1” (WIN 2018), was provided to CNL in January 2018.

CNL has supported the carrying out of these studies to assist in better understanding modern and traditional land and resource use near the WL site and Aboriginal and Treaty rights matters. The results of these studies informed the five column interests and concerns table for each Nation (see Appendix A) and list of valued components. CNL also used these studies to support the environmental assessment of the Project documented in Section 6.0. For each interest and concern in Section 1.3 of Appendix 4.0-1, CNL has included a reference to a section of the EIS where CNL made changes based on the Nation’s interest or concern.

Traditional knowledge was considered in the environmental assessment, including identification of VCs, defining spatial boundaries, description of the environment, and identification and evaluation of Project interactions, and participation in monitoring program. Traditional knowledge includes both Traditional knowledge and feedback gathered through engagement and community-led studies. Traditional knowledge was primarily gathered through the TKLUS’s and were completed to further enable opportunities to capture and include Traditional Knowledge into the environmental assessment and the EIS. CNL has supported these studies to better understand modern and traditional land and resource use near the WL site. Four Traditional Knowledge, Land Use and Occupancy Studies for the WL site were completed and shared CNL for inclusion in the EIS. For more information on the Traditional Knowledge and Land Use and Occupancy Studies, see the IER (CNL 2022).

CNL developed and verified a list of VCs for each community based on their TKLUS and feedback during engagement. These VCs were used to validate the Project’s VCs. Where information was provided by the First Nations and the Red River Métis, CNL included a list of relevant Indigenous VCs and demonstrated how they were considered in the discipline assessment. Most of the VCs identified through Indigenous and public engagement activities are already represented by the VCs selected for the environmental assessment. Moose was identified as an important species to Indigenous communities and was subsequently added as a VC in the Ecological Health Assessment (Section 6.7 Human and Ecological Health). In addition, Traditional Knowledge and Land Use and Occupancy Studies identified that Indigenous peoples harvest wild rice and medicinal plants. As such, weekay was added to the diet of a Harvester in the Human Health Assessment (Section 6.7).

To incorporate input from the First Nations and the Manitoba Métis Federation, the local and regional study areas for the Land and Resource Use VC was revised to capture Indigenous land and resource use within proximity of the WL site and on either side of the Winnipeg River (Section 6.8.1.4.1 Spatial Boundaries [traditional land and resource use assessment]). As such, updates were also warranted in Section 6.9.4.1 Spatial Boundaries (socio-economic assessment) as the relationship between traditional land and resources use has linkages to well-being. The boundaries for the study areas are designed to quantify baseline conditions at a scale that is large enough to assess to maximum predicted geographic extent of direct and indirect effects from the Project on VCs and the Project in combination with previous, existing, and reasonably foreseeable developments.

The TKLUS’s further enabled opportunities to capture and include Traditional Knowledge into the description of the environment. These studies are intended to document traditional use around the Project, local, and regional study areas. The ‘Description of the Environment’ section in the discipline assessments (Section 6.2 to Section 6.9) has been updated to include a description of how traditional land and resource use activities have changed in response to past historical events and external pressures, where available.

Traditional Knowledge and Indigenous engagement feedback also identified linkages between components of the environment that support traditional way of life, traditional land and resource use, and harvesting rights. These

linkages provide a more holistic understanding of the environment and relationships between different components, including their continued practice of culture and livelihoods. Feedback from Indigenous engagement also considered in the evaluation of the pathways. For example, a pathway may be evaluated as a secondary pathway due to their importance to Indigenous people even if there are no direct or indicate effects on a VC (Section 6.9.6 Project Interactions and Mitigation).

Indigenous engagement feedback is reflected in CNL's commitments to participation of Indigenous Nations in environmental monitoring (Section 11.4). CNL will be updating the existing WL site Environmental Assessment Follow-up Program to suit the ongoing needs of the Project, stakeholders and Indigenous Nations. CNL recognizes that the First Nations and the Manitoba Métis Federation are stewards of the land who have a great interest in participating in monitoring at WL site. As such, ongoing engagements and commitments to support meaningful discussion on the monitoring and follow-up program and how each Nation and the Manitoba Métis Federation wishes to be involved in future monitoring of the site will be included in the program. CNL has committed to engaging with each Nation and the Manitoba Métis Federation on their specific interest and concerns regarding monitoring for the Project and the existing WL site Environmental Assessment Follow-up Program.

4.4 Summary of Issues Raised During Engagement Activities that Influenced the Environmental Impact Statement

The feedback sections under Section 4.2 Indigenous Engagement describe at a high level the interest, concerns, and comments CNL has heard from each Nation and the Manitoba Métis Federation. Some of those concerns are out of scope of the EIS, in CNL's opinion. This section specifically looks at interests and concerns raised during the engagement activities that influence the scope of the environmental assessment (Table4.4-1). For more information on specific interests and concerns of each First Nation and the Manitoba Métis Federation as well as how these interest and concerns influenced the EIS, see Appendix 4.0-1 – the tables of interest and concerns including how CNL incorporated and considered feedback on mitigation measures for the Project.

Table 4.4-1: Summary of Interests and Concerns Raised During Engagement Activities that Influenced the Environmental Assessment

Interest and Concern	How the Issue was included in the Assessment	Section of the EIS that the Issue is Addressed in
Alternative Means Assessment		
Indigenous peoples expressed interest in understanding how in situ disposal was chosen as the preferred decommissioning method for WR-1 and if nearby First Nations and the Manitoba Métis Federation would have an opportunity to provide input on the chosen decommissioning method.	As a result of feedback from Indigenous peoples and the public, CNL has revised and improved the alternative analysis section, additional detail to support the selection of the preferred alternative has been included	Section 2.0 Purpose of the Project and Alternatives Assessment: *Section 2.5.4 Assessment of Alternatives*

Table 4.4-1: Summary of Interests and Concerns Raised During Engagement Activities that Influenced the Environmental Assessment

Interest and Concern	How the Issue was included in the Assessment	Section of the EIS that the Issue is Addressed in
Sagkeeng First Nation expressed interest in adding an additional alternative of rolling stewardship as an option for consideration in the Alternative Means Assessment.	As a result of this feedback, CNL added Rolling Stewardship (Alternative #6) as a proposed alternative in the alternative means assessment.	Section 2.0 Purpose of the Project and Alternatives Assessment: *Section 2.5.4.6 Assessment of Alternatives*
Sagkeeng First Nation conducted an Alternative Means Assessment to incorporate Sagkeeng's community values and preferred weighted criteria.	CNL included a new section that provides a summary of Sagkeeng First Nation's Alternative Means Assessment and explains how CNL has considered and used the report.	Section 2 Purpose of the Project and Alternatives to the Project: *Section 2.8 Sagkeeng's Alternative Means Assessment – Approach and Findings*
Indigenous communities communicated their preference towards being able to retrieve or remediate the disposed reactor at an unspecified future date should monitoring show that environmental effects are not acceptable. A specific suggestion was the use of sand instead of grout as a backfill material, with the expectation that the sand could be more easily removed in the event that retrieval or remediation efforts were undertaken.	As a result of this feedback, CNL added In Situ Disposal Using Alternative Backfill Materials as a proposed alternative in the alternative means assessment.	Section 2 Purpose of the Project and Alternatives to the Project: *Section 2.5.4.5 Alternative #5 – In Situ Disposal Using Alternative Backfill*

Table 4.4-1: Summary of Interests and Concerns Raised During Engagement Activities that Influenced the Environmental Assessment

Interest and Concern	How the Issue was included in the Assessment	Section of the EIS that the Issue is Addressed in
Existing Conditions		
Concern about the collective effects of historical changes to each Nation's cultural practices, land and resource use, and Aboriginal and Treaty rights as a result of the establishment of WL site.	The description of the existing environment for Indigenous land and resource use has been updated to include a description of how traditional land and resource use activities have changed in response to past historical events and external pressures, which has been summarized from the Traditional Knowledge and Land Use Studies. A subsection on Indigenous Community Perspectives on Health and Wellness was added to the socio-economic assessment.	Section 6.8.1 Traditional Land and Resource Use: *Section 6.8.1.5.2.2 Traditional Land and Resource Use by Indigenous Peoples* Section 6.9 Socio-economic Enviornment: *Section 6.9.5.2.1.1 Indigenous Community Perspectives on and Observataions of the Whiteshell Site* *Section 6.9.5.2.6.4 Indigenous Health*
First Nations and the Manitoba Métis Federation initially expressed concern on lack of information on Traditional Knowledge and land use in the EIS.	CNL supported, through funding or other means, four Traditional Knowledge and Land Use Studies with five First Nations (Sagkeeng First Nation, Black River First Nation, Hollow Water First Nation, Brokenhead Ojibway Nation, and Wabaseemoong Independent Nations) and the Manitoba Métis Federation. Subsequently CNL staff reviewed those documents and sought to integrate information, while improving CNL overall understanding of Indigenous interests and concerns.	The 'Description of the Environment' section in the discipline assessments (Section 6.2 to Section 6.9) has been updated to include a description of how traditional land and resource use activities have changed in response to past historical events and external pressures, where available

Table 4.4-1: Summary of Interests and Concerns Raised During Engagement Activities that Influenced the Environmental Assessment

Interest and Concern	How the Issue was included in the Assessment	Section of the EIS that the Issue is Addressed in
Effects Assessment		
Sagkeeng First Nation was concerned about the spatial boundaries used in the assessment not being reflective of those used in traditional land use studies.	CNL has separated Indigenous traditional land and resource use from other non-Indigenous land and resource use in order to reflect spatial boundaries that more closely reflect the boundaries as identified in traditional land use studies, combined with consideration of where effects are likely to be measurable. Indigenous communities that were previously included as part of the regional study area were revised to be part of the local study area, reflective of the role of traditional land and resources use and its contribution to well-being.	Section 6.8.1 Traditional Land and Resource Use: *Section 6.8.1.4.1 Spatial Boundaries* Section 6.9 Socio-economic Environment: *Section 6.9.4.1 Spatial Boundaries*
Concerns about the extent of Indigenous participation in the assessment of effects to traditional land and resource use (from the identification of pathways to the verification of results)	The assessment has been updated to include a summary of Indigenous community's conclusions about the potential effects of the Project, which has been summarized from the Traditional Knowledge and Land Use Studies.	Section 6.8.1 Traditional Land and Resource Use: *Section 6.8.1.6 Project Interactions and Mitigation*
Concerns from Indigenous peoples on the health of members in the WL site area harvest wild rice and medicinal plants. The Manitoba Métis Federation requested CNL give consideration to the potential increase in moose harvesting and consumption by its citizens.	Consumption of local plants and foods was considered as a pathway in the Environmental Risk Assessment (ERA). CNL conducted an Indigenous Food Intake Survey to understand the types and quantities of local food consumed. Based on the results of the surveys, the diet of a Harvester in the human health assessment was updated. Wild rice does not grow close to WR-1 and therefore, was not included in the assessment; however, the medicinal plant weekay was added to the diet of a Harvester in the human health assessment. Moose was also added to the diet of Harvester in the human health assessment.	Section 6.7.1 Human Health: *Section 6.7.1.7 Residual Effects Analysis*
Concerns from Indigenous communities on the long-term health effects of the Project on plants and wildlife important to Indigenous people. Indigenous communities have seen changes to the health of the animals they harvest.	CNL verified the list of important species identified by each Indigenous community to confirm that each was adequately represented by the selected representative organisms. Based on feedback from Indigenous peoples during engagement activities, moose was added as a VC to the ecological health assessment given the species importance to Indigenous people.	Section 6.7.2 Ecological Health: *Section 6.7.2.7 Residual Effects Analysis*

Table 4.4-1: Summary of Interests and Concerns Raised During Engagement Activities that Influenced the Environmental Assessment

Interest and Concern	How the Issue was included in the Assessment	Section of the EIS that the Issue is Addressed in
Concern that the Project may limit each Nation's participation in land and resource use activities, which would affect their well-being through the ability to express their culture.	The italicized text in the following pathway has been added to the socio-economic pathway: The presence of long-lived radioactive material as part of ISD may affect community well-being for Indigenous communities through the changes to the suitability of the site for future uses, *the continued inability to exercise stewardship and governance over land and resource management decisions* Psychosocial aspects are important to SFN, and as such CNL has included them in the socio-economic assessment. This pathway was elevated from a no linkage pathway to a secondary pathway due to the importance of it to Indigenous communities.	Section 6.9 Socio-economic Environment: *Section 6.9.6 Project Interactions and Mitigation*
Indigenous peoples requested more information about potential contracting opportunities with CNL, including qualifications and procurement requirements.	Various employment and contracting initiatives were added to the socio-economic assessment including: ■ CNL worked to enhance options to better match the Indigenous peoples' capabilities with their contracting needs including adding provisions to its procurement process that encourages the use of Indigenous and local small and medium-sized businesses. ■ CNL discussed the request for information sharing regarding the procurement and contracting opportunities and asked for specific capabilities that communities have related to the Project. ■ CNL facilitated introductions between the communities and the CNL procurement department. ■ To facilitate information sharing, capabilities and opportunities, CNL planned and executed three industry days and invited First Nation communities. ■ CNL created a First Nation and Métis summer student position that was advertised with First Nations and Métis communities interested in the Project. During site visits Human Resources shared information about employment opportunities at the WL site. CNL has been sharing job postings and will continue to share job postings with the First Nations and the Red River Métis.	Section 6.9 Socio-economic Assessment: *Section 6.9.6 Project Interactions and Mitigation* *Section 6.9.7 Monitoring and Follow-up*
Wabaseemoong Independent Nations noted that employment at the WL site may be difficult for members because it is not located within commuting distance of the community.	CNL recognized that the commute from the Wabaseemoong Independent Nations community was long and have made a commitment to help job candidates find appropriate housing in the region. This commitment has been included in the EIS.	Section 6.9 Socio-economic Environment: *Section 6.9.6 Project Interactions and Mitigation*

Table 4.4-1: Summary of Interests and Concerns Raised During Engagement Activities that Influenced the Environmental Assessment

Interest and Concern	How the Issue was included in the Assessment	Section of the EIS that the Issue is Addressed in
Follow-up Monitoring		
After reviewing the placement of the proposed ground monitoring wells, the Manitoba Métis Federation proposed an additional well be placed closer to the reactor.	CNL has committed to adding additional ground monitoring well(s) between WR-1 and the Winnipeg River as requested by the Red River Métis.	Section 6.3.2 Hydrogeology: *Section 6.3.2.9 Monitoring and Follow-up* Section 11.0 Summary of Monitoring and Follow-Up and Programs
First Nations and the Manitoba Métis Federation expressed an interest in being involved in determining the future use of the WL site.	CNL is working in collaboration with AECL and will be engaging local communities to discuss and consider options for the future use of the WL site. A commitment by CNL to determine the future use of the WL site, including collaboration with local stakeholders has been added to the assessment.	Section 6.8.1 Traditional Land and Resource Use: *Section 6.8.1.6 Project Interactions and Mitigation* Section 6.8.2 Other Land and Resource Use: *Section 6.8.2.6 Project Interactions and Mitigation* Section 11.0 Summary of Monitoring and Follow-Up and Programs
First Nations and the Manitoba Métis Federation expressed an interest in being involved in the development and implementation of the follow-up monitoring program.	In response, CNL has committed to working collaboratively with the First Nations and the Manitoba Métis Federation to support each Indigenous Nation to participate in environmental monitoring at the WL site. The goal of the initiative is to help address concerns regarding protection of the environment, health of people, confidence in the health of country foods and stigma associated with the Project. CNL and AECL have agreed to support an independent Sagkeeng CEMP.	Section 11.0 Summary of Monitoring and Follow-Up and Programs

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5.0 PUBLIC AND STAKEHOLDER ENGAGEMENT

Public and Indigenous engagement is a key component of the environmental assessment process and reflects the corporate social responsibility of Canadian Nuclear Laboratories (CNL). As part of our corporate, environmental, and social responsibility, CNL is committed to early, open, and ongoing public, Indigenous and stakeholder engagement and participation throughout the environmental assessment process. Through a broad range of information sharing and engagement activities, CNL seeks to build Project awareness and learn about distinct interests and concerns to strengthen mutual understanding, opportunities for collaboration and long-term relationships.

Project information distribution and public participation are important aspects of the environmental assessment process with public engagement guided by the Canadian Nuclear Safety Commission (CNSC) REGDOC-3.2.1, Public Information and Disclosure (CNSC 2018). Public engagement includes the public, as well as stakeholder representatives. An overview of Indigenous engagement for the In Situ Decommissioning of WR-1 at the Whiteshell Laboratories Site Project (Project) at the Whiteshell Laboratories (WL) site is provided in Section 4.0 Indigenous Engagement.

Consideration was also given to CNSC's *Generic Guidelines for the Preparation of an Environmental Impact Statement* (CNSC 2016), along with CNSC's REGDOC-2.9.1, *Environmental Protection: Environmental Principles, Assessments and Protection Measures* (CNSC 2020). REGDOC-2.9.1 explains that the CNSC determines the requirements for public and Indigenous engagement on a case-by-case basis, including consideration of public and Indigenous interests and concerns, potential impacts and interactions on the environment and the public, and other factors that impact the project.

This section describes past, ongoing, and proposed public and stakeholder engagement activities and events in accordance with the *Generic Guidelines for the Preparation of an Environmental Impact Statement* (CNSC 2016), which states:

> *"…the EIS will describe the ongoing and proposed participation activities that the proponent will undertake or that it has already conducted on the project. It will describe efforts made to distribute project information, as well as information and materials that were distributed during the public consultation process. The EIS will indicate the methods used, where the consultation was held, the persons and organizations consulted, the concerns voiced and the extent to which this information was incorporated in the design of the project as well as in the EIS. The EIS will provide a summary of key issues raised related to the project and its potential environmental effects, as well as describe any outstanding issues and ways to address them."*

In addition, CNSC and Canadian Environmental Assessment Agency (The Agency) guidance documents require that the following topics are to be included as part of public engagement activities:

- Current project information (CNSC 2016);
- Alternative Means (The Agency 2015);
- Valued Components (CNSC 2016);
- Spatial and Temporal Boundaries (CNSC 2016); and
- Follow-up monitoring program (CNSC 2016).

Issues, interests, and concerns raised through the public engagement process were considered as part of the environmental assessment process. For example, the future use of the WL site was identified as important for local and rural municipalities. As such, the importance of continued economic development was considered under the context of community well-being and was included as a valued component (VC) for the assessment. A summary of the issues, interests and concerns raised during public engagement and how CNL has responded to them is described in Table 5.3.1-1. Valued components are described near the beginning of each subsection of Section 6.0 Environmental Effects (Sections 6.2 Atmospheric Environment through 6.9 Socio-economic Environment). Section 2.0 Purpose of the Project and Alternatives to the Project also includes information on how public feedback was considered in the alternatives assessment.

This section of the Environmental Impact Statement (EIS) demonstrates how CNL has engaged with local communities that are interested in and potentially affected by the Project, as well as communication initiatives with regulators. The section includes a description of engagement activities, including documentation of meetings, key interests and concerns, discussion topics, outcomes, relevant agreements, and how CNL is addressing comments received. Please refer to the *Environmental Assessment Stakeholder Engagement Report – WR-1 In Situ Decommissioning* (CNL 2022b) for supporting documentation.

5.1 Engagement Objectives

CNL is committed to developing and maintaining solid, long-term relationships with all stakeholders. This includes the local communities where CNL employees live and work, the companies CNL does business with, as well as the public. CNL is committed to communicating in a timely manner and exchanging information and recognizes the importance of listening to stakeholders and working with them to resolve their concerns. Communication activities are conducted in support of a clean environment and healthy society. CNL's specific communication objectives include:

1. Initiating and maintaining two-way communication channels between CNL and local and regional communities and stakeholders, determining the best methods for sharing Project information, and facilitating input at timely junctures in the Project schedule, so that feedback can be integrated into Project planning and design, as appropriate.

2. Developing meaningful, user-friendly information and communication products for host communities and stakeholders, ensuring accessible and current information on Project activities.

3. Demonstrating CNL's long-term commitment and approach to safely and responsibly managing radioactive waste and decommissioning activities for the benefit of future generations.

4. Sharing information, building awareness, and facilitating learning opportunities with host communities and stakeholders regarding nuclear decommissioning, environmental remediation, and radioactive waste management.

5. Meeting all regulatory-based communication and engagement requirements.

CNL has employed a variety of methods and activities to achieve these objectives. The following section outlines these methods.

In March 2020, the COVID-19 pandemic impacted in-person engagement activities. CNL has adapted in accordance with all public health requirements and guidelines providing virtual platforms for meetings, workshops, webinars, Project updates, and open houses. CNL remained committed to ensure engagement activities are ongoing and in alignment with current pandemic restrictions.

CNL has completed a Stakeholder Engagement Report. Engagement activities from April 2017 to September 2022 are included the report, referred to as the Stakeholder Engagement Technical Supporting Document (SER [CNL 2022b]). Engagement activities carried out prior to April 2017 are included in the Section 5 Appendices Supporting Materials Package (CNL 2022b). The report details the engagement methods and activities that support CNL's engagement objectives. Each method or activity was applied to share information, build awareness, facilitate learning, and discuss the Project with specific stakeholders. These methods and activities provided valuable feedback for the Project team to incorporate, as presented in Section 5.2 below.

5.1.1 Evaluation

CNL is committed to conducting all operations in a safe and responsible manner in compliance with and under a well-established Quality Program. Through the program, CNL is committed to actively seeking the public feedback to improve public engagement and to find innovative and sustainable solutions to restore and protect the environment. To demonstrate that the Project communications objectives have been met, CNL conducted a self-assessment in 2021, guided by the quality program. The engagement activities were assessed based on the level of participant satisfaction, audience representation, level of engagement with subject matter experts, level of understanding of the Project, and level of increased Project understanding of community and stakeholder issues. Below is a summary of the self-assessment. The self-assessment, along with public feedback, guided the planning for future engagement activities, including some activities reported within the timeframe of this report. The assessment of the objectives is summarized below.

Assessment of Objectives One and Two

1. Initiating and maintaining two-way communication channels between CNL and local and regional communities and stakeholders, determining the best methods for sharing Project information, and facilitating input at timely junctures in the Project schedule, so that feedback can be integrated into Project planning and design, as appropriate.

2. Developing meaningful, user-friendly information and communication products for host communities and stakeholders, ensuring accessible and current information on Project activities.

CNL initiated and maintains a progressive number of communication channels between CNL host communities and stakeholders from the early stages of Project planning. As Project planning and preparation of the EIS evolved, regular Public Liaison Committee (PLC) meetings, Public Open Houses, Information Sessions, and Breakfast Briefings have been held in local communities. CNL continues to expand and evolve opportunities to ensure information is available to a wider audience.

CNL was able to accommodate diverse preferences for engagement methods, through a variety of approaches:

- In-person information sessions;
- WL site tours;
- Technical workshops with retirees and former employees;

- Downloadable technical materials (e.g., infographics about in-situ disposal [ISD] and Project timelines);
- Project videos; and
- Virtual webinars.

These enabled CNL to engage directly with stakeholders in person and virtually and allowed CNL to develop a substantive mailing list, initiate further dialogue and build and strengthen relationships. Following the 2017 submission of the Draft EIS to the CNSC, CNL began participating in externally hosted events to increase the Project's exposure and provide an opportunity for increased engagement with the Project team. CNL attended events such as the Lac du Bonnet trade fair, Manitoba Métis Federation Annual General Assembly trade show and the Brokenhead Double B agricultural festival. CNL also hosted two webinars that attracted people from across Manitoba and Canada. These events added to CNL's mailing list and introduced the Project to a broader audience.

Over the course of multiple open houses and engagements, CNL received considerable feedback on what the public was interested in and what the public needed to increase/strengthen understanding about the Project. CNL sought to refine its messages based on this feedback. CNL used feedback and input received from the PLC to confirm that public engagement was meeting regional expectations. This approach has helped CNL improve key messages and presentation material.

Adapting to different audiences was an important step in keeping the public engaged; for instance, CNL decided to take a more technical approach with WL retirees and alumni and hosted a full-day workshop on the Project. Another important evolution in engaging the public was tours. CNL hosted several tours with regional representatives and interested members of the public. Once again, through these activities CNL was able to further refine key themes and the information being provided to the public.

CNL continues to receive, track, and assess feedback for future planning.

Assessment of Objectives Three and Four

3. Demonstrating CNL's long-term commitment and approach to safely and responsibly managing radioactive waste and decommissioning activities for the benefit of future generations.

4. Sharing information, building awareness, and facilitating learning opportunities with host communities and stakeholders regarding nuclear decommissioning, environmental remediation, and radioactive waste management.

Public engagement activities routinely include the purpose of the Project and its role in CNL's long-term commitment and approach to safely reducing Canada's nuclear legacy liabilities. CNL continues to evolve Project information based on feedback and to respond to key interests, concerns, and misperceptions, particularly regarding ISD as a permanent, safe, and proven solution for the Whiteshell Reactor Disposal Facility (WRDF).

CNL measured levels of public understanding though various public feedback tools, including exit polls, feedback forms, and public engagement at various events. These measures have demonstrated improved public understanding about decommissioning, environmental remediation, and waste management over the life of the Project.

Assessment of Objective 5

5. Meeting all regulatory-based communication and engagement requirements.

All public engagement activities in support of the Project have adhered to the REGDOC 3.2.1 *Public Information and Disclosure* requirements, CNL's Public Information Program (CNL 2021), as well as CEAA 2012. Furthermore, communication activities are audited annually through CNL's Environmental Protection Program's ISO: 14001 certification. CNL also looks to third-party expertise to ensure that CNL is aware of any changing techniques and improvements, this has included training, industry experience, and international lesson learned.

5.2 Engagement Methods and Activities

CNL shares information about the Project with the public through several products and methods including community newsletters, website updates, social media posts, webinars and more.

The following subsections outline specific engagement methods undertaken for the Project, at the time of preparation of this Section (i.e., up to September 20, 2022). Engagement activities will continue as part of the environmental assessment process.

5.2.1 Public Liaison Committee Meetings

Established in 2003, the PLC meets twice annually. The objective of the PLC is to build working relationships and create opportunities for open dialogue between various stakeholders, local communities, and CNL. Members include local elected officials and industry members.

During regularly scheduled meetings, PLC members are presented with an update on the Project, information about the Whiteshell Laboratories Closure Project, environmental practices, and are given the opportunity to ask questions and discuss the information presented. The PLC members are also asked to take meeting information back to their respective constituents. Meeting notes are taken at each meeting, recording all questions and actions that occurred during a PLC meeting. Following updates during each meeting, members could seek clarification and raise any concerns they have with both the Project and the Whiteshell Laboratories Closure Project. Guided site tours were provided following many of the meetings.

A WR-1 Environmental Assessment update was an agenda item at all meetings during the period of 2016 to 2022. Other Project-related topics at PLC meetings during this period included:

- a status update on the Draft EIS submission;
- a report on a benchmarking trip to an existing ISD reactor in Hallam, Nebraska;
- updates on decommissioning, specifically of the Project;
- community interests and concerns;
- public and Indigenous engagement;
- public feedback received to date; and
- waste management and transportation.

In lieu of a meeting in the spring of 2020, the PLC was provided a written update from CNL in May on CNL's activities during and leading up to COVID. The update provided details on CNL's response to the COVID pandemic, decommissioning updates over the winter and details on the March 2020 submission of the Draft EIS.

See Appendix A of the Stakeholder Engagement Report for a PLC agenda, meeting notes and presentation.

5.2.2 Whiteshell Community Regeneration Partnership Meetings

The Whiteshell Community Regeneration Partnership (the Partnership) was formed in 2015 by the Local Government District (LGD) of Pinawa and neighboring municipalities. The Partnership addresses the economic concerns of the local municipalities that have historically had residents working at the WL site, and is driven by a desire by both the region and CNL to encourage post-closure economic development. According to the Terms of Reference from 2015 October 21: "The proposed mandate of the Community Regeneration Partnership will be to develop a socio economic plan for the vicinity of the region affected by the WL decommissioning activities, to subsequently implement the plan and to review, update and report on the plan annually" (Skinner 2016). Overall, the goal of the Partnership is job creation, replacing the employment that has been and will continue to be lost as WL site decommissioning is completed. The partnership consists of six municipalities, three economic development organizations, Sagkeeng First Nation, CNL and the Atomic Energy of Canada Limited (AECL).

CNL's involvement in the Partnership includes:

- **Listening to members**. CNL actively engages with members with the goal of hearing and understanding their priorities and concerns in regard to the WL site.
- **Data Integration**. CNL will provide requested data to the Partnership to provide the region and the social economic plan with details such as annual and 5–year rolling forecasts of employment levels and external contracting needs.
- **Regional Educational and Outreach Programs**. Provide CNL employees and the regional workforce an opportunity to improve their employment skills with educational assistance and access to internal CNL training and outside training and reskilling programs, including programs related to (e.g., decommissioning and waste management), and unrelated to the WL decommissioning objectives (e.g., new business incubation).
- **Regional Purchasing Programs**. Develop multiple programs to support the regional supply chain so they can benefit from the extensive work scope to be accomplished at the site and to establish a supply chain that will be sustainable after the WL site has been decommissioned.
- **Community Support**. Sponsor specific regional community activities and not-for-profit organizations and individual employees available to support these regional activities and organizations (CNL 2015).

As a result of the Partnership, a regional business incubator program funded by Canadian National Energy Alliance has been set up in the LGD of Pinawa. CNL regularly meets and participates in the business incubator activities that have included on-site events, presentations and tours related to the Project. In addition, and to date, CNL has introduced representatives from Sagkeeng First Nation, Black River First Nation, Brokenhead Ojibway Nation, Hollow Water First Nation, and the Manitoba Métis Federation to the Partnership.

The Partnership provides another venue for communication to the public on the Project and to receive feedback. During meetings, Partnership members are presented with information about the Whiteshell Laboratories Closure Project, the Project and CNL's environmental practices, and are given the opportunity to ask questions and discuss

the information presented. Several guided site tours have been provided to the Partnership members since its inception.

5.2.3 Municipal Engagement

CNL reached out to all regional municipalities to gauge interest on engagement with elected officials and municipal staff. CNL met with both the Town and the Rural Municipality (RM) of Lac du Bonnet, and the LGD of Pinawa. CNL also engaged with the Town of Powerview – Pine Falls and the RM of Alexander on-site, which included a tour of the reactor facility. For more information about presentations and tours see Section 5.2.4. Municipal representatives also joined CNL on the Hallam benchmarking trip (see Appendix W of the Stakeholder Engagement Report [CNL 2022b]). Following the October 2018 municipal elections, CNL provided briefings to new councillors, mayors and reeves, as requested. This included a presentation to mayor and council of the LGD of Pinawa in July 2019. Other municipal leaders have been briefed at the PLC and the Partnership meetings.

Generally, feedback from the municipalities was similar to other stakeholder feedback. Concerns were raised around the protection of the Winnipeg River; clarification was sought on decommissioning and licensing timelines, and participation in the licensing process. Questions were asked about risk to the public, how the grouting will last against the timeline for radioactivity, and what monitoring and contingencies would be in place. Concern was expressed around future use of the WL site and economic development, particularly the effect of having a reactor disposed of on-site. CNL's stakeholder engagement activities were generally thought of as positive. Some suggestions were given on engaging the local media more and the timing of open houses. It was also suggested that CNL develop an easy to understand brochure.

5.2.4 Presentations and Tours

CNL uses presentations and meetings to help share information, build awareness, and facilitate learning about the proposed Project. CNL also hosts tours of the WL site for government representatives, stakeholders, and members of the public.

These presentations and tours provide an opportunity for a general Project overview, information sharing and open dialogue about the Project between CNL and stakeholders. These visits are used as one of several means of engaging with stakeholders and generate discussion that helps to inform the Project throughout the regulatory process.

Updates during 2020, 2021 and 2022 were also provided through the PLC, the LGD of Pinawa, and the Partnership.

The Project team documents and maintains all records of meeting agendas and presentations, which can be accessed upon request.

See Appendices B and C of the Stakeholder Engagement Report for examples of a meeting agenda and a public presentation.

5.2.5 Public Open Houses

Open houses have been held in regional towns within the vicinity of the WL site. The open houses featured a combination of booths, including storyboards and fact sheets regarding various aspects of the Project and the WL site in general, and comment forms to solicit feedback from participants. CNL staff were available at open houses to address questions and hear feedback from the public.

The key interests shared during the public open houses were:

- The rationale for choosing ISD as the decommissioning method, with requests for additional information on the other decommissioning methods considered, including associated costs.
- The availability of the WL site for future economic activities.
- Understanding where used fuel would be stored.
- Understanding more about the Project, including the grout, ISD in general, where would the radioactive material be stored and how long it would take to decay, as well as why ISD was chosen (with several participants expressing a preference for complete dismantlement).
- Requests for materials, including the Comprehensive Study Report.
- Potential future uses of the WL site and how that would be determined. This concern was expressed by multiple parties, including municipalities, First Nations and the Manitoba Métis Federation, and landowners who had their land expropriated when the WL site was founded.
- Water quality in various water bodies with a request for more information on monitoring activities during institutional control and how CNL would respond if there was a release of hazardous/radioactive material.
- Water quality monitoring for groundwater and the Winnipeg River, as well as monitoring plans after decommissioning is complete.
- Historical releases of contaminants on the WL site and how they were handled.
- The radioactive material currently stored on the site and the amount of material that would be transported to the Chalk River Laboratories site.
- Comparable projects, the approval process, and what happens if ISD is not approved.
- Engagement accessibility, including interpret technical reports, and open house locations and times.

A list of public open houses and details of issues, concerns, and responses, is provided in Appendices D and E of the Stakeholder Engagement Report (CNL 2022b).

5.2.6 Poster Boards

The 15 poster boards listed according to subject in Table 5.2.6-1 below were developed with the intent to raise awareness and prompt discussion about the Project within the context of the entire Whiteshell Laboratories Closure Project. Poster boards are used in community engagement such as community open houses. The poster boards are also used to keep CNL staff informed on the Project. They are posted throughout the WL buildings and offices.

Table 5.2.6-1: Poster Boards

Environmental Protection	WR-1 In Situ Decommissioning Project	Whiteshell Laboratories Decommissioning
Winnipeg River – Risk Assessment – WR-1 Decommissioning	Hydrology – WR-1 Decommissioning	Closure Project Overview
WR-1 Environmental Assessment Valued Components	Understanding Long-term Performance	Waste Management Overview
Protecting the Environment – Canadian Nuclear Laboratories	WR-1 Closure Project – Alternative Means	Regulatory Oversight
Safe by Design – WR-1 Decommissioning Project	Public Engagement – WR-1 Closure Project	WR-1 – Area Map
	Decommissioning Solution – WR-1 Decommissioning Project	
	WR-1 Reactor In situ Disposal (two boards)	

WR-1 = Whiteshell Reactor 1

See Appendix F of the Stakeholder Engagement Report (CNL 2022b) for images of sample poster boards.

5.2.7 Webinars

A webinar is an online, interactive forum that enables information sharing and two-way dialogue between CNL and the public. Webinars have the advantage of allowing people to participate from anywhere. The cost and time associated with travel to an alternative engagement activity is eliminated. Anonymous participation is possible if desired by participants.

In 2022, WR-1 and the Nuclear Power Demonstration (NPD) Closure Project began hosting combined bi-monthly webinars, which has increased visibility of the WR-1 Project. All webinars are advertised in local papers and on CNL's social media channels. All webinars are available in both official languages and posted on CNL's YouTube page.

The webinars CNL hosted to provide information related to the Project are summarized in Table 5.2.7-1.

Table 5.2.7-1: WR-1 Webinars

Date	Topic	Peak Concurrent Viewers	Total Number of Views (to September 2022)
January 20, 2017	Whiteshell Laboratories WR-1 Reactor: In Situ Decommissioning	NA	3,000
October 24, 2018	Whiteshell Laboratories Closure Project: Project update	22	NA
July 7, 2020	Webinar: An Overview of the post-closure safety assessment of the WR-1 Disposal Facility	NA	134
August 25, 2020	Whiteshell Laboratories WR-1 Reactor: In Situ Decommissioning Project webinar	NA	186
April 20, 2021	Whiteshell Laboratories Closure Project: Environmental Protection	27	173

Table 5.2.7-1: WR-1 Webinars

Date	Topic	Peak Concurrent Viewers	Total Number of Views (to September 2022)
May 18, 2021	WR-1 Reactor Decommissioning Fact or Fiction Webinar	17	88
September 21, 2021	Whiteshell Laboratories Closure Project: Project update	39	24
November 16, 2021	Webinar- Overview of Environmental Protection at Whiteshell Laboratories- 2021 November	51	81
January 18, 2022	Regulatory process for the Nuclear Power Demonstration and WR-1 In Situ Disposal Projects	87	50
March 22, 2022	Nuclear Power Demonstration and WR-1: The design of the WR-1 and NPD reactors and In-Situ Disposal	44	86
May 10, 2022	WR-1 and Nuclear Power Demonstration: Overview of the Environmental Impact Statements	87	42

WR-1 = Whiteshell Reactor 1

Watch recorded webinars: https://www.youtube.com/channel/UC2GCEfZQgsURh4t_QZ-JwCw

See Appendix G of the Stakeholder Engagement Report (CNL 2022b) for a webinar presentation.

5.2.8 Breakfast Sessions

A series of technical Breakfast Sessions were held late 2019 and early 2020 in person, changing to a webinar later in 2020 as a result of COVID-19 restrictions. These sessions provided an opportunity to share the technical details of the Project with interested participants, as well as respond to questions and receive feedback. Table 5.2.8-1 provides a list of Breakfast Sessions dates and topics.

Table 5.2.8-1: WR-1 Breakfast Sessions

Date	Topic
November 12, 2019	Reactor Characterization
February 4, 2020	Alternatives Analysis
June 23, 2020	An overview of the post closure safety assessment of the WR-1 Disposal Facility
August 25 2020	Defence in Depth - An overview of the WR-1 Facility containment and isolation barriers
September 29, 2020	Development and test results of the WR-1 Disposal Facility grout

WR-1 = Whiteshell Reactor

See Appendix H of the Stakeholder Engagement Report (CNL 2022b) for a Breakfast Session presentation.

5.2.9 Community Engagement Activities and Conferences

CNL has extended invitations to local and regional stakeholders to participate in engagement sessions. CNL also sent out a corresponding email to all interested parties that registered their email address for updates through many engagements with the public. Table 5.2.9-1 lists all community engagement activities and site tours since engagement on the Project began.

One approach used to share information, build awareness, and facilitate learning opportunities was to have two to three CNL representatives attend community events local to the WL site. CNL representatives were available to answer questions, collect feedback and provide information about the Project at events.

Project-specific products available at community engagement activities include:

- WR-1 Project – Feedback form;
- WR-1 – Fact sheet;
- WR-1 – Project description document (Handout);
- WR-1 Project and Whiteshell Laboratories Closure Project – Poster boards;
- Copies of presentations;
- Hallam trip report;
- WR-1 model;
- Indigenous Engagement reports; and
- Current job posting.

See Appendix B of the Stakeholder Engagement Report (CNL 2022b) for a sample tour agenda.

Table 5.2.9-1: Community Engagement Activities

Date	Activity
September 20, 2017	Presentation to American Concrete Association
November 15, 2017	Alumni, Retiree WR-1 workshop technical tour
April 3 – 5, 2018	Community benchmarking tour, Hallam, Nebraska
May 26, 2018	Information booth at the Lac du Bonnet Trade
September 8, 2018	Information booth at the Brokenhead Double B agricultural festival
May 24, 2019	Lac du Bonnet and District Trade Fair
May 31, 2019	Sunrise School Division School Board tour and meeting
November 6, 2019	Take Your Kids to Work Day including tour of WR-1
August 20, 2020	CNL booth at the Lac du Bonnet Night Market
September 5, 2020	CNL booth at the Lac du Bonnet Home and Cottage Expo
May 26, 2021	In situ disposal approach to decommissioning legacy reactors meeting (Sweden)
June 8, 2021	Decommissioning Technology and Experience Workshop (United Kingdom)
June 14- 18, 2021	IAEA International Project on the Completion of Decommissioning
August 6, 2022	WL Booth at CNL Open House at Chalk River Laboratories
September 8-10, 2022	CNL WL Booth at FireCon in Thunder Bay, ON

WR-1 = Whiteshell Reactor 1

5.2.10 Employee-focused Engagement

To reach internal stakeholders (employees), different methods were employed including myCNL TV broadcasts (which are live broadcasts similar to the webinars sent out via CNL's intranet), employee information sessions, "lunch and learns", and content distributed via internal newsletters and intranet content. In the summer of 2022, CNL began holding weekly all-staff meetings each Thursday to keep staff informed. CNL also launched an internal WL-focused employee newsletter in October 2022.

All new employees take part in New Employee Orientation during which they are introduced to the proposed Project and have the opportunity to ask questions and learn about the Project. See Appendix J of the Stakeholder Engagement Report (CNL 2022b) for an example of employee engagement. Bi-monthly webinars are also shared with all staff at the WL site.

5.2.11 Alumni Technical Workshop

Following the first round of open houses, it was recognized that the WL site region has expertise that could independently review certain aspects of the Project. An Alumni Technical Workshop was held November 15, 2017, with 11 invited retirees and regional experts in attendance. The workshop started with a tour of the Whiteshell Reactor 1 (WR-1) facility and then moved into a focused technical discussion centered on some of the key aspects of the EIS. The workshop was a very productive event with questions asked and feedback/advice provided (see Appendix K of the Stakeholder Engagement Report [CNL 2022b]).

5.2.12 Web Page Content

CNL has established a Project-specific webpage: www.cnl.ca/wr1. In addition, quick links have been added to the landing page, raising Project visibility and easing access to the appropriate pages. Since April 2017, updated information has been added to the Project webpage, and webpage activity continues to be tracked and analyzed using Google Analytics.

The webpage has been updated with new content as it becomes available. Public information session posters, a hyperlink to a revised formal feedback mechanism, the Project timeline, factsheets, and Project infographics have all been added to the Project webpage.

See Section 3.12 of the Stakeholder Engagement Report for WR-1 webpage analytics.

See Appendix L of the Stakeholder Engagement Report for the WR-1 webpage landing page.

5.2.13 External Newsletter – Whiteshell CONTACT

The Whiteshell CONTACT newsletter is published and mailed to approximately 8,100 homes in the vicinity of the WL site and is available on https://www.cnl.ca/news-publications/newsletters/. This publication informs the reader on activities undertaken at the WL site and profiles CNL's community activities.

Eight issues of the newsletter were released focusing on CNL's major projects, related environmental assessment activities, as well as CNL's Environmental Stewardship. Each issue included an update on the Whiteshell Site Closure Project, including the Project, or a separate article on WR-1 in addition to the main Project update.

In the spring of 2019, CNL also published an Environmental Issue, which included articles on environmental stewardship, energy efficiencies, wildlife protection, and waste minimization.

See Appendix N the Stakeholder Engagement Report for an example of a CONTACT newsletter.

5.2.14 Email

Emails have been used to connect with internal and external stakeholders, as well as with non-government organizations (NGOs). In particular, emails were sent out to promote different events, to advise of the public comment period on the draft EIS, and to provide responses to questions submitted electronically. Stakeholders are encouraged to be added to an email distribution list to receive notices of upcoming events related to the Project (e.g., webinars, breakfast briefings). The current list has over 387 stakeholders.

See Appendix O of the Stakeholder Engagement Report for an example of a stakeholder email.

5.2.15 Advertising Methods

As different events and engagement opportunities were planned, CNL utilized advertising to announce and increase awareness of the events. Advertising is undertaken in specific regions in the vicinity of the WL site. Different forms of advertising have been utilized to reach the interested public. CNL ran advertisements in local newspaper and on the cnl.ca website and distributed a one page flyer to approximately 7,900 Canada Post mailboxes. To advertise the Breakfast Sessions and webinars and increase public awareness about technical topics, CNL posted ads in local papers for one to two weeks leading up to each session, and sent invitations to local mailing lists.

See Section 3.14 of the Stakeholder Engagement Report for detailed advertising information.

Advertising methods used include:

- advertisements posted on CNL.ca landing page and the Project-specific webpage: www.cnl.ca/wr1.
- advertisements have been included in versions of CNL's Whiteshell CONTACT newsletter when applicable.
- newspaper advertisements.
- paid Facebook advertising via "Boosted Posts".

See Appendix P of the Stakeholder Engagement Report (CNL 2022b) for a sample of advertising content.

5.2.16 Intranet – myCNL

The internal website has been used to communicate with internal stakeholders, providing updates on the Project and publicizing events related to the Project. Posts on the Project were shared on myCNL to educate, inform, and provide updates on the Project to employees.

See Appendix J of the Stakeholder Engagement Report (CNL 2022b) for an example of a myCNL posting.

5.2.17 Internal Newsletter – Voyageur

CNL's internal newsletter, Voyageur, is published each month to update current and former CNL employees (former employees can sign up as "CNL Alumni" to receive updates and the Voyageur newsletter from CNL, there are around 600 individuals on this distribution list). Over the course of the Project, the following six articles on the Project were published in the newsletter:

1. 2017 May-– The Year Ahead in WL
2. 2017 August – CNL & UOIT Partner on Hydrogen Generation

3. 2019 February – Technology Developers Advance in SMR Process
4. 2019 June – Whiteshell Open House a Success!
5. 2019 December – #Coolthings We Did in 2019
6. 2021 September – CNEA Donates $240,000 to North Forge East
7. 2021 March- CNEA Donates $80.000 to North Forge East
8. 2021 September- Indigenous Advisory Committee Kicks Off
9. 2021 December – Whiteshell Employee Transition Plan

See Appendix Q of the Stakeholder Engagement Report (CNL 2022b) for a WR-1 Voyageur article.

5.2.18 CNL Social Media

Social media is used to share information and increase awareness about CNL activities, including the Project events and to receive feedback on the Project.

From the various social media platforms, Facebook provides the strongest engagement through “comments, shares and likes” of posts. When CNL wished to raise the profile of Project events or information, “boosted” posts were used to target by location and demographics. “Boosted” posts are paid posts through Facebook. Twitter has not been used as broadly as Tweets have been found to receive very little traction, and comparatively CNL has a much larger Facebook following. While numbers are larger on LinkedIn, the demographics are far more industry based, rather than general public. Therefore, CNL utilizes LinkedIn, but in a much lower capacity than Facebook to ensure engagement is a balanced approach with general public in comparison to those actively part of the nuclear industry. YouTube has also been used successfully to engage with stakeholders. Webinars have been posted on YouTube for easy access by the public.

To support the WL projects and the WL site, CNL has used social media to promote events, share and receive information, and generally engage with the public. Social media has been an effective tool to reach and engage stakeholders. CNL’s post on April 16, 2020, sharing the support the WL team was giving to the COVID-19 response had a high level of engagement with 363 individuals interacting with the content.

Another example of how social media has supported CNL’s transparency around the WL projects and WL site is the Facebook post from October 11, 2019 that showed progress on the physical changes at the site. This post was clicked on 1,922 times.

While Twitter is still used to promote events and engage with different stakeholders, it has not proved as effective a tool for CNL’s audiences. Given the bigger following of CNL’s Facebook account, it is currently the social media of choice for reaching stakeholders.

Engagement analytics for the Project can be found in Section 3.17 of the Stakeholder Engagement Report (CNL 2022b).

See Appendix R of the Stakeholder Engagement Report for an example of a WR-1 Facebook post.

See Appendix T of the Stakeholder Engagement Report for an example of a WR-1 Tweet.

5.2.19 Media Coverage

CNL engaged in outreach with media organizations as part of the environmental assessment process. Five media outlets were invited to tour the WL site: The Clipper, CBC Radio, CBC Radio-Canada, the Winnipeg Free Press, and the Winnipeg River Advocate. Two organizations participated. Radio Canada toured the WL site. The Clipper toured the WR-1 Building and watched a video on the reactor and a presentation by CNL staff. A total of 46 articles and 16 opinion pieces were written from June 2016 to December 3, 2020, about the Project or referencing the Project.

Media coverage gradually grew over 2016 and 2017 as CNL hosted open houses, peaking in 2018 with the trip to Hallam, Nebraska, and then levelling off again in 2019 and continued through 2021. The majority of the articles were submitted by CNL or written by the paper with the tone of the coverage, neutral or supportive in nature. CNL began actively utilizing a “detect and correct” method in sending in responses to articles that help correct misinformation. This method proved effective in getting more factual information out and overall has led to more balanced coverage. CNL has also had supportive articles published by former AECL and CNL retirees. These positive articles have proved beneficial and present facts related to the Project.

Summaries of Project related media can be found in Section 3.19 and Appendix U of the Stakeholder Engagement Report (CNL 2022b).

5.2.20 Responding to Information Requests

When requests for information were received (e.g., via email, letters, formal comment cards submitted at an open house), they were electronically logged and assigned to appropriate subject matter experts. Once the response was received from the subject matter experts, it was then issued for final internal review. The response was electronically recorded and returned to the originator via the same stream it was received. If the request received was for copies of the EIS supporting documentation, the files were deposited in a Secure File Transfer Protocol site and the login information forwarded to the originator. CNL also delivered hard copies of the EIS if requested.

5.2.21 Document Repository – November 2017 – September 2022

CNL made four hard copies of the EIS publicly available, functionally creating a document repository for the EIS volumes. One hard copy of the EIS was available at both the Pinawa and Lac du Bonnet Public Libraries.

5.2.22 Release of Documents – 2017 – September 2022

To support interested members of the public’s review of Project materials, CNL has responded to requests to provide documents related to the Project. CNL notifies interested members of the public of documents as they become available by email.

5.2.23 Participant Funding

The CNSC offered funding through its Participant Funding Program to assist members of the public, First Nations and the Manitoba Métis Federation, and other stakeholders in participating in the environmental assessment, licence application review, and Commission hearing processes for the Project. Recipients provide value-added and relevant information that contributes to a better understanding of the anticipated effects of a Project. Recipients also participate in the CNSC's proceedings for this Project. The CNSC's decision on who has received funding to participate is available in the CNSC *Participant Funding Program Decision: Canadian Nuclear Laboratories' Whiteshell Reactor No. 1 (WR-1) Decommissioning Project*.

Information on participant funding for the Project is available at: PFP funding opportunities - Canadian Nuclear Safety Commission

CNL considers those that have applied and received funding from the Participant Funding Program as stakeholders that have self-selected as especially interested in the Project. As such, CNL has made particular efforts to reach out to recipients of participant funding with offers to provide information and meet with these individuals and/or organizations.

5.3 Stakeholder Feedback and Response

Public feedback continues to give valuable insight into issues that are important to stakeholders, enabling the Project team to respond to and incorporate the issues of the local community and the broader public into the planning and the EIS. For example, the future use of the WL site and employment that offsets the loss of jobs at CNL following site closure was identified as important for local municipalities and RMs. As such, the importance of continued economic development was considered under the context of community well-being and was included as a VC in the environmental assessment (Section 6.9 Socio-economic Environment). A summary of the concerns and questions raised during public engagement and how CNL has responded to them is described in Table 5.3.1-1. Valued components are described near the beginning of each subsection of Section 6.0 Environmental Effects (Sections 6.2 Atmospheric Environment through 6.9 Socio-economic Environment). Section 2.0 Purpose of the Project and Alternative Means, also includes information on how public feedback was considered in the alternatives assessment.

Throughout the engagement period, CNL continued to review and update communication channels ensuring CNL was open and reachable by the public. CNL provided user-friendly information and communications products to facilitate sharing information and updates about the Project, and addressing concerns and interests expressed, including those identified in Table 5.3.1-1. CNL actively sought feedback through provision of feedback forms at engagement sessions and online, as well as encouraging direct contact with CNL, using this feedback to inform the EIS development.

5.3.1 Public Engagement Feedback

Public feedback from all Project engagement activities described in Section 5.2 Engagement Methods and Activities help CNL to understand public interest in and awareness of the Project, as well as the effectiveness of public communication and methods of sharing information. Key themes raided during engagement activities are summarized in Table 5.3.1-1 and include areas of interest and/or concern that were frequently voiced by the public. Topics and key interests and concerns have been gathered from multiple events.

Table 5.3.1-1 Summary of Feedback and Responses

Topic	Key Interests and Concerns	Response
Regulatory Process	Requested more information on updated timing for the review process, submittal, and commission hearing.	During engagement sessions, members of the public requested more information on updated timing for the review process, submittal, and commission hearing. During these sessions, the public was advised that the environmental assessment process requires CNL to generate a thorough analysis of effects on the environment from the Project, including an EIS, a decommissioning safety assessment and a post-closure safety assessment, which are submitted to the CNSC. CNL is currently working with the CNSC to establish a revised schedule for final regulatory submittals, including the submission date for the final EIS. CNL regularly updates interested members of the public about the environmental assessment process and the Project through the engagement methods discussed in Section 5.2. CNL has received 26 comment submissions from members of the public and regulatory bodies on the EIS. Presently CNL is responding to those submissions and, subject to their acceptance by the CNSC, CNL will update and finalize the EIS. The adjustment to the schedule is being made in order to allow CNL to appropriately address these comments and for the CNSC staff to subsequently conduct a fulsome assessment of CNL's proposal. All information will be available to the public and will include a meaningful public and Indigenous engagement process. The proposed Project can only proceed if it receives regulatory approvals for demonstrating safety to the environment and people.

Table 5.3.1-1 Summary of Feedback and Responses

Topic	Key Interests and Concerns	Response
Alternative Means	How was ISD chosen as the preferred option?	Alternatives that were safe and both technically and economically feasible were presented at all the public engagements. It was explained that these options were qualitatively assessed for their environmental effect, socio-economic effect, and human health effects. Members of the public asked CNL to provide further detail on how the ISD method was chosen for the Project. In accordance with guidance from The Agency, the original EIS included qualitative assessments of the options considered. In response to requests, CNL revised the assessment of alternatives for clarity, and to incorporate feedback from the public and from First Nations and the Manitoba Métis Federation. This is provided in Section 2.0 of the EIS. The updated assessment clarifies the differences between the alternatives and explains the risks and benefits relative to each alternative. Based on this assessment, ISD is CNL's preferred option and is low risk to the public and the environment when compared to the limits established by Canada's nuclear regulator, the CNSC. Complete removal of the WR-1 following a deferment period was the decommissioning method described in the Comprehensive Study Report. Since then, CNL has re-evaluated that plan considering international best practice to reduce deferment periods. The Canadian regulations have adopted specific conditions for when ISD would be acceptable. WR-1 meets those conditions as: ■ it is a legacy facility from the dawn of the nuclear age in Canada; ■ it was not designed with decommissioning of the facility in mind; ■ all reactor fuel has been removed; ■ the use of ISD will be protective of workers, the public and the environment; and ■ the Project site will remain under institutional control for the period defined in the safety case. The ISD option is a safe decommissioning option for the WR-1 with respect to the environment, workers and the public and has been used successfully for over six decades in other parts of the world. CNL's plans for WR-1 are going through a rigorous licensing approval process by Canada's independent nuclear regulator, the CNSC. If approved, ISD will be undertaken under strict CNSC regulations.

Table 5.3.1-1 Summary of Feedback and Responses

Topic	Key Interests and Concerns	Response
Economics	What is the cost of this option in comparison to alternative methods?	Members of the public were interested in knowing the cost of ISD in comparison to alternative methods. In response, CNL included information on the approximate costs of alternative methods at subsequent open houses. The alternative means assessment (Section 2.0 Purpose of the Project and Alternatives to the Project) presents a high-level cost analysis of the ISD option compared to other alternatives considered. Costs range from approximately $43 million to $265 million. Funding for the Project is provided by AECL, a federal Crown corporation and owner of the WL site. The alternative means assessment that was conducted for the Project did not use cost as an evaluation criterion because only economically feasible options were evaluated.
Lessons Learned	Ensuring that the Project was properly quantifying and incorporating available lessons learned from other similar work already conducted and work done at the WL site.	Members of the public wanted assurance from CNL that the Project was properly quantifying and incorporating available lessons learned from other similar work already conducted and work done at the WL site. CNL has gathered data and lessons learned where available on other ISD projects (Section 2.5.1 Evaluation Approach). CNL has participated in several learning workshops with technical experts that have performed ISD and has used services and advisement from organizations that have performed the ISD method. Development of the grout formulation incorporated lessons learned from the in situ grouting of the Savannah River National Laboratory's reactors, as described in Section 3.4.6.2 Grouting of Below-Grade Structures. Lessons learned documents from previous decommissioning work, including operating experiences were reviewed as part of assessing the potential for accidents and malfunctions (Section 7.0 Accidents and Malfunctions). CNL recognizes the incredible depth of research on nuclear waste disposal that was carried out at the WL site and has been incorporating that research into the Groundwater Flow and Solute Transport Modelling (Golder 2021) and the Geosynthesis reports (CNL 2022a) supporting the EIS. Gathering and incorporating lessons learned will be an important part of the detailed work planning activities prior to starting the work.

Table 5.3.1-1 Summary of Feedback and Responses

Topic	Key Interests and Concerns	Response
Design and engineering details	What would eventual design look like?	During engagement sessions, many questions were raised on the design of the Project. When CNL submitted the EIS, it had completed a preliminary, conceptual design. Since then, the design process has continued to progress, and more refined designs have been prepared for the re-submission of the final EIS. The final detailed design will equal or surpass the performance of the conceptual design that was assessed in the EIS. The current design of the disposal system is described in Section 3.4.9.1 In Situ Disposal System. Design of the monitoring program will include input from the regulators, the Indigenous Nations, and local municipalities (Section 11.0 Summary of Monitoring and Follow-up Programs). CNL also received questions about the IAEA's safety standard for decommissioning, which states that ISD is not a suitable option for all nuclear facilities and should be considered only under certain conditions. CNL agrees with this assessment, and CNL determined that WR-1 has features that make it suitable for long-term disposal such as: its location below grade, it does not contain substantial quantities of long-lived isotopes, and that it can be monitored post-closure during the institutional control period. CNL is following IAEA safety standards for the decommissioning of the facility and more importantly is also following the IAEA safety standards for waste disposal, since the WRDF – in its end state – would be classified as a disposal site. The Agency and the CNSC require CNL to demonstrate that the proposed Project does not pose an unacceptable level of risk to human health or the environment. The Project is subject to approval by the CNSC, who has established regulations for the management of radioactive materials. They draw input to their regulations from the IAEA but are an independent regulator with the responsibility to verify the information CNL has presented as part of the EIS. The regulatory framework for this Project is provided in Section 1.7 Regulatory Framework, and AECL's and CNL's commitment to international best practices, including the IAEA is provided in Section 1.1 Project Context.

Table 5.3.1-1 Summary of Feedback and Responses

Topic	Key Interests and Concerns	Response
Effectiveness of the Grout	How effective is the grout?	Since CNL has identified ISD as the preferred option for decommissioning the WR-1, and the use of grout to fill the building below-grade has prompted many questions. CNL has developed specially-formulated grout based on the requirements of the WRDF and experience from Savannah River National Laboratory's ISD projects. The grout formulation has been designed and evaluated through a testing program to validate its performance against the required and assumed properties, to confirm it performs, as well as or better than estimated in the solute transport model, prior to the installation of any grout into the WR 1 Building. Properties of the grout are discussed in Section 3.4.6.2 Grouting of Below-Grade Structures and Systems. The primary purpose of grouting the WRDF is to stabilize the structure and resist subsidence over time. The physical presence of grout will also reduce the total amount of groundwater in the WRDF and thus reduce the amount of water available for various chemical and corrosion reactions. In addition, it provide a favourable chemical environment due to its high pH, which will slow down the rates of corrosion of the steel-based components, including the reactor vessel. The safety case for the proposed ISD does not require that the reactor vault be grouted. The existing structure provides sufficient barrier to releases, and additional grout would not considerably increase the effectiveness of that barrier. The safety case for the WRDF is built on the conservative assumption that the primary aspect of the grout to its function as a barrier is the hydraulic conductivity of grout used in the groundwater flow model. Effectiveness of the grout and concrete materials used for the ISD system have been evaluated through the sensitivity analysis evaluated and presented in Section 5.0 of the Groundwater Flow and Solute Transport Modelling Report (Golder 2021).

Table 5.3.1-1 Summary of Feedback and Responses

Topic	Key Interests and Concerns	Response
Radiological Inventory	Understanding current inventory Confirmation on how the radiological inventory will reduce over time	CNL received several requests for details on the current radiological content of the WR-1 and how the levels of radioactivity will reduce over time. It should be noted that the reactor fuel – the most radioactive part of the WR-1 – was removed in 1985. The available information on the radiological status is primarily based on reactor core modelling from the early 1990s (CNL 2022b). In response to questions, CNL has conducted further radiological characterization of the facility. A comprehensive characterization campaign was performed during 2017 and 2018 to address data gaps and to provide quantitative estimates of residual radionuclide content remaining within WR-1 systems (CNL 2022b). The updated radiological inventory information is provided in Section 3.3.3.1 Radiological Hazards.
Valued Components	Confirming environmental VCs that were identified by the Project, reflect public feedback.	CNL surveyed attendees at public open house events to get their input into the VCs selected for the Project. Section 6.1 Environmental Assessment Approach of the EIS outlines the process that was followed to develop the list of VCs. The list of VCs was presented on poster boards during all open houses, as well as on CNL's external website. CNL provided information handouts at public open houses, and created posters displaying valued components. The public was given the opportunity to identify new VCs through a questionnaire that was offered to visitors. CNL considered all suggested VCs and either included them in the assessment, determined they were effectively covered by existing VCs or provided rationale for why the VC was included in the assessment. Section 6.1 Environmental Assessment Approach outlines the process that was followed to develop the list of VCs. The feedback collected was used to validate CNL's list of VCs (See Section 4.3 of the Stakeholder Engagement Report (CNL 2022b). Public feedback has included comments and questions about the Winnipeg River VC and the future land use at the WL site. The Winnipeg River was a key concern for the members of the public, and CNL confirmed that it was represented in the EIS as a separate VC. Land and resource use is also included as VCs in Section 6.8 Land and Resource Use.

Table 5.3.1-1 Summary of Feedback and Responses

Topic	Key Interests and Concerns	Response
Protecting the Winnipeg River	The continued protection of the Winnipeg River is a key focus of the EIS. Understandably, the proximity of the WR-1 facility to the Winnipeg River prompted many questions about how the final, grouted Project would affect the waterway.	The Winnipeg River was a key concern for the members of the public. CNL confirmed that the Winnipeg River is a VC and that the continued protection of the Winnipeg River is a key focus of the EIS. Understandably, the proximity of the WR-1 to the Winnipeg River prompted many questions about how the Project would affect the waterway. Water quality, flow, recreational use, and fish and fish habitat were considered in the assessment. For the post-closure phase an Ecological Risk Assessment was completed to evaluate the potential for adverse effects on aquatic health associated with exposure to chemical and radiological contaminants from the Project in the long-term (Section 6.7.2 Ecological Health). There are no exceedances of the radiation benchmark for the aquatic biota in the Winnipeg River and all predicted doses are well below this level. Therefore, it is unlikely there would be significant adverse effects on aquatic populations or communities as a result of radionuclide releases in the long-term during the post-closure phase. CNL will implement an EAFP for the Project that will be integrated with the existing EAFP for the WL site (Section 11.0 Summary of Monitoring and Follow-up Programs). The EAFP for the Project will include sufficient information on the type, quantity and quality of information required to reliably verify effects predicted by the environmental assessment and confirm the effectiveness of mitigations. Wherever possible, existing programs will be adapted to meet the objectives of the EAFP for the Project.
Effects of the Environment on the Project (Extreme Weather Events, Forest Fires, Seismic Events)	Has the Project examined the potential effects of an earthquake or climate change or other natural disasters on WR-1?	Members of the public expressed concerns of the potential effects of an earthquake or climate change or other natural disasters on the WRDF. CNL explained that an assessment was completed that evaluated the potential effects of natural hazards (i.e., extreme weather events, forest fires and seismic events) and climate change on the Project (Section 10.0 Effects of the Environment on the Project). The Project design includes environmental design features, management practices and other mitigation to reduce the risks from natural hazards and climate change. In addition, a seismic hazard analysis was completed for the WL site, which concluded that an earthquake would not cause damage to the WRDF. To provide further confidence, CNL modelled a scenario where the concrete foundation of the WRDF failed (WRDF Barrier Failure Disruptive Event; Section 6.7 Human and Ecological Health), which predicted that adverse effects to human and ecological receptors are not anticipated from WRDF barrier failure.

Table 5.3.1-1 Summary of Feedback and Responses

Topic	Key Interests and Concerns	Response
Contingency Planning	Information on how the Project design accounts for the risk that in situ does not operate as planned. What is the contingency plan and who is responsible?	Members of the public requested information on how the Project design accounts for the risk that the WRDF does not operate as planned. CNL explained that the WRDF will include multiple barriers, including the waste form, a specialized grout formulation, the existing WR-1 Facility walls, a concrete cap and engineered cover, and the surrounding geosphere. In the very unlikely case that degradation of these barriers occurs earlier than predicted, the surface and ground water monitoring system will detect contamination migration well before it reaches the Winnipeg River. CNL will implement an EAFP for the Project that will be integrated with the existing EAFP for the WL site (CNL 2018a). The EAFP for the Project will include sufficient information on the type, quantity and quality of information required to reliably verify effects predicted by the environmental assessment and confirm the effectiveness of mitigations. If the EAFP identifies that adverse environmental effects are greater than predicted, then CNL will evaluate the need for revised mitigation actions and management practices to manage effects, with engagement with the public for openness and transparency. Where the need for revised mitigations is identified, they will be developed and implemented. Any proposals on modifications to the monitoring program will be communicated to the CNSC. Section 11.2 Adaptive Management includes CNL commitment to developing environmental mitigation actions under the Environmental Protection Program in case of unexpected monitoring results.

Table 5.3.1-1 Summary of Feedback and Responses

Topic	Key Interests and Concerns	Response
Environmental Monitoring	Information was sought on how the in situ design incorporates ongoing environmental monitoring. Interest was expressed in the depth of monitoring wells.	Members of the public requested information on how the ISD incorporates ongoing environmental monitoring. CNL explained that the EAFP developed for the Project will be integrated with the existing EAFP for the WL site. Section 11.0 Summary of Monitoring and Follow-up Programs was updated to include this commitment. The EAFP for the Project will include sufficient information on the type, quantity and quality of information required to reliably verify effects predicted by the environmental assessment and confirm the effectiveness of mitigations. Wherever possible, existing programs will be adapted to meet the objectives of the EAFP for the Project. Table 11.1-1 summarizes the conceptual monitoring programs to be included in the overall EAFP for the Project. Section 11.2 Adaptive Management was updated with CNL's commitment to engage with the local municipal governments, regulators, the CNSC, and the First Nations and the Manitoba Métis Federation on the monitoring program and incorporate their feedback on the monitoring program, where appropriate. Interest was also expressed in the depth of monitoring wells. Depths and location of monitoring wells was explained and talked about in public presentations. CNL has committed to adding additional ground monitoring well(s) between the WRDF and the Winnipeg River as requested by the Manitoba Métis Federation.

Table 5.3.1-1 Summary of Feedback and Responses

Topic	Key Interests and Concerns	Response
Future Land Use and Economic Opportunity	Requested more information on the plans for the WR-1 site after ISD is completed.	Members of the public expressed concern with the Project because it would limit the types of businesses and industries that could use the WL site for future operations and therefore reduce the number of economic development opportunities available to them. This is a major concern for local communities who have considered the operation of the WL site as an important economic contributor in the region, as expressed through the desire to recruit a new industry to the site. CNL is currently working with the communities and RMs in the local area by funding the activities of the Partnership. The goal of the Partnership is to develop a socio-economic plan for the region. CNL supported development of the regional socio-economic plan through the provision of access to CNL technical resources and contracting of graphic arts services. The plan lays out the steps needed to facilitate future economic development of the region. The public expressed hope that activities through the Partnership would replace the employment lost at the WL site with stable, high quality employment in the region. Although uncertainty remains about the timing and nature of a new industry being attracted to the site, CNL is encouraged by the interest that has been expressed to develop the site for alternative uses. Future uses and zoning for the WL site have not been determined and will be the responsibility of AECL as the owner of the site. Although a small proportion of the WL site will have restrictions on use because of the Project (i.e., 0.07 ha), it is still anticipated that the majority of the site will be safe and appropriate for unrestricted use, and that future designations will seek to maximize the amount of lands available for other uses. CNL will share information regarding future uses and access to the WL site with the Partnership as it becomes available. CNL will also support robust communication of environmental monitoring results to confirm the safety of the WL site and help address concerns and mitigate concerns about the site's suitability for future uses. These commitments have been included in Section 6.9 Socio-economic Environment.

Table 5.3.1-1 Summary of Feedback and Responses

Topic	Key Interests and Concerns	Response
IAEA guidance for In Situ Disposal	Participants wanted to ensure that international guidance on in situ design was being properly considered.	CNL received questions about the IAEA's safety standard for decommissioning, which states that in-situ disposal is not a suitable option for all nuclear facilities and should be considered only under certain conditions. CNL agrees with this assessment, and CNL determined that WRDF has features that make it suitable for long-term disposal such as: its location below grade, it does not contain substantial quantities of long-lived isotopes, and that it can be monitored post-closure during the institutional control period. CNL is following IAEA safety standards for the decommissioning of WR-1 and more importantly is also following the IAEA safety standards for waste disposal, since the facility – in its end state – would be classified as a disposal site. The Agency and the CNSC require CNL to demonstrate that the proposed Project does not pose an unacceptable level of risk to human health or the environment. The Project is subject to approval by the CNSC, who has established regulations for the management of radioactive materials. The CNSC draws input to their regulations from the IAEA but are an independent regulator with responsibility to verify the information CNL has presented as part of the EIS. The regulatory framework for the Project is provided in Section 1.7 Regulatory Framework, and AECL's and CNL's commitment to international best practices, including IAEA is provided in Section 1.1 Project Context.

CNL = Canadian Nuclear Laboratories; CNSC = Canadian Nuclear Safety Commission; EIS = environmental Impact Statement; ISD = in situ disposal; WR-1 = Whiteshell Reactor 1; AECL = Atomic Energy of Canada Limited; WL = Whiteshell Laboratories; IAEA = International Atomic Energy Agency; WRDF = Whiteshell Reactor Disposal Facility; VC = Valued Component; EAFP = Environmental Assessment Follow-up Program; ha = hectare

5.3.2 Formal Public Comments

In addition to the informal feedback that the public engagement outreach activities offer, the environmental assessment process provides an opportunity for formal feedback from the public. This process began with the formal public and Indigenous comment period on the Project Description in May 2016. Followed, by a formal public and Indigenous comment period on the EIS for the proposed Project from May 2017 until August 2017. Comments from members of the public, First Nations and the Manitoba Métis Federation, and NGOs on the EIS were consolidated by the CNSC (as the responsible authority) and received by CNL. CNL prepared responses to the formal comments which will be submitted to the CNSC and posted on the CEAA Registry under project #80142.

Previously identified areas of interest surrounding the Project continue to be prevalent in the 104 formal comments that the Project have received over the period September 2017 to December 3, 2020, including many comments and questions arising from the Alumni Technical Workshop held November 15, 2017, feedback from the April 3-5, 2018 benchmarking trip to Hallam, Nebraska, and the open house on June 8, 2019. For example, economic

regeneration, future land use, assessment of the decommissioning alternatives, and contingency plans continued to draw interest from the vicinity of the WL site.

5.4 Planned Future Engagements

The summary presented within this section is based on engagement activities up to September 2023. Future engagements will be summarized in future engagement reports. As the Project schedule evolves, CNL will continue to confirm engagement activities and provide updates to the CNSC monthly Indigenous and public engagement meetings. Planned future engagements may include but are not limited to the following:

- In-person and virtual open houses;
- information sessions (in person and virtual);
- participation in regular public events such as trade shows and street markets;
- regular website review and content update with new information added as it becomes available;
- semi-annual PLC meetings;
- bi-monthly webinars;
- WR-1 Project update letter/invitation to intervenors;
- public polling; and
- semi-annual CONTACT newsletters.

Note that throughout this section, dates and other details are provided where possible. For engagements planned for the near-term, details and dates are present, but subject to change. For engagements planned to occur farther into the future, specific dates and details of the activity are generally unavailable, to allow for flexibility and accommodation of the environmental assessment process.

CNL has planned engagements for 2022/2023, described by quarter, and looking ahead into the Project execution phase.

Fiscal Year 2022/2023 – Third Quarter (Q3) (October 1, 2022 – December 31, 2022)

CNL anticipates that media and public interest will increase following the submission of the Final EIS to the CNSC. After the submission, CNL receives feedback from the CNSC following the federal/provincial/Indigenous technical review, leading up to a two-part Commission Hearing. To address this interest and to fulfil regulatory requirements, CNL remains committed to ongoing engagement with the public.

CNL expects continued interest in the Final EIS from those who made comments and / or have been following the progress of the environmental assessment for the Project. CNL will continue to meet with stakeholders and First Nations and Manitoba Métis Federation. The focus will be on discussing how feedback has been incorporated into the Final EIS and how comments have been dispositioned. CNL will maintain regular communications through correspondence (including email blasts), meetings, information sessions, webpage content, newsletters and webinars to ensure stakeholders and First Nations and the Red River Métis are kept apprised of the environmental assessment progress.

Engagement in Q3 includes:

1. Bi-monthly webinar (September);
2. Public Liaison Committee (PLC) Meeting (November);
3. Bi-monthly webinar (November);
4. CONTACT Fall Newsletter (November); and
5. Survey of local residents, by phone and online.

Fiscal Year 2022/2023 –Fourth Quarter (Q4) (January 1, 2023 – March 31, 2023)

The 2023-year brings regular engagement activities, such as webinars that will continue to focus on issues of interest as expressed by the public. Key information updates will be shared with stakeholders through new web content, social media and emails to stakeholders.

Communication and engagement activities in Q4 include:

1. CONTACT winter edition (March);
2. Meeting with local elected officials;
3. Bi-Monthly webinar (February); and
4. Virtual Visitor's Centre (February).

Fiscal Year 2023/2024- First Quarter (Q1) (April 1, 2023 – June 30, 2023)

1. Public Liaison Committee (PLC) Meeting (May); and
2. Bi-monthly webinars.

Fiscal Year 2023/2024 – Second Quarter (Q2) (July 1, 2023 – September 30, 2023)

Regular engagement activities, such as public webinars and ad-hoc site visits will continue. Key information updates will be shared with stakeholders through web content updates, social media and emails to stakeholders. CNL will also continue to share information in interactive ways, such as video and infographics.

Engagements in Q2 include:

1. CONTACT Newsletter;
2. Bi-monthly webinars; and
3. CNA Conference.

Fiscal Year 2023/2024 - Hearing Preparation

In preparation of the two-part CNSC Commission Hearing that is anticipated to take place in 2024, CNL will continue to engage the public through a variety of mechanisms demonstrating transparency in the process and access to information. CNL will continue to be proactive with the media and engaged stakeholders to communicate the benefits of the Project. CNL will engage with stakeholders through public information sessions, site tours, advertising meetings of the Public Liaison Committee and engagement with First Nations and the Red River Métis. CNL will continue to use social media to promote key Project milestones and Project information. Information

shared leading up to the two-part Hearing, will focus on how individuals and groups can participate and how they can learn more about the Project.

Engagement activities leading up to the hearing will highlight particular aspects of importance and include:

1. PLC Meetings to provide Project updates;
2. Breakfast briefings and Information Sessions in local communities for interested members of the public;
3. Open Houses;
4. Facility Tours;
5. Public Webinars;
6. CONTACT Newsletter;
7. Municipal Council meetings to provide Project updates;
8. Stakeholder updates via email, newsletters and advertising; and
9. Updated online content.

Project Closure Phase
Pending regulatory approval, the closure phase could begin in 2025. During this period, CNL will continue to update stakeholders and encourage feedback on effects that may occur to evaluate mitigation while the Project progresses. CNL will also continue to include stakeholders in participation of environmental monitoring plans and regularly update the community on Project developments.

Regular engagement that supported the stakeholder relationships that CNL has worked to build with respect to the Project will continue. For instance, updates to the PLC, meetings with interest groups and local elected officials, as well as stakeholder emails and communicating on social media will be a key aspect to ongoing engagement.

5.4.1 Implications of the COVID-19 Pandemic

Since March 2020, the COVID-19 pandemic has directly impacted CNL's public engagement program resulting in the transition of all activities previously conducted in-person (e.g., personal meetings, open houses, site tours) into virtual engagements. The Project has been successful in its response to this transition and will continue to implement virtual engagement activities moving forward. CNL has responded by increasing its use of virtual platforms during the pandemic to maintain a connection virtually with stakeholders.

Webinars continue to be one of the most effective activities used to share Project updates and information. The Project-specific webpage is a key method used to share information. This general increase in participation and views shows that the Projects' efforts to engage virtually have been effective and that continued effort needs to be made in the future to engage virtually, even after a return to in-person engagement is available.

The virtual-based activities in 2020 through 2022 summarized in this section present several implications for future engagements:

- Improved accessibility for stakeholders who prefer to engage remotely (from their own offices, without requiring travel) and those who prefer to access online publications and CNL material on their schedule). Virtual engagement activities, such as the virtual open house, may therefore be popular to these stakeholders.

- Increased capacity to reach a broader audience, demographically and geographically. The continued availability of different virtual mediums (e.g., social media, news articles, CNL webpage) enable CNL to cater to a more diverse audience.
- Most in-person engagement activities remain on hold or have been replaced with virtual alternatives. Even after federal and provincial public health restrictions lift, many stakeholders (especially those who do not live locally), may choose to continue engaging remotely and since CNL's virtual activities have been successful in engaging the public, some future engagements will continue to be hosted virtually.
- Much, if not all, publicly generated conversations about new Project updates will continue to occur virtually through social media outlets since these will be the first avenues which will gain public attention. For example, people who use devices such as smartphones receive instant notifications or news feeds whenever an outlet, they follow gets updated. This may continue even after physical distancing restrictions caused by the pandemic have been lifted.
- The importance of remaining flexible and responding to the feedback related to engagement activities as a priority.

Overall, despite the lack of in-person activities, it is reasonable to anticipate that future Project engagement activities will be comparably successful with the use of digital and virtual platforms and media. Additionally, CNL's stakeholder engagement strategies are resilient to the challenges presented by the pandemic.

5.5 Conclusions

Methods employed to date have helped to share information and build awareness about the Project with stakeholders and have enabled the public to provide valuable feedback into the Project. CNL will continue engagement efforts to support growth in awareness and understanding of the Project.

The progression of the Project through the environmental assessment process is reflected in the evolution of stakeholder engagement strategies and in particular CNL's response to evolving engagement activities due to the COVID-19 pandemic. This report demonstrates that CNL was able to achieve its engagement objectives from 2020 through 2022 despite the challenges presented by the COVID-19 pandemic. Through direct conversations with stakeholders and members of the public during the timeframe of this report, CNL strived to address issues and concerns that the public had about the Project. In-person meetings, print media, and public information sessions facilitated organic conversations between Project staff and the public. These traditional forms of engagement are recognized by CNL to facilitate active relationship-building more tangibly with its stakeholders. However, to maintain active engagement with the public during the pandemic, CNL had to evolve its engagement strategies to accommodate a virtual environment. As a result, CNL developed virtual platforms that continued to enable direct conversation (e.g., webinars, virtual open house). The open concept and broad reach of these virtual chat "rooms" (anyone with an internet connection can participate) enabled CNL to engage with a wider audience than before. The evidence of increased participation (attendance and submission of feedback) from the public signifies the popularity and success of these virtual engagement activities. CNL will therefore, continue to use virtual platforms to provide a variety of flexible means of interacting and conversing with key stakeholders in future engagement activities.

CNL has proactively addressed the key issues raised by stakeholders, in many cases resolving those concerns. However there remains persistent issues including the perception of a potential negative effect of the WRDF on the Winnipeg River and other off-site effects. CNL will continue to share information with the public through CNL's Public Information Program (CNL 2021), including follow-up monitoring being used to verify predictions made in the final EIS.

Continuing to provide information as it becomes available will reinforce transparency and encourage further feedback which can assist CNL in understanding and incorporating stakeholder perspectives into Project planning, future communications, and the environmental assessment process.

To reduce the stigma surrounding legacy nuclear waste and remediation, CNL will continue to proactively share information with public stakeholders about its waste management practices and projects.

CNL will measure its effectiveness by continuing to self-evaluate against its communication objectives. This is an ongoing process and validation continues regularly through analysis of multiple forms of feedback.

Continued success means that CNL will endeavour to assess to what extent stakeholders participate in and trust CNL's communication and engagement. This is essential to verify and create the path for CNL's stakeholder engagement strategy in support of the Project into the future.

6.0 ENVIRONMENTAL EFFECTS

6.1 Environmental Assessment Approach

The environmental assessment process is an important tool that is used to integrate environmental and social factors into project planning and decision-making. The goal of the environmental assessment process is:

- promote sustainable development;
- engage Indigenous peoples, the public and government agencies; and
- reduce the overall biophysical, economic, social, and health effects of the Project.

An environmental assessment:

- identifies potential adverse environmental effects;
- proposes measures to mitigate adverse environmental effects;
- predicts whether there will be significant adverse environmental effects after mitigation is implemented; and
- includes a follow-up monitoring program to verify the accuracy of the environmental assessment and the effectiveness of the mitigation.

This section describes the scope and approach of the environmental assessment implemented for the Canadian Nuclear Laboratories (CNL) In Situ Decommissioning of WR-1 at the Whiteshell Laboratories Site (the Project). The environmental assessment approach applied to disciplines (e.g., atmospheric environment, hydrogeology, terrestrial biodiversity, human health and socio-economic environment) includes the following main activities (where applicable), with further detail on each provided in Sections 6.2 to 6.9:

- Step 1 – **Define the scope of the assessment**, including input received from regulatory agencies and engagement activities:
  - Identify the valued components (VCs) for each discipline that the assessment will focus on, and the associated measurement indicators and assessment endpoints for VCs.
  - Define spatial (e.g., geographic extent of the Project activities and effects) and temporal (e.g., timelines for the Project phases and effects) boundaries and assessment cases used to evaluate effects.
- Step 2 – **Describe the existing conditions**, including the cumulative effects of previous and existing developments for each VC.
- Step 3 – **Evaluate Project interaction and mitigation** by conducting a pathway analysis to identify Project components or activities with a potential to create a residual effect and describe the mitigation developed for removing pathways or limiting effects. In the assessment for some disciplines, no primary pathways for effects are identified and the assessment proceeds directly to Step 7.
- Step 4 – **Conduct an analysis for each VC to predict residual effects from the Project**. Conduct an assessment for each VC to predict the Project-specific effect, as well as cumulative effects from the Project,

other previous and existing projects and activities, and potential future projects that have been proposed but not yet approved (if applicable).

- Step 5 – **Evaluate and describe the level of certainty** that can be placed on predicted residual effects and the methods used to manage uncertainty.
- Step 6 – **Classify and determine the significance of predicted residual effects**, including Project-specific effects, and cumulative effects from the Project and potential future projects that have been proposed but not yet approved (if applicable).
- Step 7 – **Identify monitoring and follow-up programs** to confirm the effects predictions and address uncertainty.
- Step 8 – **Present a consolidated summary of conclusions** and outcomes of the assessment.

Generally, this approach is consistently applied across disciplines, with some modifications, where appropriate. For example, VCs are defined for all disciplines and there is consistency in the determination of spatial and temporal boundaries for the effects analysis. Similarly, the methods for identifying interactions that link the Project to potential effects on VCs are consistent.

In contrast, the methods for analyzing, classifying (e.g., magnitude and duration) and predicting environmental significance of residual effects can differ between discipline components. For example, human effects from a specific project are difficult to isolate from the ongoing processes of interdependent social, cultural and economic change. Evolving social trends, government policy and programming decisions, and individual choice all have effects that will be concurrent with potential effects of the Project. Biophysical disciplines (e.g., hydrogeology, aquatic environment and terrestrial environment) are influenced simultaneously by natural and human-related factors. For many biophysical disciplines, Project-specific effects can be quantified (e.g., incremental changes to ground and surface water quality, air quality, and fish and wildlife habitat). Because the socio-economic status of different communities, subpopulations and individuals may vary, a socio-economic effect may have positive aspects and negative aspects. An effect on a biophysical discipline is typically constrained to being negative or positive.

Each of the steps identified above are described in the following sections; details specific to each discipline are provided in their respective sections of the Environmental Impact Statement (EIS).

6.1.1 Scope of the Assessment

The decommissioning approach for the Whiteshell Laboratories (WL) site as described in the Comprehensive Study Report was to remove all facilities from the WL site with the exception of low-level waste trenches in the Waste Management Area, and existing contaminated river sediments, which may be managed through in situ disposal (ISD) (AECL 2001). CNL proposed in situ disposal of the WR-1 Building, which allows CNL to decommission WR-1 in a safe, cost effective manner and in a shorter timeframe without interim storage of the waste. The Project activities are limited to ISD of the WR-1 Building (i.e., the Project). Other decommissioning activities for the WL site, documented in the Comprehensive Study Report (AECL 2001), are assumed to be unmodified. Removal of the east annex and service wing of the WR-1 Complex were assessed as part of the Comprehensive Study Report and are covered under CNL's existing decommissioning licence for the WL site (Licence No. NRTEDL-W5-8.00/2024). Activities required to prepare for ISD, such as isolation of the

WR-1 Building and targeted remediation of hazardous materials, are also covered under CNL's existing decommissioning licence No. NRTEDL-W5-8.00/2024 for the WL site.

The scope of the environmental assessment incorporates advice provided in guidance documents relevant to environmental assessment practice (Section 1.6.1 Federal Review Process) and input received from regulatory agencies, Indigenous peoples and the public (Section 4.0 Indigenous Engagement and Section 5.0 Public Engagement). As described in Section 1.6.2, the *Generic Guidelines for the Preparation of an Environmental Impact Statement* (Generic EIS Guidelines) developed by the Canadian Nuclear Safety Commission (CNSC 2016) provides an outline of the information to be included in the EIS, along with a high-level description of the methods to be implemented for the environmental assessment.

6.1.2 Traditional Knowledge and Indigenous Engagement Feedback

Traditional knowledge and Indigenous engagement feedback was integrated into the development of the Project, including the environmental assessment. Four Traditional Knowledge and Land Use Studies for the WL site have been completed. Traditional Knowledge and Land Use Studies were completed to further enable opportunities to capture and include Traditional knowledge into the environmental assessment.

Interests and concerns raised by Sagkeeng First Nation (Sagkeeng); the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations during engagement were also considered for inclusion in the environmental assessment. 'Interests and Concerns' tables were developed that summarize the key interests and concerns raised by each Indigenous community to date on the Project (Appendix 4.0-1 Summary of Engagement and Summary of Interests and Concerns Tables). The key interests and concerns raised by each Indigenous community have been assembled from a number of sources provided by the community to CNL. Sources of information include formally submitted comments to the CNSC as part of the environmental assessment process, comments and questions sent to CNL regarding the Project; and summaries of topics that have been discussed between CNL and each Indigenous community at meetings, site tours, workshops benchmarking trips, and the Traditional Knowledge and Land Use Studies.

Traditional Knowledge and Land Use Studies and interests and concerns identified through Indigenous engagement were considered in the environmental assessment, including identification of VCs, defining spatial boundaries, description of the environment, identification and evaluation of Project interactions, and inclusion in monitoring programs. Available sources of Traditional knowledge and feedback from Indigenous engagement were shared with the environmental assessment discipline leads for their review and consideration in their respective assessments.

6.1.3 Valued Components

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). The selection of appropriate VCs allows the assessment to be focused on those aspects of the natural and human environment that are of greatest importance to society and species conservation.

The list of VCs selected for the Project considered a number of factors, including:

- presence, abundance and distribution within, or relevance to, the area associated with the Project;
- potential for interaction with the Project and potential vulnerability to the effects of the Project;

- species conservation status or concern (e.g., rarity, sensitivity and uniqueness);
- ecological and socio-economic value to communities, government agencies and the public;
- traditional, cultural and heritage importance to Indigenous peoples;
- legally recognized and afforded specific protection by law, policy, or regulation; and
- experience with similar projects.

Valued components were selected with due consideration of the results of baseline studies and subsequent consultation with regulators, with a focus on criteria used to evaluate the potential significance of residual effects. Since it is generally an impractical task to assess the potential effects of the Project on all the species of biota within a natural ecosystem, and specifically within the ecosystem around the WL site, representative organisms were chosen as VCs for the Project's environmental assessment. These organisms were selected because they are known to exist on the WL site and within the Winnipeg River, are representative of major taxonomic groups or exposure pathways, or have a special importance or value. As per *REGDOC-2.9.1, Environmental Principles, Assessments and Protection Measures*, VC selection focused on providing a "full accounting of effects on species with elevated conservation status and their habitat" (CNSC 2020).

The selection of VCs also considered information collected by CNL through public and Indigenous engagement activities with Sagkeeng, the Manitoba Métis Federation, Brokenhead Ojibway Nation, Black River First Nation, Hollow Water First Nation, and Wabaseemoong Independent Nations. As part of CNL's Public Information Program (CNL 2021), CNL held open house events where the public was given the opportunity to identify new VCs. Traditional Knowledge and Land Use Studies (Firelight Research and SFN 2018, BRFN, BON, and HWFN 2019, and SVS 2019) also identified VCs for consideration in the environmental assessment. The majority of the VCs identified through Indigenous and public engagement activities are already represented by the VCs selected for the environmental assessment. Moose was identified as an important species to Indigenous Nations and was subsequently added as a VC in the Ecological Health Assessment (Section 6.7 Human and Ecological Health). Where VCs identified by Indigenous Nations were not included in the assessment, rationale was provided within the discipline assessments.

CNL also carried out Indigenous engagement activities seeking to understand traditional rights-based activities such as traditional harvesting. CNL partnered with Sagkeeng and the Manitoba Métis Federation to carry out surveys on traditional harvesting and food intake. Traditional Knowledge and Land Use Studies identified that Indigenous peoples harvest wild rice and medicinal plants (i.e., weekay). As such, weekay was added to the diet of a Harvester in the Human Health Assessment; however, wild rice does not grow in close proximity to WR-1 and therefore was not added to the Human Health Assessment (see Section 6.7 Human and Ecological Health).

CNL has chosen traditional land and resource use as a VC, which considers how traditional and resource uses such as trapping, hunting, fishing, gathering, and culture might be affected by the Project. The traditional land and resource use assessment also considers the different land use practices among the various Indigenous Nations / organizations. For example, Section 6.8.1.5.2.2 Traditional Land and Resource Use by Indigenous Peoples has been updated and is segmented by Indigenous community to outline their unique ways of practicing and describing traditional uses.

The final list of VCs that are included in the environmental assessment for the Project, including rationale for their selection, is provided in Table 6.1.2-1.

Table 6.1.2-1: Valued Components Selected for the Environmental Assessment

Discipline	Valued Component	Rationale
Atmospheric Environment	Air Quality	Air quality is selected as a VC as it has been identified as an important aspect of the environment by the regulators. In addition, emissions from the Project activities have the potential to alter the existing air quality regime.
	Climate Change	This valued component, assessed through incremental changes in emissions of greenhouse gases, considers the potential of the Project to contribute to climate change.
Physical Environment	Geology*	Characteristics of geology, such as soil quality and quantity, bedrock and geomorphology, are important components that interact with other VCs (e.g., hydrology and surface water quality) and if changed by Project activities could affect terrestrial and aquatic biodiversity.
	Hydrogeology*	Characteristics of hydrogeology, such as groundwater quantity and quality are important components that interact with other VCs (e.g., hydrology and surface water quality) and if changed by Project activities could affect terrestrial and aquatic biodiversity and human health.
Surface Water Environment	Hydrology*	■ The Project may affect existing availability of the spatial and temporal distribution of water quantity for aquatic and terrestrial biodiversity, which can subsequently affect land and resource use. ■ Public and Indigenous peoples 'concerns regarding changes in water quantity in the Winnipeg River are an important consideration in understanding potential effects of the Project.
	Surface Water Quality*	There is potential for interaction with the Project; species of concern live in the river; river has ecological and socio-economic value to communities, government agencies and the public; and downstream areas have traditional, cultural and heritage importance to Indigenous peoples.
Aquatic Environment	Fish and fish habitat	The Winnipeg River supports a diverse fish community, including species at risk and species that support recreational fisheries. This VC captures the fish species identified by Indigenous Nations. The migration of radionuclides to the Winnipeg River via groundwater may potentially affect fish and fish habitat.
Terrestrial Environment	Barn swallow	■ Barn swallow (*Hirundo rustica*) has been recently downgraded to Special Concern by COSEWIC, but is federally listed as Threatened under SARA (as amended February 2022) and is listed under the MBCA. It has legal individual and habitat protection provisions under SARA and individual and nest protection under the MBCA. ■ Because the WL site is federally owned, critical habitat of the species will be afforded protection under SARA, once the features of critical habitat have been defined in a federal recovery strategy. A federal recovery strategy for barn swallow has not yet been prepared. ■ There is the potential for barn swallow to be indirectly and directly affected by the Project through sensory disturbance, habitat loss and mortality. Barn swallows have been observed nesting within WL main campus.

Table 6.1.2-1: Valued Components Selected for the Environmental Assessment

Discipline	Valued Component	Rationale
Terrestrial Environment (continued)	Golden-winged warbler	■ Golden-winged warbler (*Vermivora chrysoptera*) is federally listed as Threatened under SARA (as amended February 2022) and listed under the MBCA. It has legal individual and habitat protection provisions under SARA and individual and nest protection under MBCA. ■ As the WL site is federally owned, this species is afforded protection of critical habitat because it is listed as Threatened on Schedule 1 of SARA. Critical habitat has been partially defined for this species in the federal recovery strategy. ■ There is the potential for golden-winged warbler to be indirectly affected by the Project through sensory disturbance (i.e., noise created by decommissioning activities). ■ Avian species with the potential to occur within the WL site (no confirmed observation records to-date), that represents a guild of edge habitat specialists.
	Bats ■ Little brown myotis ■ Northern myotis	■ Little brown myotis (*Myotis lucifugus*) and northern myotis (*M. septentrionalis*) have observation records within the WL main campus. Both bat species are federally listed as Endangered (as amended February 2022) and have legal individual protection provisions under the federal SARA. ■ As the WL site is federally owned, these bat species are afforded protection of critical habitat because they are listed as Endangered on Schedule 1 of SARA. ■ Critical habitat has only been “partially identified”, for one life history requirement and habitat type (overwintering habitat), as the largest threat to these species is associated with that habitat type. No active hibernacula have been identified in the WL site and the geological conditions make the presence of caves or exposed bedrock highly unlikely. ■ Other critical habitat types that are identified, but not yet legally defined and protected as “critical habitat”, include: roosting, foraging and swarming habitat. ■ Maternity roost habitat for little brown myotis and northern myotis is potentially present in the treed areas of the WL site surrounding the WL main campus. There is the potential for both species to be indirectly affected by the Project through sensory disturbance and related habitat avoidance (caused by noise associated with decommissioning activities and potential roost abandonment). ■ Maternity roost habitat for little brown myotis is also potentially present in the WR 1 Building, and little brown myotis have the potential to be indirectly and directly affected by the through disturbance, habitat loss and mortality. ■ Represents small mammal species recorded in the WL main campus that may utilize buildings for part of their life history (maternity roosting, diurnal roosting and evening roosting).

Table 6.1.2-1: Valued Components Selected for the Environmental Assessment

Discipline	Valued Component	Rationale
Terrestrial Environment (continued)	Snapping turtle	■ Snapping turtle (*Chelydra serpentina*) have been observed within the WL site. They are federally listed as Special Concern under SARA (as amended February 2022), but they do not have legal individual protection provisions under the Act, nor do they receive protection of critical habitat. ■ There is the potential for snapping turtle to be indirectly and directly affected by the Project through sensory disturbance (noise) and mortality (i.e., vehicle strike on roads). All snapping turtle observations to-date within the WL site have been on roads. ■ Represents herpetile species that are vulnerable to mortality on roadways.
Human Health	Public Health ■ Farms A and F ■ Harvesters ■ On-site farm	Potential exposure to airborne and waterborne radiological and non-radiological emissions ■ Farms A and F includes year-round occupants, with livestock, located near the east bank of the Winnipeg River. Farm F being north-northeast of the WL site and Farm A being north of the WL site. ■ Harvesters represent Indigenous or traditional users of the area who may be exposed through harvesting of country foods. ■ In the long-term, during post-institutional control, there is the potential that a farm may inhibit the site.
	Worker Health	On-site workers not involved in performing closure activities may be potentially exposed to both radiological and non-radiological hazards (e.g., asbestos).
Ecological Health	Earthworm	Detritivore. Exposed to atmospheric release through soil.
	American Robin	Observed on-Site. Exposed to atmospheric release through the ingestion of soil invertebrates. A surrogate for insect eating birds including various species at risk under COSEWIC, ESEA or SARA.
	Loggerhead Shrike	Historically observed on-site. Exposure to atmospheric release through the ingestion of soil invertebrates, small mammals and birds. Identified as a Species at Risk under COSEWIC, ESEA or SARA. A surrogate for other predatory birds identified as Species at Risk under COSEWIC, ESEA or SARA.
	Barn Swallow	Observed on-site. Exposure to aquatic release through ingestion of aerial stages of benthic invertebrates. Identified as a Species at Risk under COSEWIC, ESEA or SARA. A surrogate for aquatic insect eating birds including various Species at Risk under COSEWIC, ESEA or SARA.
	Horned Grebe	Present in the area. Exposure to aquatic release through ingestion of water and fish. Identified as a Species at Risk under COSEWIC, ESEA or SARA. Food source for other VCs. Surrogate for other important species such as the common loon and red-necked grebe.
	Trumpeter Swan	Observed on-site. Exposure to aquatic release through ingestion of water and aquatic plants. Identified as a Species at Risk under COSEWIC, ESEA or SARA.
	Mallard	Representative of waterfowl. Exposure to aquatic release through ingestion of water, aquatic plants and benthic invertebrates. Food source for other VCs and human receptors.
	Grass and Shrubs	Present on-site. Exposure to atmospheric release through soil. Food source for other VCs.
	Berries	Present in the area. Exposure to atmospheric release through soil. Food source for VCs.
	Meadow Vole	Common in the area. Exposure to atmospheric release through ingestion of terrestrial plants. A food source for VCs.

Table 6.1.2-1: Valued Components Selected for the Environmental Assessment

Discipline	Valued Component	Rationale
Ecological Health (continued)	Common Shrew	Common in the area. Exposure to atmospheric release through ingestion of soil invertebrates. A food source for VCs.
	Snowshoe Hare	Common in the area. Exposure to atmospheric release through ingestion of terrestrial plants. A game species.
	White-tailed Deer	Common in the area. Over winters on-site. Exposure to atmospheric release through ingestion of terrestrial plants. A game species. An important game species for Traditional Communities.
	Moose	Present on-site to a limited extent. Identified as a game animal of interest for some Indigenous Nations. Exposure to aquatic release through ingestion of aquatic plants.
	Red Fox	Common in the area. Exposure to atmospheric release through the ingestion of small mammals and birds. A surrogate for the Grey Fox identified as a Species at Risk under COSEWIC, ESEA or SARA.
	Mink	Present in the area. Exposure to aquatic release through ingestion of water, waterfowl and fish.
	Little Brown Myotis	Bats observed roosting in forested areas of the WL site. Exposure to atmospheric release through ingestion of soil invertebrates. Exposure to aquatic release through ingestion of aerial stages of benthic invertebrates. Identified as a Species at Risk under COSEWIC, ESEA or SARA. A surrogate for other bats identified as Species at Risk under COSEWIC, ESEA or SARA.
	Common Shiner	Present in the Winnipeg River. Exposure to aquatic release through surface water and sediment. Identified as a Species at Risk under COSEWIC, ESEA or SARA. Small-bodied forage fish. A food source for other VCs.
	Lake Sturgeon	Present in the Winnipeg River. Exposure to aquatic release through surface water and sediment. Identified as a Species at Risk under COSEWIC, ESEA or SARA.
	Walleye	Present in the Winnipeg River. Exposure to aquatic release through surface water. A sport fish. A surrogate for other pelagic fish in the Winnipeg River such as Northern Pike and Mooneye.
	Aquatic Plants	Present in the Winnipeg River. Exposure to aquatic release through surface water. Food source for other VCs.
	Benthic Invertebrates	Present in the Winnipeg River. Exposure to aquatic release through surface water and sediment. Food source for other VCs.

Table 6.1.2-1: Valued Components Selected for the Environmental Assessment

Discipline	Valued Component	Rationale
Traditional Land and Resource Use	Cultural and Archaeological Sites	Cultural and archaeological sites are those sites protected under legislation and administered by the Manitoba Heritage Resource Branch. Cultural and archaeological sites are important for revealing past and present land use, cultural identity and relationships with other cultures and the social and biophysical environments. Potential alteration or loss of cultural and archaeological sites can have an effect on Indigenous people. Consideration of physical and cultural heritage is a requirement under Section 5 of the *Canadian Environmental Assessment Act, 2012*. The cultural and archaeological sites VC is of known importance to Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations as identified through Traditional Knowledge and Land Use Studies, engagement with CNL, and verification discussions. Consideration of physical and cultural heritage is a requirement under Section 5 of the *Canadian Environmental Assessment Act, 2012*.
	Traditional Land and Resource Use by Indigenous Peoples	Traditional Land and Resource Use is defined as the land and resource by Indigenous Peoples for traditional purposes, including hunting, fishing, trapping and gathering. Traditional land and resource use by Indigenous people is important for maintaining meaningful connections with cultural identity and community history, for food security, economic self-sufficiency, and the maintenance of individual and population health. Traditional land and resource use can also promote intergenerational connections within communities as knowledge is passed down from elders to community members, including youth. Potential changes to traditional land and resource use by Indigenous people can have an adverse effect on Indigenous people by preventing them from fully expressing their cultural identity and Treaty rights. The traditional land and resource use by Indigenous people VC is representative of the values identified by Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations, as identified through Traditional Knowledge and Land Use Studies, engagement with CNL, and verification discussions. Consideration of current land and resources use for traditional purposes is a requirement under Section 5 of *Canadian Environmental Assessment Act, 2012*.
	Winnipeg River	The public and Indigenous peoples identified the importance of the Winnipeg River. A number of communities depend on the river for drinking water, recreation, cultural vitality, inter-generational knowledge transfer and food security. The river flows into the Lake Winnipeg, one of the largest lakes in the world. The eastern shore of the lake is included in a United Nations World Heritage Site proposal (Manitoba Wildlands 2008). This watershed is valued for many reasons by many people and groups. Indigenous peoples identified the Winnipeg River as a critical resource for traditional and rights-based activities, including harvesting of fish, waterfowl, plants and other animals. The river was identified as a source of drinking water and as a transportation corridor. Further, Indigenous peoples recognize the sacredness of water, the interconnectedness of all life and the importance of protecting water. The Winnipeg River VC is of known importance to Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations as identified through Traditional Knowledge and Land Use Studies, engagement with CNL, and verification discussions.

Table 6.1.2-1: Valued Components Selected for the Environmental Assessment

Discipline	Valued Component	Rationale
Other Land and Resource Use	Land Tenure	Land tenure considers the uses, allocations and ownership of lands in proximity to the Project, including the Whiteshell Laboratories (WL) site itself. The change in decommissioning for the Whiteshell Reactor 1 (WR-1) Building will decrease the proportion of the WL site available for future land tenure by private or public entities. The use of in situ disposal may also change the perceived suitability of land use surrounding the WL site. The land tenure VC is of known importance to Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations as identified through Traditional Knowledge and Land Use Studies, engagement with CNL, and verification discussions.
	Outdoor Recreation and Tourism	The WL site is located in an area with several provincial parks, including the Whiteshell Provincial Park, that offer a variety of outdoor recreation opportunities while also being located near towns and Rural Municipalities (RMs) that rely on cottagers and tourism to contribute to their local economies.
	Winnipeg River	The public identified the importance of the Winnipeg River. A number of communities depend on the river for drinking water, recreation and food. The river flows into the Lake Winnipeg, one of the largest lakes in the world. The eastern shore of the lake is included in a United Nations World Heritage Site proposal (Manitoba Wildlands 2008). This watershed is valued for many reasons by many people and groups.
Socio-economic Environment	Employment and Income	Local communities recognize that the decommissioning of the WL site will result in changes to local employment and income opportunities. There are concerns that the change in approach to decommissioning the WR-1 Building may result in challenges to attracting new businesses to the WL site and creating future employment opportunities. The Sagkeeng First Nation; the Red River Métis; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations also identified employment as important through engagement and verification discussions.
	Business Opportunities	The proposed changes in decommissioning activities for the WR-1 Building create a different set of opportunities for contractors than the previous decommissioning plan. The Sagkeeng First Nation; the Red River Métis; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations also identified business opportunities as important through engagement and verification discussions.
	Government Finances	The LGD of Pinawa relies on a grant-in-lieu of taxes from AECL associated with the presence and operation of the WL site. The proposed changes in decommissioning activities may accelerate changes to the grant-in-lieu of taxes, which would change Pinawa's municipal revenue streams.
	Community Infrastructure and Services	A wide range of essential human needs are fulfilled by infrastructure and services in communities. Projects can place additional demands on them and their ability to meet community needs. The Project may also affect how community infrastructure and services are funded in Pinawa as AECL pays the LGD a grant-in-lieu of taxes, which is used to fund infrastructure and services, including the School District of Whiteshell.

Table 6.1.2-1: Valued Components Selected for the Environmental Assessment

Discipline	Valued Component	Rationale
Socio-economic Environment (continued)	Community Well-being	Community well-being is affected by a variety of factors, including consideration of economic well-being, physical well-being, social well-being and the environment. The change in approach to decommissioning the WR-1 Building may restrict access to more of the WL site than previously anticipated and limit its subsequent use for other activities. Indigenous Nations have expressed concern that the Project may limit their participation in land and resource use activities, which would affect their well-being through the ability to express their culture or exercise Aboriginal and Treaty rights. Communities have also expressed concern that attracting a new business/industry to the WL site is important for their continued viability, both in terms of employment/income and in terms of their long-term sustainability.
	Public Safety	Public Safety has been a concern for the overall decommissioning of the WL site, which included medium-term storage of radioactive waste and eventual transport of radiological waste to permanent disposal facilities. The Project will reduce the amount of radiological waste being transported to disposal facilities, which will reduce one public safety hazard; however, the shift to in situ disposal will create a new public concern that was also identified by Indigenous peoples as some waste will be stored on the WL site permanently. Public safety related to the transportation of radiological waste off-site is considered in this assessment; while concern related to public exposure from in situ disposal is evaluated in Section 6.7 Human and Ecological Health. Psychosocial impacts are not considered a VC; however, due to the significant importance of this concern, and in the spirit of understanding and cooperation, the EIS discusses the psychosocial impacts of perceptions of the project in Section 4, as well as mitigations CNL has and will put in place to address concerns related to fear and stigma associated with the site,

Note: Those valued components denoted with an "*" indicate a valued component that does not have an assessment endpoint.

Farm A = Easting (m): 709547, Northing (m): 5565803; Farm F = Easting (m): 708772, Northing (m): 5564710

VC = valued component; *SARA* = *Species at Risk Act*; COSEWIC = Committee on the Status of Endangered Wildlife in Canada; ESEA = *Endangered Species and Ecosystems Act*; ISD = In Situ Disposal; MBCA = *Migratory Birds Convention Act*; *CEAA* = *Canadian Environmental Assessment Act*; AECL = Atomic Energy of Canada Limited; LGD = Local Government District.

Assessment endpoints are qualitative expressions used to assess the significance of residual effects on VCs and represent the key properties of the VC that should be protected for future human generations (i.e., incorporates sustainability). For example, self-sustaining and ecologically effective fish and wildlife populations, continued land use opportunities and protection of archaeological resources may be assessment endpoints for fish and wildlife, land use and tenure, and archaeological resources, respectively.

Assessment endpoints are typically not quantifiable and require the identification of one or more measurement indicators that can be directly linked to the assessment endpoint. Measurement indicators represent properties of the environment and VCs that, when changed, could result in or contribute to an effect on assessment endpoints. Measurement indicators may be quantitative (e.g., concentrations of metals and radioactivity in surface water) or qualitative (e.g., movement and behaviour of wildlife from disturbance to habitat). Measurement indicators also provide the primary factors for discussing the uncertainty of effects on VCs and, subsequently, are key variables for study in potential follow-up and monitoring programs.

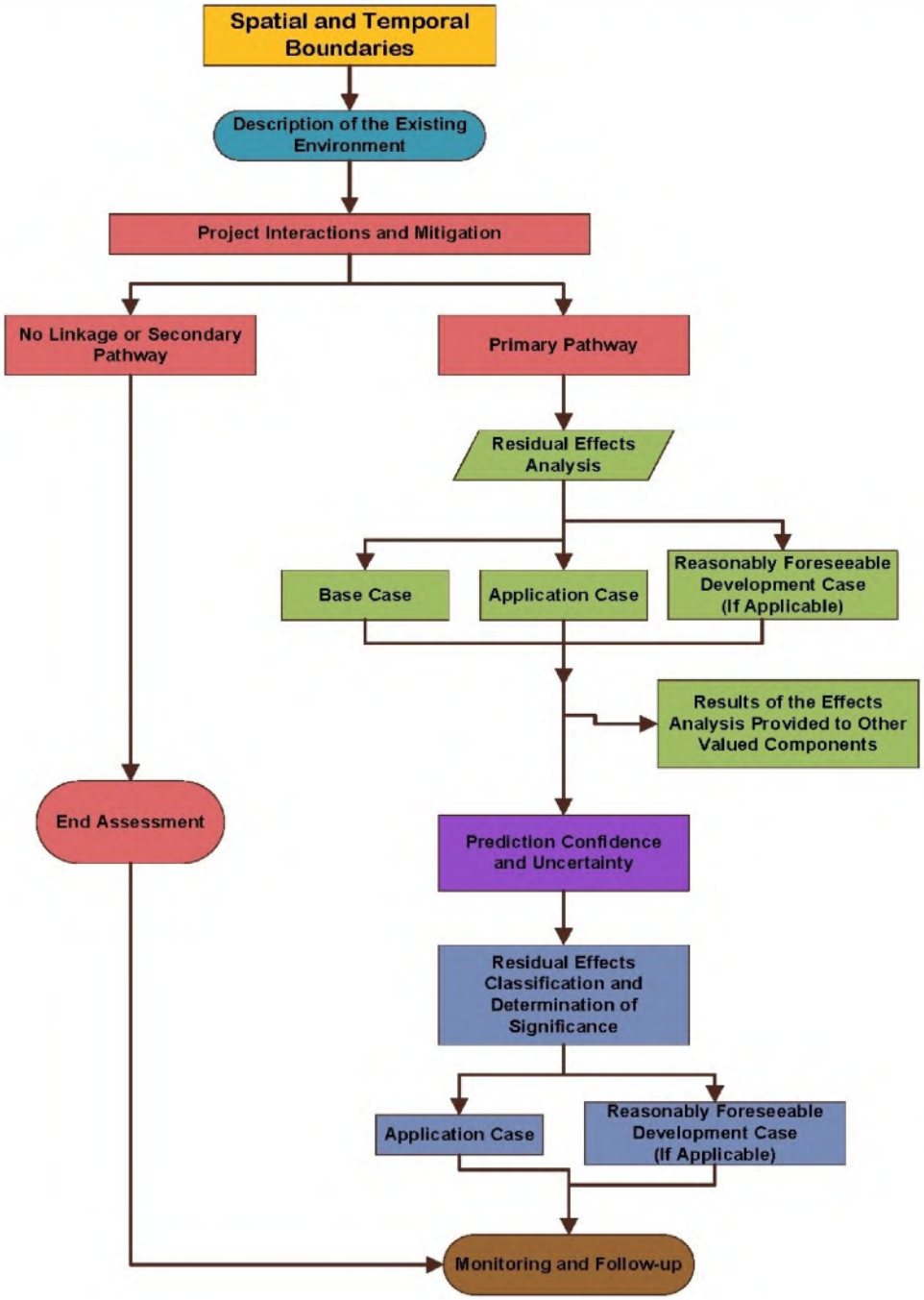
The significance of effects from the Project on VCs is evaluated by linking **changes** in measurement indicators to **effects** on the assessment endpoints. For example, changes in habitat quantity and quality (measurement indicators) are used to assess the significance of residual effects from the Project on the ability of a wildlife population to remain self-sustaining and ecologically effective (an assessment endpoint).

All VCs have measurement indicators, but not every VC has an assessment endpoint. For example, VCs such as geology, hydrogeology and surface water are considered as measurement indicators for other VCs, and do not have an assessment endpoint (i.e., may be referred to as pathway or intermediate VCs). Intermediate VCs are considered to be important aspects of the natural and human environment, and are evaluated in the EIS to determine how they may influence assessment endpoints. The evaluation includes an analysis of changes in measurement indicators for the intermediate VCs. The results of the analysis are provided to other disciplines (e.g., aquatic and terrestrial environment and human health) for inclusion in their residual effects analysis.

Valued components with no assessment endpoint are still analyzed for Project-specific and cumulative (if applicable) changes in measurement indicators. The changes are characterized in terms of magnitude, duration and geographic extent, but are not classified using rankings for effects criteria. For example, the magnitude of change in hydrological flows may be described as the relative change from baseline; however, this change would not be classified (or ranked) as low, moderate or high. This ranking would be reserved for the classification of residual effects and determination of significance for those VCs with assessment endpoints.

In summary, the same systematic and rigorous approach is applied to VCs with and without assessment endpoints, except that effects on VCs without explicit assessment endpoints are not classified using effects criteria nor evaluated for significance. The environmental assessment approach for VCs with assessment endpoints is illustrated on Figure 6.1.2-1, and the approach for VCs with no assessment endpoints is illustrated on Figure 6.1.2-2. The assessment approach is described further in Section 6.1.3 Assessment Boundaries to Section 6.1.9 Monitoring and Follow-up.

Valued Component with an Assessment Endpoint



REFERENCE(S)

1. GOLDER, 2017

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
ENVIRONMENTAL ASSESSMENT APPROACH FOR VALUED COMPONENTS WITH AN ASSESSMENT ENDPOINT

CONSULTANT

MM-YYYY	DECEMBER 2022
DESIGNED	--
PREPARED	PR/RRD
REVIEWED	KL
APPROVED	AB

PROJECT NO. 20145046 | CONTROL | REV. 2 | FIGURE **6.1.2-1**

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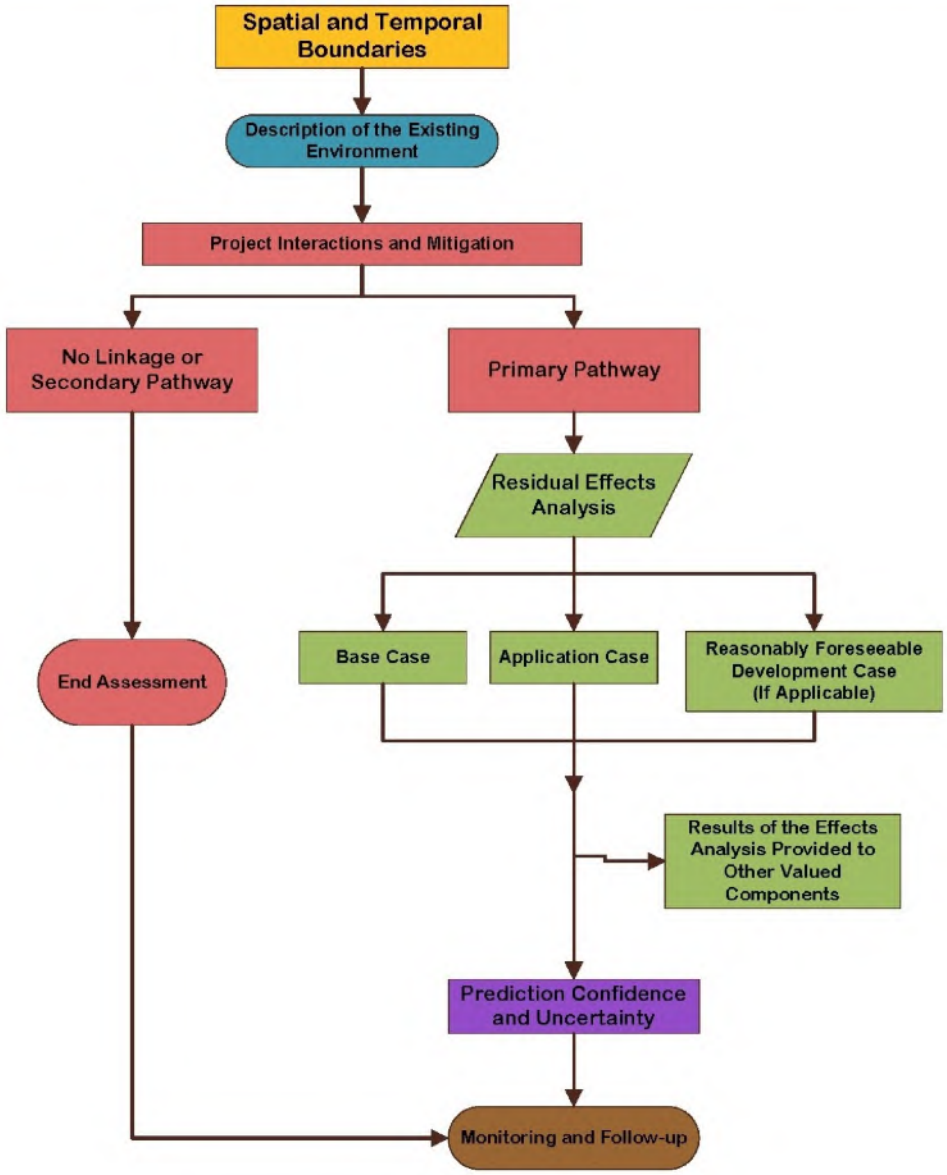
Valued Component without an Assessment Endpoint



REFERENCE(S)

1. GOLDER, 2017

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
ENVIRONMENTAL ASSESSMENT APPROACH FOR VALUED COMPONENTS WITHOUT AN ASSESSMENT ENDPOINT

CONSULTANT

MM-YYYY	DECEMBER 2022
DESIGNED	--
PREPARED	PR/RRD
REVIEWED	KL
APPROVED	AB

PROJECT NO. 20145046 | CONTROL | REV. 2 | FIGURE **6.1.2-2**

S:\Clients\Canadian Nuclear Laboratories\Manitoba\99 PRO\20145046\40 PROD\0007 EIS Sec 6.1\20145046-0007-G-0002 Figure 6.1.2-2 EA Approach without Assessment End Point.mxd

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6.1.4 Assessment Boundaries

Assessment boundaries define the geographic and temporal scope or limits of the analysis of effects from the Project on the environment. These boundaries encompass the areas within (spatial boundaries) and times during (temporal boundaries) which the Project, and in combination with previous, existing and reasonably foreseeable developments, is expected to interact with the VCs.

6.1.4.1 Spatial Boundaries

Defining the geographic extent of the study areas for each discipline is a key element of the environmental assessment process. Spatial boundaries are selected to be appropriate for each discipline (i.e., hydrogeology, aquatic environment, terrestrial environment and socio-economics) and associated VCs, using the following criteria:

- physical extent of the Project;
- physical extent of Project-related effects; and
- physical extent of key environmental systems (e.g., watershed boundary of potentially affected streams).

Individuals, populations and communities function within the environment at different spatial and temporal scales (Wiens 1989). In addition, the response of physical, chemical and biological processes to changes in the environment can occur across several spatial scales at the same time (Holling 1992; Levin 1992). The boundaries for the study areas are designed to quantify baseline conditions at a scale that is large enough to assess to maximum predicted geographic extent of direct and indirect effects from the Project on VCs and the Project in combination with previous, existing, and reasonably foreseeable developments. This environmental assessment has adopted a multi-scale approach for describing baseline conditions (existing environment) and predicting effects from the Project on VCs because the responses of physical, biological, cultural and economic properties to natural and human-induced disturbance will be unique and will occur across different scales.

As indicated in the CNSC Generic EIS Guidelines, the following spatial scales will be considered by each discipline.

- **Site Study Area (SSA):** The Site Study Area is the Project footprint (i.e., the footprint of the WR-1 Building, where Project activities would be undertaken including the Project's proposed facilities and infrastructure).
- **Local Study Area (LSA):** The Local Study Area is defined as the area existing outside the SSA, where measurable changes to the environment resulting from the proposed activities may be anticipated. The LSA varies depending on the environmental component assessed and each are described in more detail in their respective sections.
- **Regional Study Area (RSA):** The Regional Study Area is defined as the area within which the potential effects of the Project may interact with the effects of other projects. The RSA varies depending on the environmental component assessed and each are described in more detail in their respective sections.

The spatial boundaries for the study areas considered by each discipline and the rationale for their selection are identified in Section 6.2 Atmospheric Environment through Section 6.9 Socio-economic Environment under the "Assessment Boundaries" heading. The study areas are illustrated on maps of appropriate scale, which are also included in Section 6.2 Atmospheric Environment through Section 6.9 Socio-economic Environment

under the "Assessment Boundaries" heading. A summary of the spatial boundaries for this environmental assessment is provided in Table 6.1.3-1.

Table 6.1.3-1: Spatial Boundaries Selected for the Effects Assessment

Environmental Component	SSA	LSA	RSA
Atmospheric Environment	WR-1 Building (0.07 ha)	Approximately an 8 km by 8 km square that includes the SSA and the WL site (approximately 6,400 ha).	Approximately a 12 km by 12 km square surrounding the LSA (approximately 14,400 ha).
Geological and Hydrogeological Environment	WR-1 Building (0.07 ha)	Western boundary is approximately 800 metres west of the WR-1 Building. Northern boundary is approximately 450 m north of the WR-1 Building. Southern boundary is approximately 1,400 m south of the WR-1 Building. Eastern boundary is approximately 700 m east of the WR-1 Building and approximately 500 m east of the WL main campus (approximately 260 ha).	WL site (approximately 4,375 ha).
Surface Water Environment and Aquatic Environment	WR-1 Building (0.07 ha)	Fenced area of the WL main campus (approximately 29 ha)	To the north, east and south the RSA is delineated by the boundaries of the WL site. To the west, the RSA follows the west bank of the Winnipeg River adjacent to WL site. The RSA also includes the first farm located downstream on the east bank of the Winnipeg River (approximately 4,121 ha).
Terrestrial Environment	WR-1 Building (0.07 ha)	Fenced area of the WL main campus (approximately 29 ha)	The portion of the WL site on the east side of the Winnipeg River (approximately 3,710 ha).
Human Health and Ecological Health	WR-1 Building (0.07 ha)	Southern boundary extends from the west shore of the Winnipeg River to the east fence on the property line about 400 m north of Provincial Highway 211. The eastern boundary of the LSA follows the fence on the property line to the north property line. The northern boundary follows the north fence on the property line about 1.6 km and then turns north for about 400 m before turning west and extending to the west side of the Winnipeg River. Western boundary follows the west bank of the Winnipeg River for about 1.5 km and then turns west for 370 m, north for 1.4 km and then turns east for 630 m to the west side of the Winnipeg River (approximately 4,174 ha).	Approximately a 12 km by 12 km square surrounding the LSA (14,400 ha).

Table 6.1.3-1: Spatial Boundaries Selected for the Effects Assessment

Environmental Component	SSA	LSA	RSA
Land and Resource Use	WR-1 Building (0.07 ha)	To incorporate input from Indigenous Nations, the LSA was revised to capture Traditional land and resource use within proximity of the WL site and extends approximately 5 km beyond the WL site boundaries (approximately 11,917 ha)	The south boundary of the RSA extends from the west shore of the Winnipeg River to the east fence on the property line about 400 m north of Provincial Highway 211. The eastern boundary of the RSA follows the fence on the property line to the north property line. The north boundary follows the north fence on the property line about 1.6 km and then turns north for about 400 m before turning west and extending to the west side of the Winnipeg River. To incorporate input from Indigenous Nations, the RSA was revised to include the Winnipeg River from the WL site downstream to Lake Winnipeg with a 100 m buffer on either side of the river to capture Traditional land and resource use activities on either shore of the river. (approximately 14,182 ha).
Socio-economic Environment	—	Contains the Local Government Districts of Pinawa, the Town of Lac du Bonnet and the Town of Beausejour and the Rural Municipalities of Whitemouth, Lac du Bonnet and Brokenhead (approximately 278,031 ha).	Contains the Southeast Region of Manitoba and the City of Winnipeg (approximately 2,271,005 ha).

SSA = Site Study Area; LSA = Local Study Area; RSA = Regional Study Area

6.1.4.2 Temporal Boundaries

The temporal boundary of the assessment includes effects observed under existing conditions, the timeframe during which Project activities are actively occurring and the duration of predicted residual effects. The duration of an effect is defined as the amount of time between the start and end of a Project activity or stressor (which is related to the Project phases) plus the time required for the residual effect to be reversed. In some cases, a residual effect may be irreversible within the temporal boundaries of the Project if the effects were predicted to last so far into the future that they could not be predicted with any level of certainty (e.g., residual effect lasts for thousands of years).

Baseline studies associated with each VC identify temporal variation (e.g., annual or seasonal changes in water flow or habitat use, or trends over time in populations and employment) and other biophysical constraints relevant to the assessment of the Project. The final selection of temporal boundaries is discipline-specific and include consideration of the phases described above. For some VCs, residual effects are assessed for all phases of the Project, but not necessarily for each specific phase. For example, effects on wildlife begin during the closure phase with the removal and alteration of habitat (i.e., results in direct and indirect changes) and continue through the post-closure phase and for a period after the post-closure phase until reversed, unless determined to be irreversible or permanent. Therefore, effects on wildlife are analyzed and predicted from closure through to post-closure, which generates the maximum potential spatial and temporal extent of effects and provides confident and ecologically relevant effects predictions.

Alternately, for some VCs, the assessment was completed for those phases of the Project where predicted effects would be expected to peak (e.g., most air quality effects from emissions occur during closure) or at several key points in time. These points in time may include several periods within or among Project phases. Examples include comparing the maximum extent of disturbance to vegetation during closure to the amount that will be reclaimed, or evaluating surface water quality predictions at specific times that represent key milestones throughout the life of the Project. For other VCs, the assessment of effects may continue beyond the post-closure phase.

Similarly, the temporal boundaries identified for cumulative effects assessments are specific to the VCs being assessed. Temporal boundaries include the duration of residual effects from previous and existing developments that overlap with residual effects of the Project and the period during which the residual effects from reasonably foreseeable developments will overlap with residual effects from the Project. The temporal boundaries considered by each discipline are identified in Section 6.2 Atmospheric Environment through Section 6.9 Socio-economic Environment under the “Assessment Boundaries” heading.

The environmental assessment was designed to evaluate the short- and longer-term changes from the Project and associated effects on the biophysical and human environments. Projects are defined by phases, which typically includes construction, operations and reclamation and closure; however, given the nature of this Project, only the closure (which includes decommissioning and reclamation) and post-closure phases are relevant. These phases are described below.

Climate change may result in shifts in the frequency and/or intensity of the extreme weather events and forest fires. The effects of climate change are typically measured over longer periods, with the potential for climate change effects increasing as the period over which they are measured increases. The relatively short timeline for the closure phase (i.e., 2022 to 2027) means that there is smaller potential for interaction with climate change when compared to the more distant timeline of the Post-closure phase. The Closure phase of the Project is

considered to be resilient to changing climatic conditions since it occurs during time frames too short to have a high climate change risk outside of those experienced by the large range of seasonal weather conditions. An effect assessment of climate change was completed for the Project and is included in Section 10 Effects of the Environment on the Project.

6.1.4.2.1 Closure Phase

Preparation and implementation of ISD, which includes preparation for ISD, grouting of below-grade structures and systems, removal of above-grade WR-1 structures and systems, installation of the concrete cap and engineered cover, and environmental controls and final site restoration. These activities last from 2022 to 2027.

6.1.4.2.2 Post-closure Phase

The post-closure phase has two discrete periods: institutional control and post-institutional control. The institutional control period is assumed to occur from 2027 to 2127 (i.e., 100 years). The post-institutional control period is assumed to occur after year 2127 and continues indefinitely. However, it is recognized that the institutional control period will continue until the CNSC, or the appropriate regulatory authority at that time, agrees it is no longer needed.

Institutional Control Period

The institutional control period spans a minimum of 100 years (i.e., 2027 to 2127), during which long-term environmental monitoring and maintenance activities will continue to demonstrate WRDF performance is in compliance with the safety case assumptions and performance modelling.

The 100-year timeframe is not related to the design life of the WRDF barriers. The 100-year active monitoring period was selected to ensure that sufficient opportunity is provided to verify the WRDF is performing as expected. The WR-1 Groundwater Flow and Solute Transport Modelling report (Golder 2021a) indicates that in the event of a failure of the ISD primary barrier, contaminants would be detectable (albeit at very low levels) within the first 100 years. The results of the 100-year active monitoring period will support the discussions to reduce, or even stop active monitoring in the future, once sufficient data are available to provide further confidence that the ISD system is performing as expected. Additionally, beyond 100 years, there is less confidence that institutional controls, like access restrictions, can be relied upon.

Post-institutional Control Period

The post-institutional control period occurs after year 2127 and continues indefinitely. It is an assumed that institutional control eventually ends and detailed knowledge of the facility is lost. There is uncertainty around when such a phase may actually begin. But for the purposes of the assessment it is assumed to occur 100 years after closure of the facility (i.e., at the end of the institutional control period). The post-institutional control period will continue indefinitely; however, the timeframe defined for assessment of potential effects as part of the normal evolution of the Project is 10,000 years as described in Section 5.3 (Timeframes) of the Decommissioning Safety Assessment Report (Golder 2021b). This time period encompasses the phase in which peak effects are anticipated. None of the above precludes the option of extending the institutional control period beyond 100 years if the institutions in question have the resources and desire to do so. However, this EIS conservatively assumed that institutional control ends beyond 100 years from closure to assess the potential bounding effects of the ISD system. However, some passive controls will still be in place including the limited footprint, the WRDF composition being relatively impervious and made of material of no economic value, and any remaining land use restriction acting to reduce the likelihood of a human intrusion event.

6.1.4.3 Assessment Cases

This section provides a brief description the assessment cases considered in the EIS. Multiple assessment cases are considered in an EIS to characterize existing conditions, understand the potential effects of a project and to understand how these potential effects may interact with other future projects. The assessment cases are discipline-specific and include the following.

- **Base Case –** This scenario represents existing conditions and characterizes combined effects from previous and existing developments and activities. The Base Case reflects the effects of existing disturbances, such as forestry, transportation, agricultural, and residential and recreational development. Current effects from the existing WL site facilities and operations, for example, are considered part of the Base Case. In addition, existing conditions of areas not affected by the WL site are also considered as part of the Base Case. For example, Seven Sisters Generating Station is approximately 7.5 km upstream of the WL site and McArthur Generating Station is approximately 26 km downstream. Effects from the decommissioning and reclamation activities already completed at the WL site are also considered as part of the Base Case.
- **Application Case –** This scenario represents predictions of the effects of the Base Case combined with the effects that may result from the Project.
- **Reasonably Foreseeable Development (RFD) Case –** this scenario represents predictions of the cumulative effects of the Application Case, which includes the Base Case, plus projects that are currently under application review or that have officially entered a regulatory application process and are therefore, considered reasonably foreseeable. Effects from the future decommissioning and reclamation activities to be completed at the WL site are also considered as part of the RFD Case. The projects considered as RFDs are described in Table 6.1.3-2.

Table 6.1.3-2: Reasonably Foreseeable Developments Considered for the Effects Assessment

Type of Project	Location	Description	Timeframe	Disciplines in which the RFD was Considered
Infrastructure Decommissioning	WL	Decommissioning of remaining infrastructure on the WL site (includes ISD of the low-level waste trenches).	2016 to 2027	■ Section 6.2 Atmospheric Environment ■ Section 6.3.2 Hydrogeology ■ Section 6.4 Surface Water Environment ■ Section 6.5 Aquatic Environment ■ Section 6.7 Human and Ecological Health* ■ Section 6.8 Land and Resource Use

Table 6.1.3-2: Reasonably Foreseeable Developments Considered for the Effects Assessment

Type of Project	Location	Description	Timeframe	Disciplines in which the RFD was Considered
Environmental Remediation	WL	Remediation of affected lands, with the exception of the low-level waste trenches.	2016 to 2027	■ Section 6.2 Atmospheric Environment ■ Section 6.3.2 Hydrogeology ■ Section 6.4 Surface Water Environment ■ Section 6.5 Aquatic Environment ■ Section 6.7 Human and Ecological Health* ■ Section 6.8 Land and Resource Use

Note: * effects are evaluated as part of the Application Case.

6.1.5 Description of the Environment

To provide a basis for evaluating potential changes of the Project, each discipline assessment includes a description of the baseline conditions in the “Description of the Environment” subsection. The baseline studies are completed to develop an understanding of the existing physical, biological and social conditions that may be influenced by the Project and are used to prepare a Base Case. The Base Case includes the cumulative effects from all previous and existing developments in the study area of a VC. Existing environment or baseline conditions represent the historical and current environmental selection pressures that have shaped the observed patterns in VCs. Environmental selection pressures include natural (e.g., weather, predation and competition) and human-related factors (e.g., agricultural activities, forestry, traditional and sport hunting and fishing).

Existing conditions are described recognizing that baseline conditions typically fluctuate within a range of variation through time and space depending on which selection pressures are currently driving changes to the VC and system. The Base Case thus describes the existing environment without the implementation of the Project and is used to provide an understanding of the physical, biological and social conditions that may be influenced by the Project. Information sources included published and unpublished material, consultation with appropriate government staff (e.g., Manitoba Sustainable Development [now Manitoba Environment, Climate and Parks]) and baseline and other monitoring data collected by CNL. The Traditional Knowledge and Land Use Studies completed further enabled opportunities to capture and include Traditional Knowledge into the description of the environment. These studies are intended to document traditional use around the Project, local, and regional study areas. The ‘Description of the Environment’ section in the discipline assessments has been updated to include a description of how traditional land and resource use activities have changed in response to past historical events and external pressures, where available.

This information is reviewed and analyzed to determine the presence of data gaps. Depending on the degree of the risk that the data gap carries, baseline field studies may be completed to fill the identified gaps. Alternatively, uncertainties in data may be addressed through the development of monitoring programs. Relevant existing data from previous studies and the results of the recent baseline field programs are presented in the discipline-specific sections. Data that are directly relevant to the assessment of Project effects are summarized in the sub-sections in Section 6.2 Atmospheric Environment through Section 6.9 Socio-economic Environment.

6.1.6 Project Interactions and Mitigation

Interactions (linkages) between Project components or activities and the corresponding potential changes to measurement indicators are identified by a pathway analysis that is then used to focus the residual effects assessment for the VCs. The first part of the analysis is to identify all pathways by which a Project component or activity could cause a potential effect. Each pathway is initially considered to have a linkage to potential effects on VCs. Traditional Knowledge and Indigenous engagement feedback also identified linkages between components of the environment that support traditional way of life, traditional land and resource use, and harvesting rights. These linkages provide a more holistic understanding of the environment and relationships between different components, including their continued practice of culture and livelihoods.

The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. For an effect to occur there has to be a Project component or activity that results in a detectable change to the measurement indicators and a correspondent effect on a VC.

Project Activity → Effects Pathway that Results in a Detectable Change in a Measurement Indicator or Intermediate VC → Effect on the Assessment Endpoint of a VC

The development of the potential pathways is followed by a screening to determine if mitigation is required. If needed, environmental design features and mitigation that can be incorporated into the Project to remove a pathway (i.e., eliminate the potential effect) or limit (i.e., mitigate) adverse effects on VCs, will be developed. Environmental design features and mitigation include engineering design elements, environmental best practices, management policies and procedures and spill response and emergency contingency plans. The description of environmental design features and mitigation will be specific to each discipline and the associated VCs. Any uncertainty associated with the effectiveness of proposed mitigation actions will be noted.

The purpose of the pathway analysis is to focus the residual effects analysis on linkages that require a more comprehensive assessment of effects on VCs, or those pathways that are likely to result in residual effects on a VC. Pathways are determined to have no linkage, a secondary (minor) linkage, or a primary linkage using scientific knowledge, logic, experience with similar developments and the effectiveness of environmental design features. Feedback from Indigenous engagement also considered in the evaluation of the pathways. Each potential pathway is evaluated and described as follows:

- **no linkage –** analysis of the potential pathway reveals that there is no valid linkage between the Project and the VC, or the pathway is removed by environmental design features or mitigation so that the Project would not be expected to result in a measurable environmental change and would, therefore, have no residual effect on a VC relative to existing conditions or guideline values;
- **secondary –** pathway could result in a measurable minor environmental change, but would have a negligible residual effect on a VC relative to existing conditions or guideline values, and is not expected to contribute to effects of other existing, approved, or reasonably foreseeable developments to cause a significant effect; or
- **primary –** pathway is likely to result in an environmental change that could contribute to residual effects on a VC relative to existing conditions.

Pathways with no linkage to a VC, either because there was no linkage initially or because environmental design features or mitigation will remove the pathway, are not advanced for further assessment. Pathways that are assessed to be secondary and demonstrated to have a negligible effect on a VC through simple qualitative or semi-quantitative evaluation of the pathway are also not advanced for further assessment. However, a pathway may be evaluated as a secondary pathway due to their importance to Indigenous people even if there are no direct or indirect effects on a VC. In summary, pathways determined to have no linkage to a VC or those that are considered secondary are not expected to result in environmentally significant effects on the assessment endpoint of VCs, individually or cumulatively. Primary pathways require further effects analysis and classification to determine the environmental significance of the Project effects on VCs. A matrix table is included in Appendix 6.1-1 Project-Environment Interactions Matrix summarizing Project interactions for each VC that are determined to be no linkage, secondary, or primary, after consideration of environmental design features and mitigation.

6.1.7 Residual Effects Analysis

A residual adverse environmental effect is an effect that remains, or is predicted to remain, after mitigation has been implemented (The Agency 2015). Therefore, they are the expected consequences of the Project for the selected VCs. The residual effects analysis is based on the Project interactions that are determined to be primary in the pathway analysis. For primary pathways that require a residual effects analysis, assessment cases are applied (see Section 6.1.3.3 Assessment Cases) to estimate the incremental and cumulative effects from the Project. The residual effects analysis is completed for the Application Case and the RFD Case.

6.1.7.1 Application Case

This Application Case scenario represents predictions of the cumulative effects of the existing environment combined with the effects that may result from the Project. The residual effects analysis for the Application Case is based on residual Project-specific (incremental) effects that are evaluated to be primary in the pathway analysis. The environmental design features and mitigation identified in Section 6.1.5 Project Interactions and Mitigation will be described in this section. Thus, the residual effects analysis will consider all primary pathways that will likely result in detectable changes in measurement indicators and subsequent residual effects on VCs, after implementing environmental design features and mitigation.

The Application Case represents predictions of the cumulative effects of the developments in the Base Case combined with the effects from the Project. Where relevant, this case was used to identify the incremental changes from the Project that are predicted to occur between the Base Case and the Application Case. The residual effects analysis considers the proposed environmental design features and mitigation identified in Section 6.1.5 Project Interactions and Mitigation.

The temporal boundary of the Application Case begins with the anticipated first year of the Project, and continues until the predicted effects are reversed. For several VCs, the temporal extent of some effects likely will be greater than the lifespan of the Project because the effects will not be reversible until beyond closure. For other VCs, the effects may be determined to be irreversible within the temporal boundary of the assessment if the effects were predicted to last so far into the future that they could not be predicted with any level of certainty (e.g., residual effect lasts for thousands of years).

Results of the effects analyses for the Application Case are used to describe the magnitude, duration and geographic extent of the predicted changes to measurement indicators and residual effects on VC assessment endpoints. Expected changes are expressed quantitatively, wherever possible. For example, the magnitude of the

effect may be expressed in absolute or percentage values above or below baseline conditions or a guideline value. The duration, including reversibility, of the effect typically is described in years relative to the phases of development of the Project and the spatial extent of effects is typically expressed in area or distance from the Project. In addition, the direction, frequency, reversibility, probability and context of effects are described, where applicable. Rankings, such as short-term duration or moderate magnitude are not used in the effects analysis. These rankings are applied to the classification of effects and determination of significance, where definitions of these rankings are provided.

Effects on social, economic and cultural properties include positive and negative changes to employment, training and education, family income, traditional land use, family and community cohesion, and long-term social, cultural and economic sustainability. Some of these measurement indicators can be analyzed quantitatively (e.g., number of jobs created and estimated income levels). Other indicators such as community cohesion and traditional land use are more difficult to quantify and involve information from public engagement, literature, examples from similar projects under similar conditions and scientific knowledge and experience. The effects analysis considers the interactions among the unique and common attributes, challenges and opportunities related to social, cultural and economic measurement indicators.

6.1.7.2 Reasonably Foreseeable Development Case

The RFD Case scenario includes the Application Case plus additional RFDs in the region that have not yet been approved. Developments and activities that are currently under application review, or that have officially entered a regulatory application process were considered reasonably foreseeable. This section describes the general methods used to predict whether the cumulative effects from the Project, in combination with existing, previous and RFDs and activities are likely to result in environmental, social, economic, heritage and health effects, taking into account the mitigation actions proposed in the EIS. The CEAA 2012 requires that each environmental assessment of a designated project take into account any cumulative environmental effects that are likely to result from the designated project in combination with the environmental effects of other physical activities that have been or will be carried out (The Agency 2018). Cumulative effects such as those that are likely from a reviewable project, combined with the effects from prior development, existing activities and reasonably foreseeable future developments that are sufficiently certain to proceed.

The RFD Case includes the predicted duration of residual effects from the Project, plus other previous, existing and future developments and activities. Thus, the minimum temporal boundary for the Application Case and the RFD Case is the expected lifespan of the Project, which like the Base Case, includes a range of conditions over time. The difference between the Application Case and the RFD Case is that the Application Case considers the incremental effects from the Project in isolation of potential future land use activities.

The VCs requiring an analysis under the RFD Case are determined by understanding whether the residual effects from the Project and one or more additional developments (or activities) overlap or interact with the temporal or spatial distribution of the VC. Where potential cumulative effects from the RFD Case are identified for these VCs, these effects will be assessed using the same approach used for the Project-specific effects analysis (Section 6.1.6.1 Application Case).

The analysis for the RFD Case is quantitative, where possible, and qualitative, where necessary. The analysis is quantitative for those future projects that could be assigned a location, a physical footprint (i.e., known or hypothetical) on the landscape and information about project emissions (e.g., to air and water). The analysis is

qualitative for developments that did not have this information. For all RFDs, the EIS uses the most current information available for the location, size and type of activity associated with a project.

6.1.8 Prediction Confidence and Uncertainty

The purpose of an environmental assessment is to predict the future conditions of the biophysical and human environments as a result of a proposed project or development using conservative assumptions when dealing with uncertainties. Because the biophysical and human environment changes naturally and continually through time and across space, most assessments of effects embody some degree of uncertainty. In addition, Anishinaabe Traditional Knowledge holders indicate that when predicting hundreds or thousands of years in the future, it is difficult to be confident in scientific predictions.

The purpose of the uncertainty sections of the assessment is to identify the key sources of uncertainty and to discuss how uncertainty is addressed to increase the level of confidence that effects will not be worse than predicted. Confidence in effects analyses can be related to many elements, including the following:

- adequacy of the baseline data for providing an understanding of the existing conditions and future changes unrelated to the Project (e.g., rate and extent of future developments, climate change or catastrophic events);
- model inputs (e.g., changes in chemical concentration in water over time and space);
- understanding of Project-related effects on complex ecosystems that contain interactions across different scales of time and space (e.g., how and why the Project will influence wildlife);
- limited knowledge and experience with the type of effect in the system;
- knowledge of the effectiveness of the environmental design features for reducing or removing effects (e.g., environmental performance of the base liner);
- uncertainties associated with the exact location, physical footprint and activity level of a development and the timing and rate of future developments in the RFD Case; and
- uncertainties in the direction, magnitude and spatial extent of future fluctuations in ecological, cultural and socio-economic variables, independent of effects from the Project and other developments.

Uncertainty in these elements can decrease confidence in the prediction of environmental significance. Discipline studies use quantitative methods, such as sensitivity analyses, or qualitative discussion to assess prediction confidence to the extent reasonable. The assumptions for statistical tests and details on models that were used as part of the assessment are discussed within each discipline of study. Where possible, methods are used to reduce uncertainty and increase the level of confidence in effects predictions. For example, the timeframe defined for assessment of potential effects to groundwater as part of the normal evolution of the Project is estimated to be 10,000 years. This time period encompasses the phase in which peak effects to groundwater are anticipated (Section 6.3.2 Hydrogeology). These peak effects were then included in the Environmental Risk Assessment so that doses arising from post-closure have not been underestimated (Section 6.7 Human and Ecological Health). A conservative approach was implemented when information is limited so that effects are typically overestimated (e.g., defining the key input variables so that the result is a conservatively high effects prediction). Other examples include the following:

- using the results from several models and analyses to help reduce bias and increase precision in prediction; and
- using data from effects monitoring programs and literature as inputs for models rather than strictly hypothetical or theoretical values.

Where appropriate, residual uncertainty is addressed by additional mitigation and in monitoring and follow-up programs. Each discipline of study includes a discussion of how uncertainty is addressed and provides a qualitative evaluation of the resulting level of confidence, which is included in the residual effects classification and determination of significance discussions.

6.1.9 Residual Effects Classification and Determination of Significance

6.1.9.1 Residual Effects Classification

The purpose of the residual effects classification is to describe the residual incremental and cumulative adverse effects from the Project and other developments on VCs using a common set of criteria. The classification criteria provide definitions that permit a clear, thorough and unambiguous classification of residual effects such that reviewers and readers can follow and apply the logic used in the assessment and reach the same classification for a given residual effect. The residual effects classification is then used to make significance determinations. The intent of the environmental assessment is to predict if the Project is likely to cause a significant adverse effect on the environment or to cause public concern.

The classification of residual adverse effects and the determination of significance are completed for those VCs that have assessment endpoints, and where residual adverse effects are predicted. The residual effects classification takes into consideration additional mitigation identified (if applicable) in the residual effects assessment. The results of the classification are used to determine the significance of predicted adverse effects.

Effects are classified using the following criteria, which follows the Generic EIS Guidelines provided by the CNSC (CNSC 2016) and the *Operational Policy Statement Determining Whether a Designated Project is Likely to Cause Significant Adverse Environmental Effects under the Canadian Environmental Assessment Act, 2012* (The Agency 2015). Specific definitions for the classification criteria have been developed for each VC or discipline of study.

Direction – Direction indicates whether the residual effect on a VC is negative, positive or neutral (i.e., no change). Neutral and positive changes are not assessed for significance.

Magnitude – Magnitude is a measure of the intensity of a residual effect, or the degree of change caused by the Project (and other developments, if applicable) relative to the Base Case, guidelines or threshold values. Magnitude is typically classified into three scales: negligible to low, moderate and high. The scales of magnitude are specific to each VC or discipline of study and incorporate the geographic extent and duration of residual effects in context of the properties of VC assessment endpoints. Where possible, magnitude is reported in absolute and in relative terms.

Geographic Extent – This criterion refers to the spatial extent of the effect, and is different from the spatial boundary (i.e., study area) for the residual effects analysis. The spatial boundary for the residual effects analysis represents the maximum area used for the assessment, and is related to the spatial distribution and movement of VCs. The geographic extent of residual effects can occur on multiple scales within the spatial boundary of the assessment. Geographic extent refers to the area affected, and is often categorized into three scales of local, regional and beyond regional.

Duration – Duration is defined as the amount of time (usually in years) from the beginning of a residual effect on when the residual effect to a VC is reversed and is expressed relative to Project phases. Duration has two components. It is the amount of time between the start and end of a Project activity or stressor (which is related to Project development phases), plus the time required for the residual effect to be reversed.

Reversibility – After removal of the activity or stressor, reversibility is the likelihood that the Project will no longer influence a VC in a future predicted period. Reversibility usually has only two alternatives: reversible or irreversible. The period is provided for reversibility (i.e., duration) if a residual effect is reversible. Permanent residual effects are considered irreversible.

Frequency – Frequency refers to how often a residual effect will occur and may be expressed as isolated, periodic or continuous. Frequency is explained more fully by identifying when the residual effect occurs (e.g., once at the beginning of the Project). If the frequency is periodic, then the length of time between occurrences and the seasonality of occurrences (if present) is discussed.

Likelihood – Likelihood is the probability of an effect occurring and is described in parallel with uncertainty. This criterion may be influenced by a variety of factors, such as the likelihood of disturbance occurring or the likelihood of mitigation being successful. Four classification categories are typically used: unlikely, possible, likely and highly likely.

The specific definitions applied to the above classification criteria for each VC or discipline of study are based on the ecological or socio-economic processes and properties of the VC or discipline of study. Although some professional judgement or experienced opinion is inevitable in determining the scales for effects predictions, the residual effects, to the extent possible, are classified using scientific principles, established guidelines, thresholds or target values and supporting evidence.

6.1.9.2 Determination of Significance

The residual effects classification of primary pathways and the associated predicted changes in measurement indicators provide the foundation for determining the significance of incremental and cumulative effects from the Project and other existing, approved and RFDs on VC assessment endpoints. For some VCs, there may be no RFD Case and the assessment is limited to determining the significance of residual effects from the Project and previous and existing developments (i.e., Application Case). For those VCs that may be influenced by forecasted future developments, the assessment includes classifying and determining the significance of cumulative effects from all previous, existing and future developments, including the Project (i.e., RFD Case). The classification of residual adverse effects and the determination of significance are completed only for those VCs that have assessment endpoints. Although the neutral and positive residual effects associated with the Project are reported in this section, they are not assessed for significance.

Magnitude is the primary criterion used to determine the significance of effects on VCs. Where possible and appropriate, established guidelines, thresholds and screening values are used to support the classification of the predicted amount of change in measurement indicators and associated effects on VC assessment endpoints. For some disciplines and VCs, such as aquatic health effects to fish, guideline or threshold values are known with reasonable certainty, which increases confidence in effects predictions and significance determinations. For other VCs of the biophysical and human environments, social and ecological benchmarks or effects thresholds are not known with reasonable certainty, which decreases confidence in determining the significance of predicted effects. For example, critical thresholds and screening levels for measurement indicators such as habitat quality, quantity and connectivity, and ecologically effective population sizes are frequently not available for plant, fish and wildlife species. Because of the uncertainty regarding the effects of development on VCs, magnitude classification is conducted conservatively to increase confidence that effects will not be underestimated. Furthermore, the determination of significance considers the level of confidence in the effects predictions.

Magnitude also considers the geographic extent and duration of residual effects that are specific to VC assessment endpoints. For example, the magnitude of an effect on a fish or wildlife VC from changes in habitat availability and connectivity depends on the spatial extent (e.g., amount of area or proportion of the population) and duration of the changes in habitat (e.g., how long populations using that habitat may be adversely affected). Duration includes consideration of reversibility; a reversible effect from development does not result in a permanent adverse effect and therefore may be considered to be of lower magnitude. The duration of residual effects to VCs with high resilience (ability to recover from disturbance) would be expected to be shorter relative to VCs with lower resilience to disturbance.

Frequency and likelihood are considered as modifiers when determining significance, where applicable. For example, the magnitude of the effect from the loss of individuals from a wildlife population due to collisions with vehicles will depend partially on how often animal-vehicle collisions occur over the life of a project. For some effects, such as the physical loss of habitat from the WR-1 Building, the likelihood is high and has little influence on the significance of effects (i.e., the decline in habitat is certain and significance depends on the amount of change over space and time [magnitude]). Alternately, the magnitude of an effect may vary from low to high depending on the probability of different projected outcomes of climate change and the degree of success in actions implemented to mitigate effects from climate change.

The evaluation of significance for biophysical VCs considers the entire set of primary pathways that influence a particular assessment endpoint; thus, significance is not explicitly assigned to each pathway. Rather, the relative contribution of each pathway is used to determine the significance of potential adverse effects of the Project and other developments on an assessment endpoint. This approach is known as a "weight of evidence" approach (i.e., an evaluation of the persuasiveness of the collective evidence). For example, a pathway with a high magnitude (which would include a large geographic extent and a long-term duration) is given more weight in determining significance relative to pathways with smaller scale effects. The relative effect from each pathway is discussed; however, pathways that are predicted to have the greatest influence on effects to assessment endpoints are assumed to contribute the most to the determination of significance. This method is used to identify predicted residual adverse effects that have sufficient magnitude, duration and geographic extent to result in significant adverse effects on VC assessment endpoints.

Classification of residual effects and determination of significance for the human environment generally follow the methods used for biophysical VCs. However, there are some differences in the selection and definition of effects criteria. For socio-economic VCs, direction, magnitude, geographic extent and duration are the criteria used to classify effects and evaluate the significance of changes to assessment endpoints. The assessment of significance considers the scale of these criteria (e.g., low magnitude, regional geographic extent and long-term duration) and scientific knowledge and experience, which is based on the context of the communities involved, and the informed value and judgement of interested and affected organizations and specialists. The level of significance takes into consideration the effectiveness of the proposed mitigation (i.e., policies, practices and investments) and benefit enhancement programs to limit negative effects and foster positive effects on the continued persistence of long-term sustainable social, cultural and economic features of the human environment.

Details on the approach and methods for classifying residual effects and determining significance on VCs of the biophysical and human environments are provided in the applicable discipline sections of the EIS. The definition of a significant effect is specific to each discipline and will be provided in each discipline section. Significance is determined for the residual adverse effects of the Project overall, for the cumulative residual adverse effects from the Project and previous and existing developments (Application Case), and for the Project and previous, existing and RFDs (RFD Case). The following is a summary of some of the key factors considered in the determination of significance on VCs of the biophysical and human environments.

- Results from the residual effects classification of primary pathways and associated predicted changes in measurement indicators.
- Magnitude is the primary criterion used to determine significance, with geographic extent and duration (which implies reversibility) providing important context for assigning magnitude. Frequency and likelihood act as modifiers for determining significance, where applicable.
- The degree of uncertainty in the effects estimates also influences the classification of magnitude and the determination of significance. Where uncertainty was high and the effect might be either significant or not significant, the assessment conservatively identified the effect as significant and provided additional follow-up actions to reduce uncertainty.

6.1.10 Monitoring and Follow-up

In the EIS, monitoring programs are proposed to address the uncertainties associated with the effects predictions and the performance of mitigation. In general, monitoring is used to verify the effects predictions. Monitoring is used to identify any unanticipated effects and provide for the implementation of adaptive management to limit these effects. Typically, monitoring includes one or more of the following categories, which may be applied during the development of the Project.

- **Compliance Inspections –** monitoring activities, procedures and programs undertaken to confirm the implementation of approved design standards, mitigation and conditions of approval and company commitments (e.g., inspecting the installation of a silt fence).
- **Environmental Monitoring –** monitoring to track conditions or issues during the development lifespan of the Project, and to subsequently provide for the implementation of adaptive management (e.g., monitoring of treated wastewater discharge quality and volumes).
- **Follow-up Monitoring –** programs designed to test the accuracy of effects predictions, reduce or address uncertainties, determine the effectiveness of mitigation, or provide appropriate feedback to operations for modifying or adopting new mitigation designs, policies and practices (e.g., monitoring of Winnipeg River for water quality effects). Results from these programs can be used to increase the certainty of effect predictions in future environmental assessments.

Proposed monitoring and follow-up programs are discussed in each discipline section of the EIS and, upon Project approval, will be included in the Whiteshell Laboratories Integrated Monitoring Framework and coordinated with the existing Environmental Assessment Follow-up Program being conducted as specified in the Comprehensive Study Report (AECL 2001), where practical. CNL will implement an Environmental Assessment Follow-up Program for the Project to verify the accuracy of environmental effects and determine the effectiveness of mitigation that have or are to be implemented. Where relevant, conceptual monitoring programs will be proposed to deal with the uncertainties associated with the effect predictions and mitigation.

CNL has committed to engaging with each Nation on their specific interest and concerns regarding monitoring for the Project and the existing WL site Environmental Assessment Follow-up Program. CNL has committed to working collaboratively with the engaged First Nations and the Red River Métis to participate in environmental monitoring at the WL site. Each Nation may have different preferences for how to participate in the initiative and CNL commits to development of a program that is flexible to the needs of each Nation.

An annual progress report on the Environmental Assessment Follow-up Program for the Project will be prepared and will include a summary of the environmental monitoring results for the Project. Public and Indigenous information activities required as part of CNL's Public Information Program will be part of the Environmental Assessment Follow-up Program for the Project and will be summarized as part of the annual progress report.

6.2 Atmospheric Environment

This section of the Environmental Impact Statement (EIS) for the Canadian Nuclear Laboratories (CNL) In Situ Decommissioning of Whiteshell Reactor 1 (WR-1) at the Whiteshell Laboratories Site (the Project) characterizes potential residual effects of the Project on the atmospheric environment. Section 6.2.1 focuses on air quality and Section 6.2.2 focuses on greenhouse gas (GHG) emissions.

A quantitative noise assessment has not been completed for inclusion in this EIS as it is not anticipated that there are sensitive human receptors in the vicinity of the Project that would experience nuisance effects from the closure and post-closure phases of the Project. A qualitative discussion of potential effects from noise (i.e., sensory disturbance) on wildlife is provided in Section 6.6 Terrestrial Environment and on community well-being in Section 6.9 Socio-economic Environment.

6.2.1 Air Quality

6.2.1.1 Scope of the Assessment

The scope of the air quality assessment focuses on predicting changes in indicator compounds emissions and comparison of these changes to the applicable guidelines and standards. The indicator compounds emissions from the Project include suspended particulate matter (SPM), particles nominally smaller than 10 micrometres (µm) in diameter (PM_{10}), particles nominally smaller than 2.5 µm in diameter ($PM_{2.5}$), carbon monoxide (CO), sulphur dioxide (SO_2) and nitrogen oxides (NO_x) expressed as nitrogen dioxide (NO_2). Emissions of particulates (SPM, PM_{10} and $PM_{2.5}$), CO, SO_2 and NO_x have the potential to affect aquatic, human and terrestrial wildlife health. Particulates emissions, which are also referred to as fugitive dust, can also be a nuisance issue over which the public is concerned. The assessment of air quality within Section 6.2.1 Air Quality focuses on predicting changes in the concentrations of above-mentioned indicator compounds emissions; radiological and non-radiological hazardous parameters are considered in Section 6.7 Human and Ecological Health. Parameters with no established federal or provincial standards or criteria were not considered.

The air quality assessment follows the overall environmental assessment approach and methods described in Section 6.1 Environmental Assessment Approach. The assessment is completed in the following primary steps.

- **Step 1 – Identify Valued Components (VCs) and define the spatial boundaries, temporal boundaries and assessment cases** (refer to Sections 6.2.1.3 Valued Components and Section 6.2.1.4 Assessment Boundaries) for the air quality assessment. The VCs, assessment endpoints and measurement indicators used to assess Project related changes to air quality, the spatial and temporal boundaries at which the assessment occurred, and the assessment cases considered are described.
- **Step 2 – Describe the existing conditions** (refer to Section 6.2.1.5 Description of the Environment). Existing conditions in the local and regional areas are described, including the combined effects of previous and existing developments (Base Case). The existing environment represents the historical and current environmental pressures that have shaped the observed patterns in the environment (i.e., natural variation).
- **Step 3 – Evaluate Project interactions and mitigation** (refer to Section 6.2.1.6 Project Interactions and Mitigation). Project components and/or activities with the potential to affect air quality are identified and mitigation options are presented to limit or avoid these effects. A pathways analysis is then used to focus on key interactions between the Project and the environment and determine if mitigation can limit or eliminate the predicted residual effects. The pathways analysis considers interactions that may result during normal or

routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. Where effects are adequately mitigated and are not forwarded for further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are described. Primary pathways that may lead to residual effects to air quality after incorporating mitigation are carried forward to Step 4 for further analysis and residual effects characterization.

- **Step 4 – Present the methods and results of the residual effects analysis** (refer to Section 6.2.1.7 Residual Effects Analysis). This section outlines the methods used to predict and characterize residual effects to air quality from primary effect pathways. The analysis results are also presented including the characterization of incremental effects from the Project, as well as cumulative effects of the Project in combination with other reasonably foreseeable developments (if applicable). A key outcome of this section is the predicted changes to emissions of indicator compounds that are passed on to other disciplines for their assessment.
- **Step 5 – Describe the level of certainty and management of uncertainty** (refer to Section 6.2.1.8 Prediction Confidence and Uncertainty). The purpose of this section is to evaluate the available literature, data and models used for the assessment, and describe the level of certainty that can be placed on predicted residual effects. This section will also identify how the uncertainty has been managed so that the effects are not underestimated.
- **Step 6 – Classify and determine the significance of the predicted residual effects** (refer to Section 6.2.1.9 Residual Effects Classification and Determination of Significance). Residual effects predicted from primary pathways are classified using a common set of criteria: direction, magnitude, geographic extent, duration, reversibility, frequency, and likelihood. A determination of the significance of the predicted residual effects from the Project for the air quality VC is made.
- **Step 7 - Identify monitoring and follow-up** (refer to Section 6.2.1.10 Monitoring and Follow-up) required to confirm effects predictions and address uncertainty.
- **Step 8 - Present a consolidated summary of conclusions and outcomes of the assessment** (refer to Section 6.2.1.11 Conclusions) of residual effects on air quality.

6.2.1.2 Indigenous Engagement Feedback – Key Interests and Concerns

Interests and concerns raised by Sagkeeng First Nation (Sagkeeng); the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations during engagement are related to the air quality assessment are summarized in Table 6.2.1-1. Other general concerns and questions raised during Indigenous engagement activities are documented in Section 4 Indigenous Engagement.

Table 6.2.1-1: Summary of Key Interests and Concerns Raised During Indigenous Engagement Activities Related to the Air Quality Assessment

Interest and Concern	Inclusion Status	Additional information and Rationale
Air Emissions and Monitoring ■ Downwind effects of air emissions associated with operations at the WL site.	Already included in the environmental assessment	Predicted changes in air quality are assessed in Section 6.2.1.7.2 Application Case Results.
Monitoring ■ Air emissions and monitoring practices on the site currently and into the future.	Already included in the environmental assessment	Information on monitoring related to air quality is provided in Section 6.2.1.10 Monitoring and Follow-up.

6.2.1.3 Valued Components

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). Air quality was selected as a VC as there is a potential for the Project activities to release air emissions that could affect the local air quality (Table 6.2.1-2). Meteorology is also important as it governs the transport, dispersion and deposition of air emissions from the Project. Sagkeeng; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations did not identify additional VCs beyond those included in Table 6.2.1-2.

Table 6.2.1-2: Valued Components for Air Quality Assessment

Valued Component	Rationale for Selection
Air Quality	Air quality is selected as a VC as it has been identified as an important aspect of the environment by the regulators. In addition, emissions from the Project activities have the potential to alter the existing air quality regime.

VC = valued component

Assessment endpoints are qualitative expressions used to assess the significance of residual effects on VCs and represent the key properties of the VC that should be protected for future generations. The assessment endpoint for air quality is performance against the criteria and thresholds for protection of human health and the environment. Measurement indicators represent properties of the environment and VCs that, when changed, could result in or contribute to an effect on a VC. Measurement indicators also provide the primary factors for discussing the uncertainty of effects on VCs and, subsequently, are the key variables for study in follow-up and monitoring programs. The assessment of air quality focused on predicting changes in the concentrations of selected non-radiological indicator compounds (Table 6.2.1-3). These compounds are generally accepted as indicative of changing air quality and for which relevant air quality criteria exist. The selected non-radiological indicator compounds fall into the following two categories:

- **particulate matter**: SPM, PM_{10} and $PM_{2.5}$; and
- **combustion gases**: NO_X represented by NO_2, SO_2 and CO.

These indicator compounds are associated with various Project activities. Particulate matter is typically associated with airborne dust from demolition and decommissioning activities including the mobile concrete batching plant, construction equipment and vehicles travelling over on-site paved roads, as well as material handling activities. Products of combustion (NO_2, SO_2 and CO) are associated with the exhaust from on-site vehicles.

Hazardous radiological and non-radiological air emissions are assessed in the Environmental Risk Assessment technical supporting document (ERA TSD [EcoMetrix 2021) and summarized in Section 6.7 (Human and Ecological Health) of the EIS. The indicator compounds and the hazardous radiological and non-radiological air emissions are assessed in different sections because the hazardous radiological and non-radiological emissions require additional screening and assessment as part of the ERA TSD to meet the requirements for the Canadian Standards Association (CSA) N288.6 Standard on Environmental Risk Assessment for Class I Nuclear Facilities (CSA Group 2012).

While ozone (O_3) is not directly emitted into the atmosphere from the Project, it is associated with the reaction of NO_X and volatile organic compounds (VOCs) to create NO_2 (MOECC 2016). Ozone baseline data will be used to calculate the NO_2 emissions from the Project. The VOCs, while a criteria air contaminant, are not considered indicator compounds for this Project. The VOCs are not expected to be emitted from the decommissioning activities with the exception of some VOC emissions from fuel combustion. There are no provincial or federal standards for total VOCs to compare predicted concentrations, therefore, were not retained for the air quality baseline assessment. Polycyclic aromatic hydrocarbons (PAHs) and metals are not considered as indicator compounds as their associated emission factors, where applicable, are considerably lower than the assessed indicator compounds (e.g., NOx). It is not expected that emissions from fuel combustion would result in substantial predicted concentrations. Non-road mobile fuel combustion products may include hydrocarbons; however, the associated emission factors may represent total hydrocarbons or non-methane hydrocarbons.

Components of the residual organic coolant that is in piping in tanks are not considered indicator compounds for this Project. The residual organic coolant has been drained, with the remainder to be filled as practical in place. The material in question is OS-84 and the Safety Data Sheet (AECL 2014) notes that the material's evaporation rate is negligible with a vapour pressure of lower than 0.001 hPa; therefore, the coolant's components are not volatile and are not expected to be released to the atmosphere in measurable amounts.

The measurement indicator used for assessing the effects of the Project on the air quality VC considers a combination of indicator compounds and their associated averaging period(s) where federal and/or provincial air quality objectives and criteria are available. A single measure is used when evaluating effects, namely the maximum predicted concentration resulting from the Project activities. To evaluate the effect of project-related changes to air quality on other VCs, the results of the air quality assessment were provided to the disciplines listed in Table 6.2.1-3.

Table 6.2.1-3: Assessment Endpoints and Measurement Indicators for the Air Quality Assessment

Valued Component	Assessment Endpoints	Measurement Indicators	Discipline Assessments where Effects on Air Quality are Considered
Air Quality	Performance against criteria and thresholds for protection of human health and the environment	Changes to ambient concentrations of criteria air contaminants (SPM, PM_{10}, $PM_{2.5}$, NO_2, SO_2 and CO).	■ Surface Water Quality (Section 6.4.2); ■ Aquatic Environment (Section 6.5); ■ Terrestrial Environment (Section 6.6); ■ Human and Ecological Health (Section 6.7); and ■ Land and Resource Use (Section 6.8).

SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; NO_2 = nitrogen dioxide; SO_2 = sulphur dioxide; CO = carbon monoxide.

6.2.1.4 Assessment Boundaries

6.2.1.4.1 Spatial Boundaries

The spatial boundaries selected for the air quality assessment are presented on Figure 6.2.1-1 and are described below.

- **Site Study Area (SSA):** is the WR-1 Building and represents the Project footprint (i.e., where Project activities will be undertaken; 0.07 ha).
- **Local Study Area (LSA):** is defined as the area within which there is potential for measurable changes resulting from the proposed Project activities. The LSA is defined to encompass activities and sources of emissions associated with the Project and is equivalent to approximately 8 km by 8 km square that includes the SSA and the WL site (approximately 6,400 ha).
- **Regional Study Area (RSA):** is defined as the area within which the potential effects of the Project may interact with the effects of other existing or reasonably foreseeable projects. The RSA is equivalent to approximately a 12 km by 12 km square surrounding the LSA (approximately 14,400 ha; Figure 6.2.1-1). This area was selected to include the entire Pinawa Provincial Park to support the land use assessment.

The LSA and the RSA were selected to assess the maximum potential effects for the Project. The size of the LSA and RSA capture the maximum potential effects considering that potential effects of the Project are predicted to remain close to the emission sources centered around WR-1 and to decrease with distance. To provide a conservative assessment, the maximum predicted air quality results at the LSA boundary are presented and are considered to be representative of the highest concentrations at ground-level of contaminants expected outside the LSA from Project activities.

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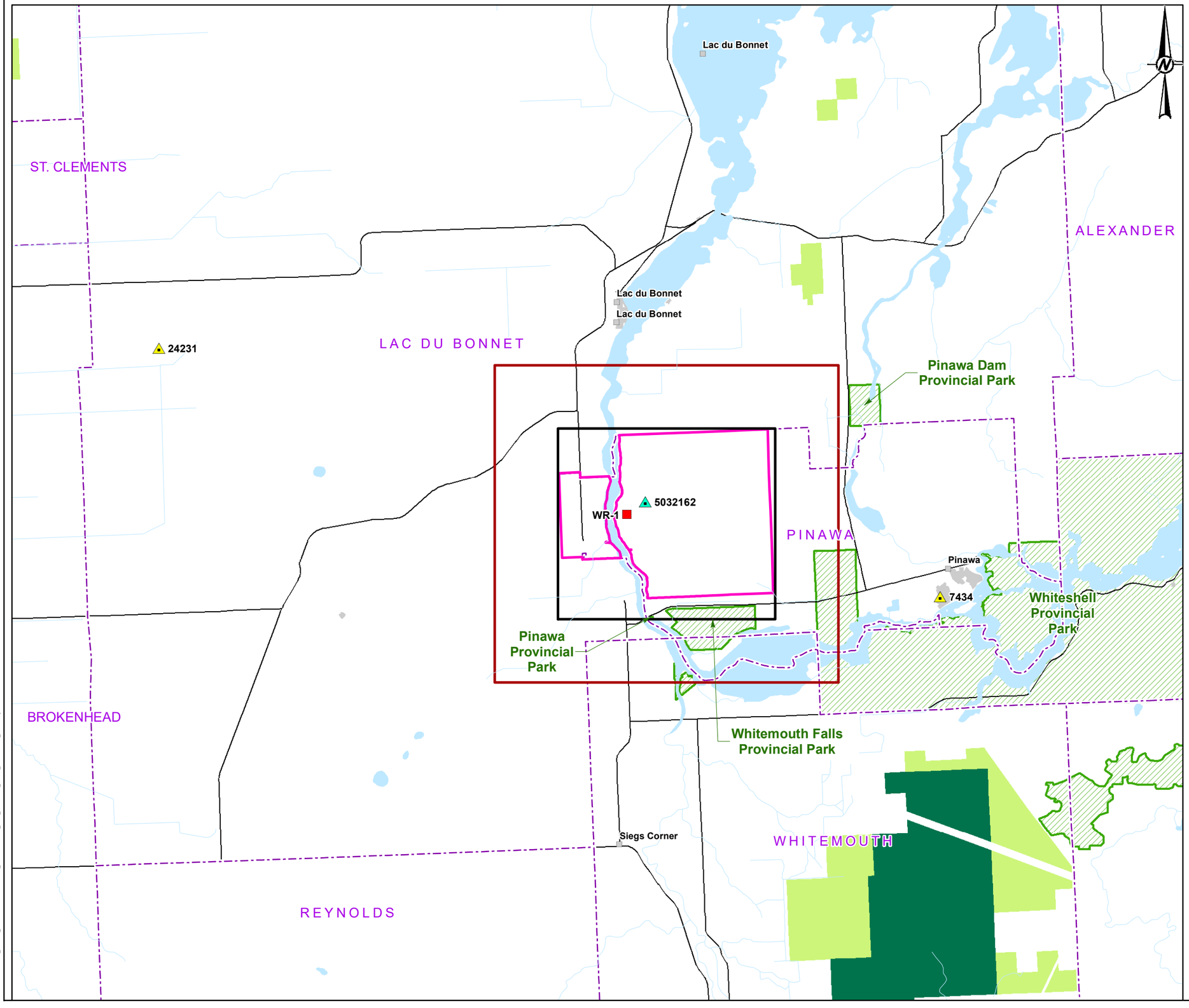

LEGEND

- WR-1 BUILDING (SITE STUDY AREA)
- METEOROLOGY STATION
- NAPS STATION
- NPRI FACILITY
- WHITESHELL LABORATORIES SITE
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

BASE FEATURES

- CITY/TOWN
- MAJOR ROAD
- WATERCOURSE
- WATERBODY
- MUNICIPAL BOUNDARY

PROTECTED AREAS

- ECOLOGICAL RESERVE
- WILDLIFE MANAGEMENT AREA
- PROVINCIAL PARK

0 5 10
1:150,000 KILOMETRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY PROVIDED BY CNL (2016-11-22)
3. TOPOGRAPHIC MAP -
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
SPATIAL BOUNDARIES FOR THE AIR QUALITY ASSESSMENT

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/PR/RRD
REVIEWED	KL
APPROVED	SC

PROJECT NO.	CONTROL	REV.	FIGURE
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6.2.1.4.2 Temporal Boundaries

The temporal boundary of the assessment is the timeframe during which Project activities are actively occurring and the duration of predicted residual effects. The duration of an effect is defined as the amount of time between the start and end of a Project activity or stressor (which is related to the Project phases) plus the time required for the residual effect to be reversed. In some cases, a residual effect may be irreversible within the temporal boundaries of the Project if the effects were predicted to last so far into the future that they could not be predicted with any level of certainty (e.g., residual effect lasts for thousands of years). The Project consists of two phases: closure and post-closure.

The stages and associated activities during the closure phase of the Project are presented in Table 6.2.1-4. Project Stages 1 to 3 involve overlapping years of activities and include the following sources of emissions:

- on-road vehicles exhaust and dust from paved roads;
- non-road vehicles exhaust;
- material handling (grouting and demolition);
- batch mixing plant or similar equipment; and
- emergency power generators.

Project Stages 1 to 3 are considered to involve the highest level of emissions compared to the remaining stages as they occur during overlapping years. Project Stages 4 to 6 will include substantially less road and non-road activities and will not include the batch mixing plant or similar equipment, demolition or propane combustion, resulting in lower emissions. Emissions sources for Stage 4 were compiled to verify Stages 1 to 3 as the bounding case for the atmospheric assessment (Golder 2020a). While Stage 4 includes travel on unpaved roads that have a greater emission factor than paved roads, the vehicular travel along the roads is assumed to be substantially less when compared to Stages 1 to 3. The remaining sources of emissions from Stage 4 are also substantially less than in Stages 1 to 3, as a result, no further assessment is required. Therefore, only activities associated with Stages 1 to 3 are considered in the air quality assessment as they represent the most conservative air emission scenario. Details on the sources of emissions are provided in Appendix 6.2-2.

The post-closure phase has two discrete periods: institutional control and post-institutional control. Institutional control is estimated to last 100 years during which long term monitoring and maintenance activities will continue to demonstrate Whiteshell Reactor Disposal Facility (WRDF) performance is in compliance with the safety case assumptions and performance modelling. The 100 year timeframe is not related to the design life of the WRDF barriers. The 100-year active monitoring period was selected to ensure that sufficient opportunity is provided to verify the WRDF is performing as expected. Additionally, beyond 100 years, there is less confidence that institutional controls, like access restrictions, can be relied upon. Although the duration of institutional control is estimated at 100 years, it is recognized that it will continue until the CNSC, or the appropriate authority at the time, agrees it is no longer needed.

Post-institutional control occurs after year 2127 and continues indefinitely. The post-closure phase will continue indefinitely; however, the timeframe defined for assessment of potential effects as part of the normal evolution of the Project is 10,000 years. This time period encompasses the phase in which peak effects are anticipated. No sources of indicator compound emissions are expected during the post-closure phase as a result of the Project; therefore, has not been evaluated in the air quality assessment.

Table 6.2.1-4: Project Stages and Associated Activities during the Closure Phase

Project Stage	Activity Description	Duration	Number of Years
1	Preparation for In Situ Disposal	2022 to 2025	3
2	Grouting of below-grade structures and systems	2025	1
3	Removal of above-grade WR-1 structures	2024-2025	2
4	Installation of concrete cap and engineered cover	2026	1
5	Final site restoration	2026	1
6	Preparation for Institutional Control	2026	1

6.2.1.4.3 Assessment Cases

The assessment cases considered in the air quality assessment include the Base Case, Application Case and the Reasonably Foreseeable Development (RFD) Case.

- **Base Case:** represents existing conditions and characterizes combined effects from previous and existing developments and activities. The Base Case reflects the effects of existing disturbances, such as forestry, transportation, agricultural and residential and recreational development. Current effects from the existing facilities and operations at the WL site, for example, are considered part of the Base Case. In addition, existing conditions of areas not affected by the WL site are also considered as part of the Base Case.
- **Application Case:** represents the effects of the Base Case combined with the predicted effects that from the Project. The Application Case includes Project Stages 1 to 3; the emissions and associated effects during these stages of the Project represent the bounding cases.
- **RFD Case:** represents the predictions of the cumulative effects of the Application Case, plus projects that are currently under application review or that have officially entered a regulatory application process and that overlap with the air quality RSA. Foreseeable developments in the air quality RSA that are expected to overlap with residual effects on air quality from the Project include the decommissioning of the remaining infrastructure and support facilities and remediation of affected lands at the WL site as per the existing decommissioning licence (Table 6.2.1-5). A Comprehensive Study Report (AECL 2001) under the *Canadian Environmental Assessment Act* (1992) was completed for the decommissioning of the WL site. The Environmental Assessment decision to approve the Project was announced by the Minister of the Environment in March 2002 and a decommissioning licence was issued to Atomic Energy of Canada Limited (AECL) and subsequently to CNL.

Table 6.2.1-5: Reasonably Foreseeable Developments considered in the Air Quality and Greenhouse Gas Assessment

Type of Project	Location	Description	Timeframe	Overlap with Valued Components
Infrastructure Decommissioning	WL	Decommissioning of remaining infrastructure on the WL site (includes in situ disposal of the low-level waste trenches).	2016 to 2027	Yes – there is both spatial and temporal overlap of effects with the Project
Environmental Remediation	WL	Remediation of affected lands, with the exception of the low-level waste trenches.	2016 to 2027	Yes – there is both spatial and temporal overlap of effects with the Project

6.2.1.5 Description of the Environment

6.2.1.5.1 Methods

This section documents the methods, data and results that were used to describe the background air quality at the Project and in the LSA and RSA for indicator compounds. For each indicator compound identified in Section 6.2.1.3 Valued Components, the assessment was carried out by:

- identifying and comparing air quality guidelines in Manitoba and/or Canada for the indicator compounds;
- assessing air quality data sources for use in the background air quality assessment; and
- comparing air quality monitored data to the applicable air quality guidelines.

These steps are detailed in the following sections.

Applicable Criteria

The relevant air quality criteria used for screening air quality effects in the region include Manitoba Air Quality Criteria. The Province of Manitoba, Department of Sustainable Development (now Manitoba Environment, Climate and Parks), Climate Change and Air Quality Branch (Manitoba) has set guidelines related to ambient air concentrations and are summarized in *Objectives and Guidelines for Various Air Pollutants: Ambient Air Quality Criteria* (Manitoba AAQC; Government of Manitoba 2005). The Manitoba AAQC are maximum concentration levels set for the protection and preservation of ambient air quality within Manitoba. The criteria are classified as objectives, guidelines or refer to Canada-wide Standards. The Canada-wide Standards were updated in 2012 and are now known as Canadian Ambient Air Quality Standards (CAAQS). The Manitoba AAQC are characterized as maximum tolerable, acceptable, or desirable level concentrations in ambient air, and intend to serve as guidance for air quality assessments.

The Manitoba AAQC state the following:

- Maximum Acceptable Levels are not to be exceeded in any urban centre including areas that are in the vicinity of industries with atmospheric emissions;
- within rural areas, the goal is to maintain concentrations at or below Maximum Desirable Levels; and
- Maximum Tolerable Levels are only for evaluation purposes to identify the severity of an anthropogenic or natural phenomenon to protect human health and institute appropriate corrective action.

As the Project is in a rural area, the Maximum Desirable Levels were used to assess background air quality conditions, if available; where the Maximum Desirable Levels were not available, the Maximum Acceptable Levels were used.

There are two sets of federal objectives and criteria: the National Ambient Air Quality Objectives (NAAQOs) and the CAAQSs. Similar to the Manitoba AAQCs, the NAAQOs are benchmarks that can be used to facilitate air quality management on a regional scale and provide goals for outdoor air quality that protect public health, the environment, or aesthetic properties of the environment (CCME 1999).

The NAAQOs are not regulatory criteria, rather the federal government has established the following levels of NAAQOs (Health Canada 1994):

- the Maximum Desirable Level defines the long-term goal for air quality and provides a basis for an anti-degradation policy for unpolluted parts of the country and for the continuing development of control technology; and
- the Maximum Acceptable Level is intended to provide adequate protection against adverse effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well-being.

The CAAQSs have been developed under the *Canadian Environmental Protection Act, 1999* and include standards for $PM_{2.5}$ and ozone that must be achieved by 2020. In 2015 the standard was phased in, with the final standard phase in date in 2020 (Government of Canada 2013). Similar to the NAAQOs, the CAAQSs are not regulatory limits, but rather, are used as national targets for $PM_{2.5}$ and ozone (CCME 2014).

Monitoring data in Canada periodically exceeds these criteria, objectives, and standards at different locations for different periods of time. Measured concentrations above these values does not necessarily result in immediate adverse effects but serves as a guidance for areas where air quality could potentially be improved and to take actions to reduce or limit exposure.

A summary of the applicable Manitoba and federal objectives and criteria for the Project are listed in Table 6.2.1-6.

Table 6.2.1-6: Summary of the Applicable Manitoba and Federal Objectives and Criteria

Contaminant	Criteria Classification	Averaging Period	Manitoba AAQC[a] (µg/m³)			Canada-wide Standards[b] (µg/m³)	Canadian Ambient Air Quality Standards[c] (µg/m³)	National Ambient Air Quality Standards and Objectives[d] (µg/m³)	
			Tolerable	Acceptable	Desirable			Desirable	Acceptable
SPM	Objective	24-hr	400	120	—	—	—	—	120
SPM	Objective	Annual	—	70	60	—	—	60	70
PM_{10}	Guideline	24-hr	—	50	—	—	—	—	—
$PM_{2.5}$	Guideline	24-hr	—	—	—	30	27[e]	—	—
$PM_{2.5}$	Guideline	Annual	—	—	—	—	8.8[e]	—	—
CO	Objective	1-hr	—	35,000	15,000	—	—	15,000	35,000
CO	Objective	8-hr	20,000	15,000	6,000	—	—	6,000	15,000
NO_2	Objective	1-hr	1000	400	—	—	—	—	400
NO_2	Objective	24-hr	—	200	—	—	—	—	200
NO_2	Objective	Annual	—	100	30	—	—	60	100
O_3	Objective	1-hr	400	160	100	—	—	100	160
O_3	Objective	Annual	—	30	—	—	—	—	—
O_3	Guideline	8-hr	—	—	—	128	122[f]	—	—
SO_2	Objective	1-hr		900	450	—	—	450	900
SO_2	Objective	24-hr	800	300	150	—	—	150	300
SO_2	Objective	Annual	—	60	30	—	—	30	60

a) Manitoba AAQC (Government of Manitoba 2005).
b) Canada-wide Standard as published in the Manitoba AAQC (2005) (updated in 2012 to CAAQS).
c) CAAQS published in the Canada Gazette Volume 147, No. 21 - May 25, 2013. Final standard phase in date of 2020 used.
d) CCME 1999.
e) The 24-hour CAAQS for $PM_{2.5}$ is based on the three-year average of the annual 98th percentile of the daily averaged monitored data. The annual CAAQS for $PM_{2.5}$ is based on the three-year average of annual averaged monitored data.
f) The 8-hour CAAQS for O_3 is based on the fourth highest 8-hour value annually, averaged over a 3-year period.
µg/m³ = micrograms per cubic metre; SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; CO = carbon monoxide; NO_2 = nitrogen dioxide; O_3 = ozone; SO_2 = sulphur dioxide; — = No guideline available.

Baseline Air Quality Data

In Manitoba, regional air quality is monitored through a network of air quality monitoring stations operated by the Environment and Climate Change Canada (ECCC) National Air Pollution Surveillance (NAPS) program. These stations are operated under strict quality assurance and quality control procedures. Existing air quality was characterized using background air concentrations from monitoring data sources near the Project. The Comprehensive Study Report (see Section 5.4.1 and Section 5.4.2 of AECL 2001) included an air quality baseline assessment that used monitoring stations that are no longer in operation or have been relocated (i.e., Winnipeg's station ID 9119); therefore, the data from these stations was not considered in this assessment.

There are no air quality monitoring stations within the RSA; however, three air quality monitoring stations are located within 300 km of the Project: Winnipeg (65 Ellen Street), Experimental Lakes and Brandon Assiniboine Community College (Assiniboine). The 65 Ellen Street station was the only air quality monitoring station located within 100 km of the Project[1]. The 65 Ellen Street station includes indicator compounds with the exception of SPM. The 65 Ellen Street station is located approximately 84 km from the Project, in an urban area and approximately 60 to 70 km away from two large bodies of water.

The second closest station, Experimental Lakes is located approximately 180 km away from the Project and is situated in one of the largest research areas for freshwater lakes that is managed by the International Institute for Sustainable Development (IISD 2016). The data from this station is heavily influenced by the more than 50 surrounding freshwater lakes and the station only monitors ozone, which makes it difficult to compare with the other data sets. The limited data from this station are not considered representative of the air quality within the LSA and RSA, and therefore, were not used in the air quality assessment.

The next closest air quality monitoring station is in Brandon Assiniboine Community College (Assiniboine) and includes all indicator compounds except for CO, SO_2 and SPM. The Assiniboine station is located approximately 280 km from the Project.

Ideally, an air quality monitoring station would be within proximity of the Project with a similar geographical siting and similar influences; however, the NAPS program focuses on areas that are affected by local sources and not on remote un-affected areas like the WL site. The Winnipeg station is both the closest station to the Project and has the most indicator compounds. As the station is in a more industrial and urban area, the air quality data from the selected station can be considered to provide conservative air quality estimates and are likely to be greater than the existing conditions in the RSA. Therefore, for the Project, the 65 Ellen Street station is the most representative station of the RSA, although there are differences in the geographical setting.

While the Assiniboine station is farther away and has less indicator compounds compared to the 65 Ellen Street station, it was selected to be included in the background air quality assessment for comparison to the 65 Ellen Street station. Its geographical siting is not as remote as the Project, has little influence from waterbodies, is located within an industrial setting and is not considered to be as representative as the 65 Ellen Street station for the WL site.

[1] The second monitoring station in Winnipeg was not selected for this assessment as it monitors fewer indicator compounds.

The relative locations of the two air monitoring stations selected to describe the background air quality for the LSA and RSA (i.e., 65 Ellen Street and Assiniboine) are provided in Table 6.2.1-7 and the station locations are shown on Figure 6.2.1-2. Any other stations are located more than 400 km away from the Project, and therefore, were not retained for the assessment given the long distance. For this assessment, data from 2009 to 2013 was used, which is the most recent five-year period at the time of this assessment for which all data are available, and quality assured by ECCC.

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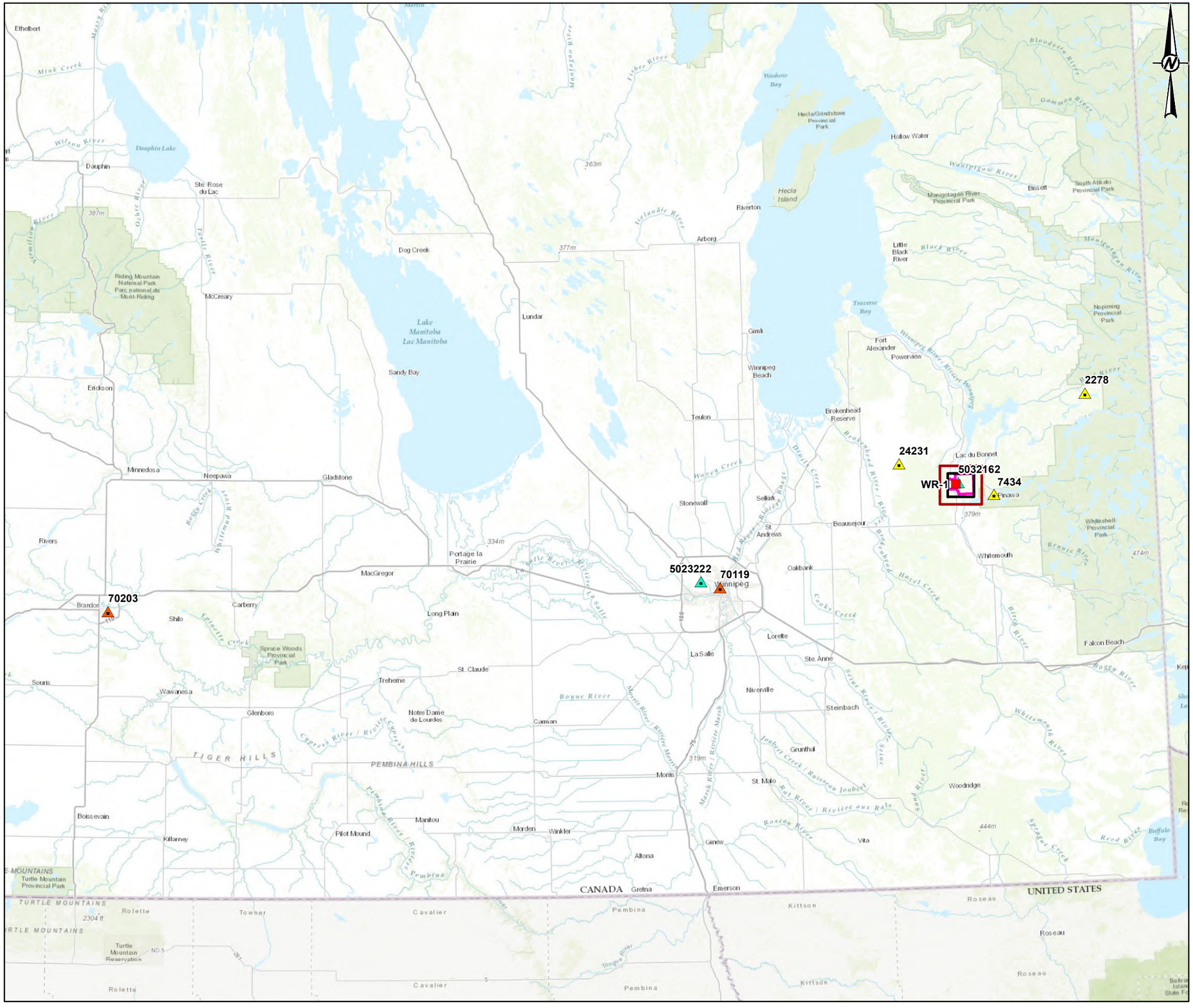

LEGEND

- WR-1 BUILDING (SITE STUDY AREA)
- METEOROLOGY STATION
- NAPS STATION
- NPRI FACILITY
- WHITESHELL LABORATORIES SITE
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

BASE FEATURES

- MAJOR ROAD
- WATERCOURSE
- WATERBODY

0 25 50 75

1:1,250,000 KILOMETRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY PROVIDED BY CNL (2016-11-22)
3. TOPOGRAPHIC MAP - SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
LOCATION OF NAPS STATIONS, METEOROLOGY STATIONS AND NPRI REPORTING FACILITIES

CONSULTANT

WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/PR/RRD
REVIEWED	KL
APPROVED	SC

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0008	2	**6.2.1-2**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

Path: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0008_EIS_Sec_6.2\20145046-0008-RAA-0006_Figure 6_2_1-2 - Location of NAPS, Meteorology and NPRI Stations.mxd

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Table 6.2.1-7: Location of Background Air Monitoring Stations Selected for the Project

City	NAPS Station ID	Location	Latitude and Longitude	Distance to the Project[(a)] (km)	Direction
Winnipeg	70119	Outside Regional Study Area	49.89809, -97.14652	84	Southwest
Brandon	70203	Outside Regional Study Area	49.83918, -99.9206	280	Southwest

a) Approximate distance from Project.

NAPS = National Air Pollution Surveillance.

The air flow into the WL site varies in direction but is predominantly blowing from the south and south-southeast and slightly less predominantly from the north-northwest and northwest. The Project is in a fairly remote area, with very few industrial emission sources that influence the airshed surrounding the Project. The air flow into the Winnipeg area is from the south, thereby, including local and transboundary industrial influences. As the selected monitoring stations are in more industrial and urban areas, the air quality data from the selected stations can be considered to provide conservative air quality estimates and are likely to be greater than the existing conditions in the RSA.

Table 6.2.1-8 provides a summary of the monitoring data available from each of the two selected stations for the period from 2000 through 2013. At the time of this assessment, complete datasets were available up until 2013, with only partial information available for 2014 and 2015. Not all compounds have the same data availability period for a given station, as additional compounds are added to the station at different dates as required by the ECCC (e.g., SO_2 was only monitored starting in 2008).

Table 6.2.1-8: Availability of Ambient Air Quality Data (Years)

Compound	65 Ellen Street Station	Assiniboine Station
SPM[(a)]	—	—
PM_{10}	2006 - 2013	2006 - 2013
$PM_{2.5}$	2000 - 2002, 2013	2001 - 2002, 2013
NO_2	2000 - 2013	2000 - 2010, 2012 - 2013
NO	2000 - 2013	2000 - 2013
SO_2	2008 - 2013	—
CO	2006 - 2013	—
O_3	2000 - 2013	2000 - 2013

a) SPM values may be calculated from the monitored values of PM_{10}.

SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; NO_2 = nitrogen dioxide; NO = nitrogen oxide; CO = carbon monoxide; SO_2 = sulphur dioxide; O_3 = ozone; — = data for the parameter were not available at that station.

6.2.1.5.2 Results

Table 6.2.1-9 provides a summary of the existing air quality data for the RSA based on data from the 65 Ellen Street station. The comparison of the 65 Ellen Street station and the Assiniboine station is provided in Appendix 6.2-1.

The data presented in Table 6.2.1-9 represent the 90th percentile of the 1-hour, 8-hour and 24-hour measurements, which are typically used to represent the background air quality value when conducting an effects assessment, as this value is exceeded only 10% of the time (AESRD 2013). The annual average concentration is used for annual background levels and based on the measurement data. The existing concentrations are below the respective provincial and federal criteria for each indicator compound, suggesting that the region has generally good air quality.

Table 6.2.1-9: Background Air Quality Values (90th Percentile, Average for Annual Only) [(a)]

Indicator	Averaging Period	65 Ellen Street Station (µg/m³)	Background Air Quality (Base Case) (µg/m³)
SPM[(b)]	24-hour	22.46	**22.46**
	Annual	13.72	**13.72**
PM_{10}	24-hour	11.23	**11.23**
$PM_{2.5}$[(c)]	24-hour	11.58	**11.58**
	Annual	6.64	**6.64**
NO_2	1-Hour	39.50	**39.50**
	24-Hour	35.41	**35.41**
	Annual	18.48	**18.48**
SO_2	1-Hour	2.62	**2.62**
	24-Hour	2.62	**2.62**
	Annual	0.75	**0.75**
CO	1-Hour	801.67	**801.67**
	8-Hour	916.19	**916.19**
O_3[(c)]	1-Hour	74.57	**74.57**
	8-Hour	86.35	**86.35**

Bolded values represent the Base Case air quality.

a) Data measured in parts per billion (ppb) or parts per million (ppm), were converted to µg/m³ assuming standard temperature and pressure (25°C and one atmosphere of pressure).

b) The 24-hour CAAQS for $PM_{2.5}$ is based on the three-year average of the annual 98th percentile of the daily averaged monitored data. The annual CAAQS for $PM_{2.5}$ is based on the three-year average of annual averaged monitored data. Please note, the table does not present the values to compare to the relevant CAAQS due to insufficient data.

c) The 8-hour CAAQS for O_3 is based on the fourth highest 8-hour value annually, averaged over a 3-year period. Please note, the table does not present the values to compare to the relevant CAAQS.

µg/m³ = microgram per cubic metre; SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; NO_2 = nitrogen dioxide; SO_2 = sulphur dioxide; CO = carbon monoxide; O_3 = ozone.

6.2.1.6 Project Interactions and Mitigation

6.2.1.6.1 Methods

This section describes the process by which interactions between Project components and activities and air quality were identified and evaluated. Potential effect pathways are identified, and mitigation developed to eliminate and/or reduce effects is presented. A pathways analysis is then used to focus the assessment on key interactions between the Project and the environment by evaluating the different effect pathways to assess if, after incorporation of mitigation, there is still potential to cause residual effects. Where effects will be adequately mitigated and are not forwarded for further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are articulated. Primary pathways that may lead to residual effects after incorporation of mitigation are further characterized in Section 6.2.1.7 Residual Effects Analysis. As such, this section helps to focus the remainder of the assessment on those interactions (effects pathways) likely to result in residual adverse effects.

The first part of the analysis was to identify the potential effects pathways for all stages of the Project. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. The next step in the analysis was the development of environmental design features and mitigation practices that could be incorporated into the Project to eliminate and/or reduce effects to air quality. Environmental design features included design elements, environmental best practices and management policies and procedures. Environmental design features and mitigation were developed through an iterative process between the engineering and environmental teams, combined with input from Project-specific or regional engagement with other interested parties. The design features and/or mitigation were selected considering their effectiveness for implementation and maintenance, and their appropriateness within the context of the identified effect pathways.

After incorporation of mitigation, potential pathways were evaluated into the following categories using scientific knowledge, logic, experience with similar developments and the effectiveness of environmental design features and mitigation.

- **No linkage pathway –** pathway is removed by environmental design features or mitigation such that the Project would not be expected to result in a measurable environmental change to concentrations of indicator compounds relative to Base Case values, and therefore would have no residual effects to air quality.
- **Secondary pathway –** the pathway could result in a measurable minor change to concentrations of indicator compounds, but would have a negligible residual effect on air quality relative to Base Case and/or guideline values and is not expected to contribute cumulatively to other Project effects or to the effects of other past, present or reasonably foreseeable developments to cause a significant effect.
- **Primary pathway –** the pathway is likely to result in an environmental change to concentrations of indicator compounds relative to the Base Case and/or guideline values that could contribute to residual effects to air quality.

Environmental design features and mitigation that have been or could be incorporated into the Project to eliminate and/or reduce adverse effects to air quality were considered. Potential pathways that were completely removed due to implementation of environmental design or mitigation were not assessed further. Pathways that were assessed to be secondary and demonstrated to have a negligible residual effect to air quality through simple qualitative or semi-quantitative evaluation of the pathway were also not advanced for further assessment. Primary pathways were carried forward for more detailed quantitative and/or qualitative effects analysis to characterize the residual effects of the Project on air quality.

CNL's *Management and Monitoring of Emissions* (CNL 2018) outlines the requirements for identification, control and treatment of emissions at CNL sites. Some applicable mitigation methods are described below.

- Facilities shall be designed, operated, decommissioned and abandoned such that radioactive and non-radioactive emissions to the environment remain As Low As Reasonably Achievable (ALARA), economic and social factors being taken into account.
- Radioactive and non-radioactive emissions to the environment from CNL facilities and sites shall be controlled so as to remain below regulatory release limits specified in any applicable legislation, license, permit or approval issued in respect of the operation of that specific facility or site by a regulatory agency having jurisdiction.
- To the extent practical, emissions to the environment should be controlled by proactive prevention of the emission at the source, through means such as:
  - selecting or using such types, quantities, and physical and chemical forms of radioactive and non-radioactive contaminants, or materials that may become contaminated in use, that minimize the potential for and significance of emissions; and
  - implementing preventative maintenance and inspection programs on systems containing radioactive or non-radioactive contaminants.

6.2.1.6.2 Results

The potential pathways from sources of air emissions to air quality are dependent on the presence and relative intensity of the activity over the Project phases. Activities that use vehicles, mobile equipment, or stationary combustion sources would emit indicator compounds. Material handling activities would emit fugitive dust, as would vehicle movements on paved roads. Each activity would have a different level of intensity or use a different amount of equipment depending on the phase in which the activity occurred. Pathways through which the Project may interact with and result in changes to concentrations of indicator compounds is provided in Table 6.2.1-10.

Table 6.2.1-10: Pathways Analysis for the Air Quality Valued Component

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
Closure Phase ■ Stage 1: Preparation for in situ disposal ■ Stage 2: Grouting of below-grade structures and systems ■ Stage 3: Removal of above-grade WR-1 structures and systems	Closure activities will alter concentrations of indicator compounds, including: ■ use of vehicles and equipment that combust fuel and emit indicator compounds; ■ material handling, for grouting, demolition, or soil remediation; ■ vehicles travelling on roads; ■ operation of batch mixing plant or similar equipment for grout production.	■ Implementation of CNL's *Environmental Protection* (CNL 2021), *Management and Monitoring of Emissions* (CNL 2018), and the WL Open Air Demolition Technical Basis document (CNL 2020), which includes operational control monitoring, air verification monitoring and environmental monitoring. ■ Implementation of dust management techniques to control dust generated by the Project, consistent with the Environmental Assessment Follow-up Program for the WL site. ■ Use of contamination immobilization agents, containment, ventilation and HEPA filters to control generation of airborne emissions during decontamination or removal of contaminated systems or structures. ■ Use of dust suppression methods during building demolition or soil remediation activities to control airborne emissions and nuisance dust during building demolition or soil remediation. Methods may include: ▪ wetting techniques during demolition to limit mobility of dust; ▪ wind restrictions during demolition to stop work or apply wetting techniques; and ▪ hydro seeding during backfilling and landscaping to reduce soil erosion. ■ Road watering and chemical dust suppressant when necessary. Dust suppressant is already used annually at the WL site for select unpaved roads. ■ Removal of accumulations of particulates (e.g., dirt) on road as soon as possible. ■ On-site vehicles and equipment engines will meet Tier 3 emission standards, where possible and be maintained in good working order. ■ Limit idling of vehicles on-site and speed on roads. ■ Use of tarps or 3 sided enclosures for raw material storage.	Primary

Table 6.2.1-10: Pathways Analysis for the Air Quality Valued Component

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
Closure Phase ■ Stage 1: Preparation for in situ disposal ■ Stage 2: Grouting of below-grade structures and systems ■ Stage 3: Removal of above-grade WR-1 structures and systems	Closure activities for the Project will overlap with decommissioning of the remaining infrastructure and support facilities at the WL site as per the existing decommissioning licence.	■ Implementation of CNL's *Environmental Protection* (CNL 2021), *Management and Monitoring of Emissions* (CNL 2018), and the WL Open Air Demolition Technical Basis document (CNL 2020), which includes operational control monitoring, air verification monitoring and environmental monitoring. ■ Use of contamination immobilization agents, containment, ventilation and HEPA filters to control generation of airborne emissions during decontamination or removal of contaminated systems or structures. ■ Use of dust suppression methods during building demolition or soil remediation activities to control airborne emissions and nuisance dust during building demolition or soil remediation. Methods may include: ▪ wetting techniques during demolition to limit mobility of dust; ▪ wind restrictions during demolition to stop work or apply wetting techniques; and ▪ hydro seeding during backfilling and landscaping to reduce soil erosion. ■ Curtailment of activities during periods of adverse meteorological conditions (e.g., during periods of high winds). ■ Maintenance of on-site access routes. ■ Continued implementation of the Environmental Assessment Follow-up Program for the WL site.	Secondary

6.2.1.6.2.1 No Linkage Pathways

There are no pathways identified as having no linkages to effects to the air quality VC.

6.2.1.6.2.2 Secondary Pathways

In some cases, a Project source of effect and an interaction with an assessment endpoint exists but mitigation is expected to cause minor changes to the environment and a negligible effect on air quality relative to the existing Base Case and/or guidelines. The following pathway is expected to result in negligible effects on the air quality VC and is not evaluated further in the EIS.

- **Closure activities for the Project will overlap with decommissioning of the remaining infrastructure and support facilities at the WL site as per the existing decommissioning licence.**

The Comprehensive Study Report (see Section 6.3.1 of AECL 2001) evaluated the effects of physical works/activities on the atmospheric environment from closure of the WL site. Physical work/activities evaluated for indicator compounds included:

- disconnecting of nuclear facility services and maintenance of buildings;
- removal of hazardous materials from facilities;
- methane pollution from organic material that may be in the inactive landfill;
- retrieval and repackaging of waste from existing storage facilities and construction of new storage area;
- demolition of facilities and disposal of rubble as clean fill; and
- site restoration (AECL 2001).

Results of the air quality assessment completed as part of the Comprehensive Study Report indicated that from time-to-time nuisance dust will be generated. Mitigation practices will be implemented to limit potential effects to air quality, including dust control measures (e.g., containment and suppression), curtailment of activities during periods of high winds and maintenance of on-site access routes (see Section 6.3.1 of AECL 2001). In addition, dust monitoring stations have been established on site to collect airborne particulate samples as part of environmental monitoring during decommissioning activities. Special enclosures to cover large areas are currently in use and additional ones may be implemented in the future to contain potential airborne emissions from decommissioning activities (e.g., decommissioning of the Waste Management Area). In addition, temporary ventilated enclosures that implement HEPA filtration are used where airborne contamination is a potential hazard during work. This protects workers and the environment. The evaluation of effects to air quality from decommissioning and reclamation activities for the entire WL site concluded that release of air emissions is negligible; consequently, no significant effects were predicted (AECL 2001).

Radiological, industrial, and environmental hazards will be remediated as practical and required for building demolition. The goal is to remove or remediate radiologically contaminated areas and systems so that the building and non-grouted reactor areas can be released for demolition as clean (non-contaminated). A Radiological Clearance Survey of the building will be performed to demonstrate remaining areas and systems are clean, confirm areas that are contaminated, and/or identify areas that are not feasible to demonstrate as clean. Contaminated areas that are not feasible to remove, remediate, or demonstrate as clean, will be identified and marked for segregation during demolition. An assessment will be done on whether such building areas or systems pose a risk for cross-contamination of clean building areas and the subsequent need to be managed as radioactive waste.

The magnitude of potential dispersion of contamination during demolition and the need to implement contamination controls will be assessed in accordance with the WL Open-Air Demolition Technical Basis Document (CNL 2020).

To control the radiological air emissions, the criteria for moving from enclosed decontamination to open-air demolition will be determined using the WL Open Air Demolition Technical Basis document (CNL 2020). This document outlines the methodology by which the remaining activity that is left in the building for the demolition is correlated to the method of demolition and doses to adjacent receptors are determined. Based on the dose constraints and Derived Air Concentrations a screening level will be assigned to the demolition work, ranging from Level 1 where no additional modeling or special precautions are necessary to Level 3, where in-depth modeling will be required, and demolition controls will be subject to approval by the Radiation Protection and Environmental Protection program managers. Generally, open-air demolition is not performed above Level 3 dose constraint.

The Comprehensive Study Report included consideration of the WR-1 Building in the original evaluation of residual effects to air quality (see Section 6.3.1 of AECL 2001). Although the decommissioning strategy has changed for WR-1 from a complete removal of the facility to in situ disposal, activities related to the decommissioning of the reactor are expected to be less disruptive than those assessed in the Comprehensive Study Report (AECL 2001) for the currently approved decommissioning approach (i.e., complete removal of the facility). Mitigation such as the use of dust suppression methods will be implemented during building demolition or soil remediation activities to control airborne emissions and nuisance dust during building demolition or soil remediation will be implemented to further limit emissions. Consequently, the Project is not anticipated to result in a change in the conclusions of the 2001 Comprehensive Study Report related to air quality (see Section 6.2.1.7.2 Application Case Results for the Project air quality predictions).

As such, the Project is not expected to contribute cumulatively to the effects of decommissioning of the remaining infrastructure and support facilities at the WL to cause a significant effect; consequently, this pathway is considered to be secondary.

6.2.1.6.2.3 Primary Pathways

Project activities completed during Stage 1, 2 and 3 of the closure phase were identified as having a residual effect on the air quality VC, and therefore, are carried forward to the residual effects analysis. Closure activities for the Project include:

- use of vehicles and equipment combust fuel and emit indicator compounds;
- material handling for grouting and demolition emit fugitive dust;
- vehicles travelling on roads emit fugitive dust; and
- operation of batch mixing plant or similar equipment for grout production emits fugitive dust.

6.2.1.7 Residual Effects Analysis

6.2.1.7.1 Methods

Residual effects of the Project are those effects that remain after implementation of all mitigation. The assessment of effects of the Project on air quality involves two steps, namely the calculation of emission rates (which include the implementation of mitigation) and dispersion modelling to predict the resulting concentrations of indicator compounds. These steps are described below.

Emissions Quantification

The method used for calculating and quantifying air emissions resulting from the Project involved the following steps:

- **Identifying emissions sources:** Emission sources were identified based on the Project conceptual design and the Project information provided in Section 3.0 Project Description.
- **Calculating emission rates:** Air emission rates were calculated using accepted methods, such as emission factors, and were based on activity data provided in Section 3.0 Project Description, as well as MOBILE6.2.C modelling results provided in Appendix 6.2-2. Emission rates were calculated for the Application Case scenario.
- **Summarizing overall emissions:** The calculated emissions were summarized by Project stage for the closure phase.

The emission estimation methods used in the air quality assessment follow generally accepted practices for conducting environmental assessments and, where appropriate, guidance in Appendix C of *REGDOC-2.9.1, Environmental Principles, Assessments and Protection Measures* (CNSC 2020). Scientifically accepted by Manitoba Sustainable Development (now Manitoba Environment, Climate and Parks) (Draft Guidelines) and well-documented emission factors, such as AP-42 from the United States Environmental Protection Agency (US EPA 1995) were used to estimate maximum and average emission rates. Details of the specific emission calculation methods and resulting emissions are provided in Appendix 6.2-2.

Dispersion Modelling

The modelling approach used to evaluate the likely environmental effects for the air quality indicators followed generally accepted practices for conducting environmental assessments and modelling guidance. It should be noted that the Manitoba Sustainable Development (now Manitoba Environment, Climate and Parks), Climate Change and Air Quality Branch, has limited dispersion modelling guidance included in the *Draft Guidelines for Air Dispersion Modelling in Manitoba* - Air Quality section (Manitoba Conservation 2006). Therefore, the Draft Guidelines and the following guidance documents were followed as appropriate: *Air Dispersion Modelling Guideline for Ontario* (MOECC 2017), the *Saskatchewan Air Quality Modelling Guideline* (SK MOE 2012) and in *Modeling Fugitive Dust Sources* (National Stone, Sand and Gravel Association 2004). The air dispersion modelling for the Project included the following approach:

- SCREEN3 dispersion modelling for emissions sources other than paved roads; and
- CAL3HQC dispersion modelling for paved roads.

The selection of the SCREEN3 and CAL3QHC models were based on the following capabilities:

- has a technical basis that is scientifically sound and is in keeping with the current understanding of dispersion in the atmosphere;
- applies formulations that are clearly delineated and are subjected to rigorous independent scrutiny;
- makes predictions that are consistent with observations;
- is recognized by federal and provincial regulators as one suitable for use;
- evaluates the source configurations and indicator compounds associated with the Project;
- the terrain surrounding the Project is relatively simple;
- allows for the use of worst-case meteorological data; and
- long-range transport of compounds is not anticipated.

Given that the main source of emissions is the Project itself and the emissions from vehicles travelling on the roads, it is appropriate to use the SCREEN3 model in combination with the CAL3QHC model. The SCREEN3 model uses Gaussian algorithms and is known to overestimate emissions. The CAL3QHC model is recommended to assess emissions from vehicular traffic and allows for the incorporation of road layout and signalization. The dispersion modelling results, which correspond to the sum of the emissions of each model, represent a conservative estimate as it assumes that the location of the maximum from each model would overlap in space and time, which would not occur in reality. This allows for a conservative estimate that does not underestimate the potential effects from the Project. The conservativeness included in the models to reduce uncertainty is discussed in Section 6.2.1.8.

Details regarding the dispersion modelling, including receptor grids and source input parameters are provided in Appendix 6.2-3.

6.2.1.7.2 Application Case Results

Average and Maximum Emission Rates

In accordance with REGDOC-2.9.1 (CNSC 2020), average and maximum emission rates have been provided for the Application Case. Table 6.2.1-11 and Table 6.2.1-12 summarize the average and maximum daily emission rates in grams per second (g/s) for the Application Case. The largest contributors to the emissions of the contaminants are as follows:

- SPM, PM_{10} and $PM_{2.5}$: paved roads;
- NOx (as NO_2) and CO: non-road equipment exhaust; and
- SO_2: emergency power generators fuel combustion.

Details of the specific emission calculation methods and resulting emissions estimates used for dispersion modelling are provided in Appendix 6.2-2.

Table 6.2.1-11: Maximum Scenario Summary of Daily Emissions Rates during the Closure Phase

Project Stage	Project Activity	Duration	Project Component		Emission Source Type	Daily Emission Rates (g/s)					
						SPM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO
1	Preparation for in situ disposal	2022 to 2025	1.1	Create pathways between rooms	Non-road Equipment Exhaust	4.38×10^{-3}	4.38×10^{-3}	4.24×10^{-3}	7.29×10^{-2}	1.46×10^{-4}	2.46×10^{-2}
			1.2	Batch mixing plant or similar equipment (temporary)	Process	7.62×10^{-2}	2.62×10^{-2}	5.46×10^{-3}	—	—	—
					Non-road Equipment Exhaust	2.08×10^{-3}	2.08×10^{-3}	2.02×10^{-3}	4.08×10^{-2}	4.81×10^{-5}	2.05×10^{-2}
					Raw Material Handling	4.09×10^{-3}	1.93×10^{-3}	2.93×10^{-4}	—	—	—
					Road Exhaust	3.70×10^{-4}	3.70×10^{-4}	2.20×10^{-4}	1.02×10^{-2}	6.76×10^{-5}	5.37×10^{-3}
					Paved Roads	3.51×10^{0}	6.73×10^{-1}	1.63×10^{-1}	—	—	—
					Propane Combustion	4.13×10^{-4}	4.13×10^{-4}	4.13×10^{-4}	2.69×10^{-2}	3.10×10^{-3}	1.55×10^{-2}
2	Grouting of below-grade structures and systems	2025	2.1	Fill below-grade areas with grout according to engineered fill schedule (multiple lifts of grouting pours)	Non-road Equipment Exhaust	5.91×10^{-3}	5.91×10^{-3}	5.73×10^{-3}	9.84×10^{-2}	1.96×10^{-4}	3.19×10^{-2}
					Material Handling	8.02×10^{-3}	3.79×10^{-3}	5.74×10^{-4}	—	—	—
3	Removal of above-grade WR-1 structures and systems	2024 to 2025	3.1	Demolition of main reactor hall, the above-grade portion of the Primary Heat transport System, the 50T reactor hall bridge crane and the Ventilation Stack	Non-road Equipment Exhaust	6.10×10^{-2}	6.10×10^{-2}	5.92×10^{-2}	1.02×10^{0}	2.03×10^{-3}	3.39×10^{-1}
					Demolition	1.83×10^{-1}	1.83×10^{-1}	1.83×10^{-2}	—	—	—
			3.2	Removal of hazardous waste	Road Exhaust	3.20×10^{-6}	3.20×10^{-6}	1.90×10^{-6}	8.82×10^{-5}	5.84×10^{-7}	4.64×10^{-5}
					Paved Roads	3.03×10^{-2}	5.81×10^{-3}	1.41×10^{-3}	—	—	—
			3.3	Recycling of materials	Road Exhaust	9.59×10^{-6}	9.59×10^{-6}	5.70×10^{-6}	2.65×10^{-4}	1.75×10^{-6}	1.39×10^{-4}
					Paved Roads	9.08×10^{-2}	1.74×10^{-2}	4.22×10^{-3}	—	—	—
			3.4	Disposal of asbestos at the WL landfill[a]	Road Exhaust	4.64×10^{-6}	4.64×10^{-6}	2.76×10^{-6}	1.28×10^{-4}	8.48×10^{-7}	6.73×10^{-5}
					Paved Roads	4.39×10^{-2}	8.44×10^{-3}	2.04×10^{-3}	—	—	—
Miscellaneous			Emergency Power Generators		Combustion	—	—	—	2.18×10^{-1}	1.44×10^{-2}	4.70×10^{-2}
					Total	**4.02×10^{0}**	**9.94×10^{-1}**	**2.67×10^{-1}**	**1.49×10^{0}**	**2.00×10^{-2}**	**4.84×10^{-1}**

a) For the emissions estimate, it was assumed that clean asbestos would be disposed of at the WL Landfill; however, some clean asbestos may be disposed of offsite. This scenario would not significantly affect the assessment due to the minimal number of trucks required to dispose of the asbestos (<4 total trucks over the course of the closure phase).

SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; NO_X = oxides of nitrogen; SO_2 = sulphur dioxide; CO = carbon monoxide.

Table 6.2.1-12: Average Scenario Summary of Emissions Rates during the Closure Phase

Project Stage	Project Activity	Duration	Project Component		Emission Source Type	Daily Emission Rates (g/s)					
						SPM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO
1	Preparation for in situ disposal	2022 to 2025	1.1	Create pathways between rooms	Non-road Equipment Exhaust	3.28×10^{-3}	3.28×10^{-3}	3.18×10^{-3}	5.47×10^{-2}	1.09×10^{-4}	1.84×10^{-2}
			1.2	Batch mixing plant or similar equipment (temporary)	Process	4.04×10^{-2}	1.39×10^{-2}	2.89×10^{-3}	—	—	—
					Non-road Equipment Exhaust	1.56×10^{-3}	1.56×10^{-3}	1.52×10^{-3}	3.06×10^{-2}	3.61×10^{-5}	1.54×10^{-2}
					Raw Material Handling	2.17×10^{-3}	1.03×10^{-3}	1.55×10^{-4}	—	—	—
					Road Exhaust	1.95×10^{-4}	1.95×10^{-4}	1.16×10^{-4}	5.37×10^{-3}	3.56×10^{-5}	2.82×10^{-3}
					Paved Roads	1.84×10^{0}	3.54×10^{-1}	8.56×10^{-2}	—	—	—
					Propane Combustion	4.13×10^{-4}	4.13×10^{-4}	4.13×10^{-4}	2.69×10^{-2}	3.10×10^{-3}	1.55×10^{-2}
2	Grouting of below-grade structures and systems	2025	2.1	Fill below-grade areas with grout according to engineered fill schedule (multiple lifts of grouting pours)	Non-road Equipment Exhaust	5.91×10^{-3}	5.91×10^{-3}	5.73×10^{-3}	9.84×10^{-2}	1.96×10^{-4}	3.19×10^{-2}
					Material Handling	4.25×10^{-3}	2.01×10^{-3}	3.04×10^{-4}	—	—	—
3	Removal of above-grade WR-1 structures and systems	2024 to 2025	3.1	Demolition of main reactor hall, the above-grade portion of the Primary Heat transport System, the 50T reactor hall bridge crane and the Ventilation Stack	Non-road Equipment Exhaust	4.58×10^{-2}	4.58×10^{-2}	4.44×10^{-2}	7.63×10^{-1}	1.52×10^{-3}	2.54×10^{-1}
					Demolition	4.81×10^{-2}	4.81×10^{-2}	4.81×10^{-3}	—	—	—
			3.2	Removal of hazardous waste	Road Exhaust	3.20×10^{-6}	3.20×10^{-6}	1.90×10^{-6}	8.82×10^{-5}	5.84×10^{-7}	4.64×10^{-5}
					Paved Roads	3.03×10^{-2}	5.81×10^{-3}	1.41×10^{-3}	—	—	—
			3.3	Recycling of materials	Road Exhaust	9.59×10^{-6}	9.59×10^{-6}	5.70×10^{-6}	2.65×10^{-4}	1.75×10^{-6}	1.39×10^{-4}
					Paved Roads	9.08×10^{-2}	1.74×10^{-2}	4.22×10^{-3}	—	—	—
			3.4	Disposal of asbestos at the WL landfill[a]	Road Exhaust	4.64×10^{-6}	4.64×10^{-6}	2.76×10^{-6}	1.28×10^{-4}	8.48×10^{-7}	6.73×10^{-5}
					Paved Roads	4.39×10^{-2}	8.44×10^{-3}	2.04×10^{-3}	—	—	—
Miscellaneous			Emergency Power Generators		Combustion	—	—	—	2.18×10^{-1}	1.44×10^{-2}	4.70×10^{-2}
					Total	**6.78×10^{-1}**	**2.20×10^{-1}**	**8.96×10^{-2}**	**1.23×10^{0}**	**3.51×10^{-1}**	**2.16×10^{0}**

a) For the emissions estimate, it was assumed that clean asbestos would be disposed of at the WL Landfill; however, some clean asbestos may be disposed of offsite.

SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; NO_X = oxides of nitrogen; SO_2 = sulphur dioxide; CO = carbon monoxide.

Negligible Emissions from the Project

There are many activities associated with the Project that produce emissions; however, not all activities produce emissions for any or all compounds that are relevant to the overall emissions assessment. All activities that potentially produce emissions were evaluated to assess their relevance; however, only activities that were considered to be relevant were included in the assessment.

The following lists rationale as to why certain activities and/or emissions of certain compounds can be excluded from the assessment:

- the emission rates of certain compounds are very small relative to the overall emissions at the Project;
- the emissions of certain sources are known to not be relevant due to the type of operations in the assessment; and
- the location of the source relative to the rest of the sources on-site (i.e., the source is located far away from any potential receptors).

Table 6.2.1-13 lists the activities that were not assessed and the accompanying rationale.

Table 6.2.1-13: Emissions Not Included in the Air Quality Assessment

Activity/Compound	Rationale for Excluding from the Air Quality Assessment
Emergency power equipment	Emissions from the emergency power equipment were only included for contaminants with an averaging period of 1 hour (NO_2, CO, SO_2). Other averaging periods for NO_2, CO and SO_2 exclude the generators emissions. Other contaminants with longer averaging periods (particulates) are excluded from the emergency power equipment assessment. The generators only operate periodically during monthly routine maintenance testing and a duration of one hour per month, rather than continuously. Additionally, the emergency power generators will only be used to supply electricity during power outage when other equipment is not in operation. Therefore, only routine maintenance of one hour per month is included in the representative scenario.
Snow removal equipment	Emissions from this equipment occur seasonally and are infrequent (i.e., only during the winter following a snowfall), and therefore, are not included in the representative scenario.
Operations support activities, such as maintenance activities	Emissions from these sources are infrequent, relatively small and do not occur at all times compared to the other activities that are occurring regularly and/or continuously. For example, these activities may include minor vehicles maintenance.
Combustion from Propane Space Heating	At the time of the assessment, it is unknown when the electric building heating systems will be taken offline for the WR-1 Building and replacement heating using propane has not been confirmed. The possible emissions from the combustion of propane used to replace the electric space heating would account for less than 5% of the total emissions from the Project and were not included in the representative scenario.
Removal of the Primary Heat Transport system	Releases from dust or gaseous emissions from removal of the PHT system are expected to be negligible because these particulates are anticipated to be captured in the remnant organics (oil), within the system. In addition, the structure is made of steel not concrete, which also inhibits the collection of dust and particulates on the PHT system. Regardless of the decontamination and dismantling techniques used for the WR-1, best practices will be implemented and will follow the Environmental Protection Plan. Releases of radiological emissions from the removal of the PHT system are evaluated in Section 6.7 Human and Ecological Health.

Table 6.2.1-13: Emissions Not Included in the Air Quality Assessment

Activity/Compound	Rationale for Excluding from the Air Quality Assessment
Non-road nuisance dust	Potential sources of dust not already included in the assessment will be managed through CNL's *Management and Monitoring of Emissions* (CNL 2018).
Non-dust fugitive emissions	■ Materials such as insulating material and asbestos are handled through existing strict procedures outlined in the *Management Control Procedure, Controlling Asbestos Hazards* (CNL 2017) and are therefore not included in the assessment. ■ The bulk of the residual organic coolant that is in piping and tanks has been drained out, with the remainder to be filled as practical in place. This coolant, OS-84, has a negligible evaporation rate and its vapour pressure is lower than 0.001 hectopascal pressure unit. Therefore, the coolant's components are not volatile and are not expected to be released to the atmosphere in measurable amounts.

NO_2 = nitrogen dioxide; CO = carbon monoxide; SO_2 = sulphur dioxide; PHT = primary heat transport; WR-1 = Whiteshell Reactor 1.

Predicted Modelling Concentrations

Ground level concentrations resulting from the Application Case for the air quality indicator compounds were predicted with the aid of the estimated emission rates (Table 6.2.1-11 and Table 6.2.1-12) and SCREEN3 and CAL3QHC dispersion models. The Maximum Scenario predicted ground level concentrations at the LSA boundary for the Application Case are presented in Table 6.2.1-14 (Average Scenario predicted concentrations are not presented as they are lower than the Maximum Scenario). The maximum predicted incremental ground level concentration represents the incremental effect of the Project, without taking into consideration existing Base Case concentrations. The predicted ground level concentrations for the Application Case represent the combined concentrations of the Base Case plus the incremental concentrations from the Project. Predicted ground level concentrations for the Application Case are below applicable air quality guidelines and/or standards (Table 6.2.1-14).

Table 6.2.1-14: Concentrations at the Local Study Area Boundary for the Base Case and Application Case

Contaminant		Chemical Abstracts Service Number	Averaging Period	Applicable Air Quality Guideline or Standard [a] (µg/m³)	Base Case Concentration[b] (µg/m³)	Maximum Scenario Maximum Predicted Incremental Concentration (µg/m³)	Application Case Concentration (µg/m³)	Application Case Concentration Percent of Applicable Air Quality Guideline of Standard
Suspended Particulate Matter	SPM	N/A-1	24-hour	120	22.46	72.79	95.25	79%
Suspended Particulate Matter	SPM	N/A-1	Annual	60	13.72	12.93	26.65	44%
Particulate Matter <10 µm	PM_{10}	N/A-2	24-hour	50	11.23	24.85	36.08	72%
Particulate Matter <2.5 µm	$PM_{2.5}$	N/A-3	24-hour	27[c]	11.58	7.79	19.37	72%
Particulate Matter <2.5 µm	$PM_{2.5}$	N/A-3	Annual	8.8[c]	6.64	1.21	7.85	89%
Nitrogen Dioxide[d]	NO_2	10102-44-0	1-Hour	400	39.5	172.99	212.49	53%
Nitrogen Dioxide[d]	NO_2	10102-44-0	24-Hour	200	35.41	72.74	108.15	54%
Nitrogen Dioxide[d]	NO_2	10102-44-0	Annual	30	18.48	9.58	28.06	94%
Sulfur Dioxide	SO_2	7446-09-5	1-Hour	450	2.62	42.38	45.00	10%
Sulfur Dioxide	SO_2	7446-09-5	24-Hour	150	2.62	0.98	3.60	2%
Sulfur Dioxide	SO_2	7446-09-5	Annual	30	0.75	0.13	0.88	3%
Carbon Monoxide	CO	630-08-0	1-Hour	15,000	801.67	257.12	1058.79	7%
Carbon Monoxide	CO	630-08-0	8-Hour	6,000	916.19	143.64	1059.83	18%

a) Table 13 in Appendix 6.2-1 identifies which guideline or standard was used in the screening of effects to air quality.
b) The 90th percentile background concentrations; values for SPM are calculated from the PM_{10} values as described in Appendix 6.2-1. Data measured in parts per billion (ppb) or parts per million (ppm), were converted to µg/m³ assuming standard temperature and pressure (25°C and one atmosphere of pressure). Although ozone was assessed as part of baseline conditions to calculate the NO_2 emissions from the Application Case, these are not presented in this table as emissions of ozone are not quantified for the Project's activities since they are not directly emitted into the atmosphere from the Project
c) The 24-hour CAAQS for $PM_{2.5}$ is based on the three-year average of the annual 98th percentile of the daily averaged monitored data. The annual CAAQS for $PM_{2.5}$ is based on the three-year average of annual averaged monitored data. Please note, the table does not present the values to compare to the relevant CAAQS due to insufficient data.
d) Calculated using the Ozone Limiting Method. Refer to Appendix 6.2-3 for methods.
µg/m³ = micrograms per cubic metre.

6.2.1.8 Prediction Confidence and Uncertainty

Potential sources of uncertainty in the assessment of air quality include:

- the accuracy and representativeness of the activity data and emission factors used to estimate emissions;
- the accuracy and representativeness of the meteorological data used in the SCREEN3 dispersion model;
- the accuracy of formulations within the SCREEN3 and CAL3QHC dispersion modelling systems;
- the representativeness of the ambient data used to represent background concentrations; and
- the potential error associated with omitting some emission sources.

Dispersion models employ assumptions that simplify the random processes associated with atmospheric motions and turbulence. While this simplification limits the model's ability to replicate individual events, the strength of the model lies in the ability to predict overall values for a given set of input parameters. Considerable effort was undertaken by the US EPA during the development and testing of the dispersion models, such that the model predictions can be relied on as reasonable estimates of the likely concentrations. SCREEN3 and CAL3QHC are based on known theory and proven to reliably produce repeatable results (Section 6.2.1.7.1). To limit the uncertainty associated with emissions input to the model, assumptions that are likely to over predict emissions or concentrations were made where practical. These conservative assumptions were used to manage the above uncertainties and are described as follows below.

- The Application Case (i.e., during the closure phase, Project Stages 1 to 3) were assumed to occur simultaneously. It is conservatively assumed that all non-road equipment is operating simultaneously during the daytime operating hours for Project Stages 1 to 3 and for the entire duration of these three stages. In reality, it is unlikely that all equipment would operate simultaneously and that the same type of equipment will operate simultaneously for different components of these stages. The modelling assessment includes all operations occurring simultaneously and continuous over the entire modelling period.
- It is assumed that all equipment will comply with US EPA Tier 3 emissions standards, where possible. Tier 3 standards have begun being phased-out in Canada (variable depending on the engine sizes) and new equipment will be required to comply with interim Tier 4 or Tier 4 emissions standards starting in 2014 (Environment Canada 2012).
- Combustion emissions from the propane-fired boiler were based on an assumed maximum equipment firing rate.
- Project activities were modelled as a volume source. Modelling the emissions as a volume source is conservative since this model source type does not take advantage of favourable dispersion characteristics such as plume buoyancy and initial exit velocity of emissions from the propane-fired boiler, batch mixing plant or similar equipment. Further, the dispersion modelling source dimensions selected for the volume source result in a dispersion modelling source which is smaller than the corresponding real-life source. This is conservative since estimated emissions occur over a smaller area, and thus, are more concentrated (and therefore less dispersed) at the point of release.

- The emission estimates for fugitive road dust from paved roads are conservative and overestimate emissions from facility roadways for the following reasons:
  - The US EPA AP 42 equations were developed from measured emissions from public roadways and as a result will tend to overestimate low speed vehicle traffic from construction and industrial sites.
  - All roadways at the Project were modelled assuming simultaneous and continuous use; however, it is unlikely that this situation will occur in reality.
  - As the dust best management practices are revised through continuous improvements, the emissions from the on-site roadways are likely to decrease.
- Site-specific meteorological data were not used as SCREEN3 and CAL3QHC used the worst-case meteorological conditions possible for each model. The worst-case meteorological conditions are those that produce the lowest dispersion of emissions over the distances considered by the model and, therefore, resulting in conservative predictions of concentrations.
- The combined effect from road and non-road emission sources is estimated by adding the maximum predicted concentrations from the SCREEN3 and CAL3QHC models. This is conservative as it is assumed that each model's worst-case meteorological conditions occur at the same time and the same receptor.
- The modelling assessment includes all operations occurring simultaneously and continuous over the entire modelling period. Variable emission rates were not used for the material handling activities and vehicle traffic although these activities are planning to only occur during the daytime and weekdays. Seasonal variability for fugitive dust emissions was also not considered in the assessment.
- The influence of natural mitigation from events such as rainfall, snowfall, residual moisture, or snow cover was not considered in estimating fugitive dust emission rates. The modelling will likely yield higher concentrations since contaminants will be deposited from the air by dry or wet depletion and deposition processes.
- The parameters that were required for fugitive dust modelling from paved roads include site geometry inputs, locations and dimension of the roadway segments, worst-case meteorological conditions, receptor locations and vehicle emission rates. This is a conservative approach to estimate the maximum off-property concentrations.
- There is limited number of stations available in the area. While there is some uncertainty associated with the use of the Winnipeg (65 Ellen Street) station, this station represents the best station with appropriate data quality. The air flow into the WL site varies in direction but is predominantly blowing from the south and south-southeast and slightly less predominantly from the north-northwest and northwest. The Project is in a fairly remote area, with very few industrial emission sources that influence the airshed surrounding the Project. The air flow into the Winnipeg area is from the south, (including local and transboundary industrial influences). Therefore, because the selected monitoring station is in a more industrial and urban area, the air quality data from the station can be considered to provide conservative air quality estimates for a rural and remote area and is likely to be greater than the existing conditions in the RSA.

It is assumed that the conservative emission rates, when combined with the conservative operating conditions and conservative dispersion modelling assumptions described herein, are not likely to under predict the modelled concentrations at each of the identified receptors.

6.2.1.9 Residual Effects Classification and Determination of Significance

This section classifies the residual effects from changes to measurement indicators for the Application Case and presents a determination of significance for the air quality VC.

6.2.1.9.1 Residual Effects Classification

Effects from adverse residual changes to measurement indicators were classified using a categorical scale and common words to facilitate the determination of significance. The purpose of categorical classification is to provide definitions that permit a clear, thorough and unambiguous classification of residual effects such that reviewers and readers can follow and apply the logic used in the assessment and reach the same classification for a given residual effect.

Residual adverse effects were classified using the criteria and definitions outlined in Table 6.2.1-15. For air quality, residual effects stop almost immediately when the Project activity stops. It should be noted that reversibility refers to effects to air quality only; how effects to air quality affect other VCs are assessed in their discipline-specific sections.

Table 6.2.1-15: Definitions of Assessment Criteria for Classifying Predicted Residual Adverse Effects to Air Quality

Criteria	Description	Definition
Direction	Direction relates to the "value" of the effect in relation to the environment.	**Positive:** Maximum concentration for an indicator compound represents a decrease from Base Case.
		Negative: Maximum concentration for an indicator compound represents an increase from Base Case.
		Neutral: No change in concentrations of an indicator compound relative to Base Case.
Magnitude	Magnitude is the intensity of the effect or a measure of the degree of change from existing (baseline) conditions or guidelines expected to occur in the criterion.	**Negligible:** Maximum concentration for an indicator compound is <5% of the corresponding criteria[(a)]
		Low: Maximum concentration for an indicator compound is less than 50% of the corresponding criteria[(a)]
		Moderate: Maximum concentration for an indicator compound is between 50% and 100% of the corresponding criteria[(a)]
		High: Maximum concentration for an indicator compound is above the corresponding criteria[(a)]
Geographic extent	Geographic extent refers to the spatial area over which an effect will occur/can be detected (distance covered or range).	**Local:** Effect is limited to within the LSA
		Regional: Effect extends beyond the LSA, but is contained within the RSA
		Beyond Regional: Effect extends beyond the RSA

Table 6.2.1-15: Definitions of Assessment Criteria for Classifying Predicted Residual Adverse Effects to Air Quality

Criteria	Description	Definition
Duration	Duration is the period of time over which the environmental effect will be present. The amount of time between the start and end of an activity or stressor (which relates to project phases), plus the time required for the effect to be reversed. Duration and reversibility are functions of the length of time a criterion is exposed to activities.	**Short-term:** Effects are not evident beyond Application Case (i.e., closure phase, Project Stages 1 to 3)
		Medium-term: Effects are not evident beyond all project phases
		Long-term: Effects are not evident beyond the completion of all project phases
		Permanent: Effects are not reversible
Frequency	Frequency refers to the occurrence of the environmental effect over the duration of the assessment.	**Infrequent:** Effects are confined to a specific discrete period
		Frequent: Effects occur intermittently, but repeatedly, or continuous over the assessment period
Reversibility	Reversibility is an indicator of the potential for recovery of the criterion from an effect. Reversible implies that the effect will not influence the criterion at a future predicted period in time. For effects that are permanent, the effect is determined to be irreversible.	**Reversible:** Change of state in environment is not permanent
		Irreversible: Change of state in the environment is permanent
Likelihood	Likelihood is a measure of the probability that an activity will result in an environmental effect.	**Low:** Effect is unlikely to occur
		Medium: Effect is likely to occur
		High: Effect is highly likely to occur

a) Table 13 in Appendix 6.2-1 identifies which guideline or standard was used in the screening of effects to air quality.
LSA = Local Study Area; RSA = Regional Study Area.

6.2.1.9.2 Determination of Significance

The residual effects classification of primary pathways and the associated predicted changes in measurement indicators provide the foundation for determining the significance of residual effects from the Project on air quality. Where possible and appropriate, established guidelines, thresholds and screening values were used to support the classification of the predicted amount of change in measurement indicators and associated effects on air quality. For an effect to be deemed significant, the effect on an indicator compound must be adverse (negative in direction), exceed relevant guideline/standard (high in magnitude), extend beyond the local study area (regional in geographic extent) and irreversible or only reversible following completion of the Project phases (long-term in duration). As part of the determination of significance, confidence in the assessment identified in Section 6.2.1.7 was considered for the air quality VC.

As presented in Table 6.2.1-16, the direction is negative for all indicator compounds as there are emissions during the Application Case. However, the magnitude of changes to indicator compound emissions are predicted to be low to moderate as the predicted concentrations of each indicator compound from the Application Case are below their relevant guideline/standard. The predicted effects are limited to the RSA, and therefore the geographic extent of changes to all indicator compounds is regional for the Application Case. Although there are planned stages for the closure phase beyond the Application Case (Phases 4-6), emissions of indicator compounds during these phases will be lower than the Application Case; therefore, the duration of effect is conservatively considered to be short-term. Criteria air contaminants will be emitted continuously or near-continuously during the Application Case, and therefore the frequency of effect is frequent. The likelihood of emissions from the Project changing indicator compound concentrations for the Application Case phases is high.

Based on the low to moderate magnitude, the regional geographical extent of the effect and the short-term duration, the overall residual adverse effect of the Application Case on air quality is determined to be not significant.

Table 6.2.1-16: Classification of Predicted Residual Adverse Effects on Air Quality for the Application Case

Indicator Compound	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood
SPM	Negative	Moderate	Regional	Short-term	Frequent	Reversible	High
PM_{10}	Negative	Moderate	Regional	Short-term	Frequent	Reversible	High
$PM_{2.5}$	Negative	Moderate	Regional	Short-term	Frequent	Reversible	High
NO_2	Negative	Moderate	Regional	Short-term	Frequent	Reversible	High
SO_2	Negative	Low	Regional	Short-term	Frequent	Reversible	High
CO	Negative	Low	Regional	Short-term	Frequent	Reversible	High

SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; NO_2 = nitrogen dioxide; SO_2 = sulphur dioxide; CO = carbon monoxide.

6.2.1.10 Monitoring and Follow-up

CNL's *Environmental Protection* (CNL 2021) requires air quality concerns related to the Project be addressed. As part of this program, CNL requires contractors to conform to *Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities* (Environment Canada 2005). In addition, this program provides air quality monitoring during decommissioning work to meet the applicable criteria.

Implementation of CNL's *Management and Monitoring of Emissions* (CNL 2018), which includes operational control monitoring, air verification monitoring and environmental monitoring, will continue for the Project. In addition, CNL will implement an Environmental Assessment Follow-up Program for the Project with the purposes to:

- verify effects predictions and compare actual with predicted effects;
- confirm effectiveness of mitigation and in doing so evaluate if alternate mitigation is required;
- provide information for use in adaptive management to address potential unforeseen effects; and
- demonstrate compliance with regulatory requirements.

This monitoring will be integrated with that for the existing Environmental Assessment Follow-up Program for the WL site, where practical. It is noted that data generated by the monitoring program will be evaluated on an ongoing basis within an adaptive management framework. Within this framework, modifications to the program may be appropriate to confirm data continue to fulfill program objectives. For example, should a contaminant of potential concern reach concentrations outside the range predicted in the EIS, including the findings from the Environmental Risk Assessment, the frequency of sampling may be increased and additional locations may be sampled to investigate the source of the increased concentrations. Conversely, cessation of a monitoring activity might be appropriate once it has been shown that an effect has stabilized, or has been reduced to a level where it is no longer considered significant with respect to regulatory requirements or community concerns. Any proposals for modifications to the monitoring program and the rationale for the modifications will be communicated to the CNSC prior to implementation. Additional information on the Environmental Assessment Follow-up Program for the Project can be found in Section 11.0 Summary of Monitoring and Follow-up Programs.

CNL will continue to proactively seek, engage, and support meaningful discussions with First Nations and the Manitoba Métis Federation and communities of interest on issues and opportunities related to the Project, including the monitoring and follow-up program. For example, the Wabaseemoong Independent Nations expressed interest in and concern about air emissions and monitoring practices on the site currently and into the future. In response to this concern, CNL shared on-site and off-site monitoring locations on for the existing operation and indicated that monitoring results will be publicly available on their website. CNL has advanced its plans relative to monitoring and follow-up and has sent Wabaseemoong Independent Nations a list of monitoring activities and invited them to participate. CNL continues to pursue discussions with Wabaseemoong Independent Nations and Indigenous peoples and communities of interest on air quality monitoring and will continue to invite Wabaseemoong Independent Nations to participate in monitoring activities.

CNL has also had discussions with First Nations and the Manitoba Métis Federation on how future monitoring on the WL site could incorporate Indigenous interests, as well as discussion on participation and/or oversight by Indigenous peoples. CNL will continually evaluate both the process and the outcome of the ongoing engagement and communication activities, to address and manage issues as they arise.

Table 6.2.1-17: Monitoring and Follow up Programs for Air Quality

Valued Component	Project Phase, Potential Effect and Conceptual Monitoring Program	Monitoring Program Objective	Suggested Duration	Implementing Program
Air Quality	**Potential Source(s) of Effects:** ■ Closure activities will result in fugitive dust emissions **Proposed Monitoring:** ■ Application of aggregate to unpaved roads – a record will be kept of the date of each application of aggregate to unpaved roads. ■ Dust Control on Roads – a record will be maintained of dust control treatment for roads. ■ Site inspection – during periods of high dust susceptibility, regular inspections will be carried out to monitor the efficacy of dust mitigation and any potential concerns with regards to fugitive dust, and if required implementation of mitigation will be recommended. Environmental conditions will be recorded. ■ Confirmatory monitoring of total suspended particulates (PM_{10}) and radioactivity will be conducted during demolishing and other dust generating activities. **Trigger for Further Action:** ■ Investigation if parameters above predictions, applicable guidelines, thresholds or limits, or if actual number of vehicles/kilometres travelled exceeds the prediction on which emission estimates were based. ■ If high levels of dust are identified (qualitative), adjust dust suppression measures accordingly.	■ Verify that mitigation are being incorporated as planned and are effective. ■ Verify predictions are within air quality criteria. ■ Demonstrate compliance with regulatory requirements.	Through the closure phase.	■ Captured through the implementation of CNL's *Management and Monitoring of Emissions* (CNL 2018), which includes operational control monitoring and verification monitoring. ■ WL currently conducts industrial hygiene assessments of lead, asbestos and mould within facilities as part of the decommissioning planning process. ■ Emissions associated with NPRI reporting are estimated. Facility to ensure that NPRI reporting includes updated estimates.

PM_{10} = particles nominally smaller than 10 micrometres in diameter; NPRI = National Pollutant Release Inventory

6.2.1.11 Conclusions

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). Air quality was selected as a VC as emissions from the Project activities have the potential to alter the existing air quality regime. Sagkeeng; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations did not identify additional valued components beyond air quality. The assessment endpoint for the air quality assessment are performance against criteria and thresholds for protection of human health and the environment. The measurement indicators for air quality include changes in ambient concentrations of indicator compounds in comparison to the provincial or federal ambient air quality criteria.

Residual effects from activities that occur during the Application Case have been identified as the primary linkage to potentially affect ambient air quality. During the Application Case, Project activities will result in emissions associated with the operation of vehicles and equipment, as well as material handling emissions from the demolition and grouting and temporary batch mixing plant or similar equipment. A summary of the predicted residual adverse effects for air quality, including associated mitigation, are provided and examples of mitigation practices implemented to limit predicted residual effects to air quality include:

- implementation of CNL's *Environmental Protection* (CNL 2021) and *Management and Monitoring of Emissions* (CNL 2018), which includes operational control monitoring, air verification monitoring and environmental monitoring;
- on-site vehicles and equipment engines will meet a minimum of Tier 3 emission standards, where possible, and be maintained in good working order;
- limit idling of vehicles on-site and limit speed on roads; and
- use of tarps or 3-sided enclosures for raw material storage.

The predicted residual effects air quality were estimated to increase because of the Project. Fugitive dust from vehicle movement on paved roads is the largest contributor to SPM, PM_{10} and $PM_{2.5}$ emissions. Non-road equipment exhaust emissions are the largest contributors to NOx (as NO_2) and CO emissions. Finally, the largest contributor to SO_2 is fuel combustion for emergency power generators. Predicted concentrations for the Application Case are below applicable air quality guidelines and/or standards. Following the methods described above, the residual effects from the Project on air quality was determined to be not significant (Table 6.2.1-18). This conclusion applies to the air quality interests and concerns raised by the engaged First Nations and the Manitoba Métis Federation, which were encompassed by the assessment (Table 6.2.1-1).

The *Management and Monitoring of Emissions* (CNL 2018) outlines the key management practices that limit air quality emissions effects, as well as the current monitoring requirements. Current and future monitoring of air quality was of interest to Indigenous peoples. CNL will continue to proactively seek, engage, and support meaningful discussions with First Nations and the Manitoba Métis Federation and communities of interest on issues and opportunities related to the Project, including the monitoring and follow-up program.

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Table 6.2.1-18: Summary of Predicted Residual Adverse Effects for Atmospheric Environment Valued Components

Valued Compound	Assessment Endpoint	Residual Adverse Effects	Phase the Project Effect Occurs in	Contributing Project Activity	Proposed Mitigation	Significance
Air Quality	Performance against criteria and thresholds for protection of human health and the environment	Closure activities will alter concentrations of indicator compounds, including: ■ use of vehicles and equipment that combust fuel and emit indicator compounds; ■ material handling, for grouting and demolition; ■ vehicles travelling on roads; ■ operation of batch mixing plant or similar equipment for grout production.	Closure Phase	■ Stage 1: Preparation for in situ disposal ■ Stage 2: Grouting of below-grade structures and systems ■ Stage 3: Removal of above-grade WR-1 structures and systems	■ Implementation of CNL's Environmental Protection Program and *Management and Monitoring of Emissions*, which includes operational control monitoring, air verification monitoring and environmental monitoring. ■ Implementation of dust management techniques to control dust generated by the Project, consistent with the Environmental Assessment Follow-up Program for the WL site. ■ Use of contamination immobilization agents, containment, ventilation and HEPA filters to control generation of airborne emissions during decontamination or removal of contaminated systems or structures. ■ Use of dust suppression methods during building demolition or soil remediation activities to control airborne emissions and nuisance dust during building demolition or soil remediation. Methods may include: ▪ wetting techniques during demolition to limit mobility of dust; ▪ wind restrictions during demolition to stop work or apply wetting techniques; and ▪ hydro seeding during backfilling and landscaping to reduce soil erosion. ■ Road watering and chemical dust suppressant when necessary. Dust suppressant is already used annually at the site for select unpaved roads. ■ Removal of accumulations of particulates (e.g., dirt) on road as soon as possible. ■ On-site vehicles and equipment engines will meet Tier 3 emission standards, where possible, and be maintained in good working order. ■ Limit idling of vehicles on-site and speed on roads. ■ Use of tarps or 3-sided enclosures for raw material storage.	Not Significant

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6.2.2 Greenhouse Gases

6.2.2.1 Scope of the Assessment

Greenhouse gases have the potential to affect future climate as they contribute to the greenhouse effect by absorbing infrared radiation in the atmosphere, increasing temperature and changing weather patterns. The GHG assessment follows the overall environmental assessment approach and methods described in Section 6.1. The assessment is completed in the following primary steps.

- **Step 1 – Identify Valued Components (VCs) and define the spatial boundaries, temporal boundaries and assessment cases** (refer to Sections 6.2.2.3 Valued Components and Section 6.2.2.4 Assessment Boundaries) for the GHG assessment. The VCs, assessment endpoints and measurement indicators used to assess Project related changes to GHG, the spatial and temporal boundaries at which the assessment occurred, and, the assessment cases considered are described.
- **Step 2 – Describe the existing conditions** (refer to Section 6.2.2.5 Description of the Environment). Existing conditions in the local and regional areas are described, including the combined effects of previous and existing developments (Base Case). The existing environment represents the historical and current environmental pressures that have shaped the observed patterns in the environment (i.e., natural variation).
- **Step 3 – Evaluate Project interactions and mitigation** (refer to Section 6.2.2.6 Project Interactions and Mitigation). Project components and/or activities with the potential to release GHG are identified and mitigation options are presented to limit or avoid these effects. A pathways analysis is then used to focus on key interactions between the Project and the environment and determine if mitigation can limit or eliminate the predicted residual effects. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. Where effects are adequately mitigated and are not forwarded for further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are described. Primary pathways were not identified for climate change; therefore, no residual effects are carried forward for further analysis and characterization.
- **Step 4 – Present the methods and results of the residual effects analysis**. This step was not required as no primary pathways were identified in the GHG assessment.
- **Step 5 – Describe the level of certainty and management of uncertainty** (refer to Section 6.2.2.7). The purpose of this section is to evaluate the available literature and data used for the assessment and describe the level of certainty that can be placed on estimated emissions. This section will also identify how the uncertainty has been managed.
- **Step 6 – Classify and determine the significance of the predicted residual effects.** This step was not required as no residual adverse effects were identified in the GHG assessment.
- **Step 7 – Identify monitoring and follow-up** (refer to Section 6.2.2.8 Monitoring and Follow-up) required to confirm effects predictions and address uncertainty.
- **Step 8 – Present a consolidated summary of conclusions and outcomes of the assessment** (refer to Section 6.2.2.9 Conclusions) for GHG.

6.2.2.2 Indigenous Engagement Feedback – Key Interests and Concerns

While interest in how CNL manages GHG has been evident during engagement, no specific concerns regarding GHG emissions specific to the Project have been identified. Other general concerns and questions raised during Indigenous engagement activities are documented in Section 4 Indigenous Engagement.

6.2.2.3 Valued Components

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). Climate change was selected as a VC for the GHG assessment as there is a potential for the Project activities to release GHG emissions that could contribute incrementally to climate change (Table 6.2.2-1). The mechanism by which the Project has the potential to contribute to global climate change is by the addition of GHG emissions. Greenhouse gases refer to a group of gases that build up in the atmosphere and have the potential to contribute incrementally to climate change.

Table 6.2.2-1: Valued Components for Greenhouse Gas Assessment

Valued Component	Rationale for Selection
Climate Change	This valued component, assessed through incremental changes in emissions of greenhouse gases, considers the potential of the Project to contribute to climate change.

Assessment endpoints are qualitative expressions used to assess the significance of residual effects on VCs and represent the key properties of the VC that should be protected for future generations. The assessment endpoint for climate change is comparison to provincial and national totals. Measurement indicators represent properties of the environment and VCs that, when changed, could result in or contribute to an effect on an assessment endpoint. Measurement indicators also provide the primary factors for discussing the uncertainty of effects on VCs and, subsequently, are the key variables for study in follow-up and monitoring programs. The measurement indicators considered in the climate change assessment include changes in concentrations of the following GHG emissions:

- carbon dioxide (CO_2);
- methane (CH_4); and
- nitrous oxide (N_2O).

There are no Project activities that are expected to emit sulphur hexafluoride (SF_6), perfluorocarbons (PFCs) or hydrofluorocarbons (HFCs); therefore, these compounds are not included in the GHG assessment. Greenhouse gas emissions are expressed as tonnes of equivalent CO_2 (CO_2e), calculated by multiplying the annual emissions of each indicator compound by its 100-year global warming potential. A single measure is used when evaluating effects, namely the maximum annual GHG emissions resulting from the Project activities in tonnes of CO_2e. The assessment endpoints and measurement indicators used in the climate change assessment are listed in Table 6.2.2-2.

Table 6.2.2-2: Assessment Endpoints and Measurement Indicators for the Greenhouse Gas Assessment

Valued Component	Assessment Endpoints	Measurement Indicators
Climate Change	Comparison of greenhouse gas emissions to provincial and national totals	Changes in greenhouse gas emissions (CO_2, CH_4 and N_2O) compared to provincial and national totals

CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide.

6.2.2.4 Assessment Boundaries

6.2.2.4.1 Spatial Boundaries

The spatial boundaries for the GHG assessment are considered to be beyond regional as the predicted residual adverse effect of GHG emissions is considered global in nature.

6.2.2.4.2 Temporal Boundaries

Temporal boundaries (i.e., project phases) establish the timeframe during which Project effects are assessed. The temporal boundaries for the GHG assessment are the same as those defined for the air quality assessment (see Section 6.2.1.3.2 Temporal Boundaries).

6.2.2.4.3 Assessment Cases

The assessment cases are defined in the air quality assessment (Section 6.2.1.3.3 Assessment Cases). The GHG assessment includes evaluation of the Base Case and Application Case.

6.2.2.5 Description of the Environment

6.2.2.5.1 Methods

This section documents the methods, data and results that were used to assess the GHG emissions in the LSA and RSA.

Applicable Criteria

The relevant GHG emissions criteria include the provincial and federal emission levels. These emission levels are calculated using the assessment frameworks summarized below, followed by the baseline GHG emissions levels considered for the Base Case.

Technical Guidance on Reporting Greenhouse Gas Emissions, Environment and Climate Change Canada (November 2015)

The *Technical Guidance on Reporting Greenhouse Gas Emissions* (November 2015; the GHG Reporting Program [GHGRP] Guideline) provides direction in identifying if facilities are required to submit a GHG report to ECCC under the GHGRP, an overview of the reporting process, as well as technical information related to GHG emissions estimations, including identifying GHG emission sources subject to reporting. The GHGRP Guideline references GHG estimation methodologies from the United Nations Framework Convention on Climate Change and was developed by the Intergovernmental Panel on Climate Change. The GHGRP Guideline states that “no specific estimation methods are prescribed” and that facilities should choose estimation methods that are most appropriate for their particular industry but are consistent with the guidelines adopted by the United Nations

Framework Convention on Climate Change for preparing GHG inventories. The reporting threshold for the GHGRP is 50,000 tonnes of CO_2e.

There is no GHG regulatory program specific to Manitoba currently in place; however, Manitoba is in the process of developing a regulation for mandatory reporting of GHG emissions (IISD 2015). While the regulation is under development, Manitoba continues to rely on the federal GHGRP to collect GHG data for the large emitters and other GHG sources Manitoba covered through the National Inventory Report for Canada (Environment Canada 2014).

Baseline GHG Emissions Data

Existing GHG emissions are not measured; however, they are routinely estimated. For the purposes of this GHG assessment, federal and provincial reported GHG data is used to describe the GHG emissions.

6.2.2.5.2 Results

In 2015, Canada represented less than 2% of total global GHG emissions (ECCC 2019a). Therefore, any GHG emissions from the Project may be considered negligible on a global scale. The latest available federal and provincial facility reported GHG data were used to describe the background GHG emissions. The latest available federal and provincial data are from the 2017 reporting year (ECCC 2019b). The WL main campus was not required to report GHG emissions in 2014 under the Federal GHGRP; however, these numbers are reported within the CNL Annual Safety Review Report. Total federal and provincial GHG emissions are provided in Table 6.2.2-3.

Table 6.2.2-3: Baseline Greenhouse Gas Emissions

Source	GHG Emissions[(a)] (tonnes CO_2e)
Canada-wide 2017 GHG Emissions	716,000,000
Manitoba-wide 2017 GHG Emissions	22,000,000

GHG = greenhouse gases; CO_2e = carbon dioxide equivalent.

a) GHG emissions obtained from ECCC National Inventory Report 1990-2017: Greenhouse Gas Sources and Sinks in Canada (ECCC 2019b).

6.2.2.6 Project Interactions and Mitigation

6.2.2.6.1 Methods

This section describes the process by which interactions between Project components and activities and GHG were identified and evaluated. Potential effect pathways are identified, and mitigation developed to eliminate and/or reduce effects is presented. A pathways analysis is then used to focus the assessment on key interactions between the Project and the environment by evaluating the different effect pathways to determine if, after incorporation of mitigation, there is still potential to cause residual effects. Where effects will be adequately mitigated and are not forwarded for further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are articulated. Primary pathways that may lead to residual effects after incorporation of mitigation are further characterized in subsequent subsections of the assessment. As such this section helps to focus the remainder of the assessment on those interactions (effects pathways) likely to result in residual adverse effects.

The first part of the analysis was to identify the potential effects pathways for all stages of the Project. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. The next step in the analysis was the development of environmental design features and mitigation practices that could be incorporated into the Project to eliminate and/or reduce releases of GHG emissions. Environmental design features included design elements, best environmental practices, best available technologies, and management policies and procedures. Environmental design features and mitigation were developed through an iterative process between the engineering and environmental teams, combined with input from project-specific or regional engagement with other interested parties. The design features and/or mitigation were selected considering their effectiveness for implementation and maintenance, and their appropriateness within the context of the identified effect pathways.

After incorporation of mitigation, potential pathways were evaluated into the following categories using scientific knowledge, logic, experience with similar developments and the effectiveness of environmental design features and mitigation.

- **No linkage pathway –** pathway is removed by environmental design features or mitigation such that the Project would not be expected to result in a measurable environmental change to concentrations of GHG emissions relative to Base Case values, and therefore would have no residual effects to climate change.
- **Secondary pathway –** the pathway could result in a measurable minor change to GHG emissions, but would have a negligible residual effect on climate change relative to Base Case and/or guideline values and is not expected to contribute cumulatively to other Project effects or to the effects of other past, present or reasonably foreseeable developments to cause a significant effect.
- **Primary pathway –** the pathway is likely to result in an environmental change to GHG emissions relative to the Base Case and/or guideline values that could contribute to residual effects to climate change.

Environmental design features and mitigation that have been or could be incorporated into the Project to eliminate and/or reduce adverse effects to climate change were considered. Potential pathways that were completely removed due to implementation of environmental design or mitigation were not assessed further. Pathways that were assessed to be secondary and demonstrated to have a negligible residual effect to climate change through simple qualitative or semi-quantitative evaluation of the pathway were also not advanced for further assessment.

Primary pathways are carried forward for more detailed quantitative and/or qualitative effects analysis to characterize the residual effects of the Project on climate change.

6.2.2.6.2 Results

Pathways through which all components of the Project may interact with and result in releases of GHG emissions are provided in Table 6.2.2-4. The GHG emissions were estimated by considering the mitigation considered to be integral to the design and implementation of the Project activities. These mitigations, which are typical and consistent with best practices are presented in Table 6.2.2-4.

Table 6.2.2-4: Pathways Analysis for Greenhouse Gas Emissions

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
Closure Phase ■ Stage 1: Preparation for in situ disposal ■ Stage 2: Grouting of below-grade structures and systems ■ Stage 3: Removal of above-grade WR-1 structures and systems	Vehicles and equipment used for closure activities combust fuel and emit GHGs.	■ Implementation of CNL's *Environmental Protection Program* and *Standard for Management and Monitoring of Emissions*, which includes operational control monitoring and environmental monitoring. ■ On-site vehicles and equipment engines will be maintained in good working order. ■ Limit idling of vehicles on-site.	Secondary

GHGs = greenhouse gasses.

6.2.2.6.2.1 No Linkage Pathways

There are no pathways identified as having no linkages to effects on climate change.

6.2.2.6.2.2 Secondary Pathways

In some cases, a Project interaction exists, but mitigation is expected to cause minor changes to the environment relative to the existing Base Case and/or guidelines. The following pathway is expected to result in a negligible release of GHG emissions and will not be evaluated further in the EIS.

- **Vehicles and equipment used for closure activities combust fuel and emit GHGs.**

The assessment of effects of releases of GHG from the Project on climate change involves two steps, namely the calculation of emission rates (which include the implementation of mitigation) and comparison to provincial and federal emissions. Details of the specific GHG emission source identification, calculation methods and sample calculations are provided in Appendix 6.2-2; a summary is provided below.

Identification of emission sources was completed by defining a reporting inventory boundary, which frames the GHG emission sources that are included in the assessment for the Project. The reporting inventory boundary is based on the GHGRP; and therefore, all stationary fuel combustion emissions and on-site mobile emissions have been included in the GHG assessment. The source categories included in the GHG assessment are:

- on-site stationary fuel combustion sources (including eight months of propane heating the WR-1 Building once it is disconnected from the grid);
- on-site stationary fuel combustion for generators; and

- on-site mobile fuel combustion sources.

All activities that potentially produce GHG emissions were evaluated to assess their relevance; however, only activities that emit GHGs were included in the assessment. Table 6.2.2-5ists the activities that were not considered to be relevant (e.g., not included in the assessment) and the accompanying rationale.

Table 6.2.2-5: Emissions Not Included in the Greenhouse Gas Emissions Assessment

Activity/Compound	Rationale for Excluding from the GHG Assessment
Emissions from electricity consumption	Emissions from the electricity consumption from the Project are excluded from the greenhouse gas (GHG) assessment. This is consistent with the Greenhouse Gas Reporting Program (GHGRP) as only direct GHG emissions from sources operating at the facility are reported. Emissions from electricity consumption are considered as indirect emissions.
Emissions from transportation that occurred outside the Whiteshell Laboratories (WL) Site boundary	The transportation emissions to and from the site are excluded and should not be reported in accordance to the GHGRP. Only emissions from machinery used for the on-site transportation of materials or products used in the Project activities are included in the GHG assessment.
Snow removal equipment	Emissions from this equipment occur seasonally and are infrequent (i.e., only during the winter following a snowfall), and therefore, are not included in the representative scenario.
Upstream GHG emissions	A March 19, 2016 Notice in the Canada Gazette presented ECCC's proposed method for estimating the upstream GHG emissions associated with projects undergoing federal environmental assessments. Upstream GHG emissions are those resulting from all industrial activities from the point of resource extraction to the Project. The specific processes will vary by resource but generally include extraction, processing, handling and transportation. The final block volume of 15,000m^3 of grout is not planned to enable new soil or clay extraction or cement production facilities. Rather, the Project will be a customer for existing soil or clay supply and cement facilities and is unlikely to affect the Provincial supply and demand for these materials. Therefore, these indirect and upstream emissions have been excluded from the assessment. However, an upstream GHG assessment has been conducted and the resulting GHG emissions estimates are considerably lower than the ECCC's Strategic Assessment of Climate Change (ECCC 2020) threshold for requiring an upstream GHG assessment, therefore, the upstream GHG assessment (Golder 2020b) has not been included in this report but is available as a standalone document.
Land Clearing (Carbon Sinks)	There is no land clearing associated with the Project and therefore no negative impact on carbon sinks. During the Final Site Restoration stage, the reclaimed WL site will have a vegetative grass cover producing an overall positive impact on carbon sinks for the Project. The area of the reclaimed land will not result in a significant change in GHG emissions, and therefore, an assessment has not been conducted
Emissions from Accidents or Malfunctions	There are no potentially large sources of GHG emissions from accidents or malfunctions associated with the Project, and therefore, are not included in the assessment.
Emissions Intensity	There are no products manufactured as part of the Project to estimate an emissions intensity, and therefore, an intensity estimate is not included in the assessment.
Net-Zero Plan	A Net-Zero Plan is not required as the Project is not planning to operate beyond 2050.

The emission estimation methods follow the following guidance:

- ECCC's Technical Guidance on Reporting GHG Emissions (ECCC 2019a);
- Part 2 of ECCC's National Inventory Report 1990-2013[2] (Environment Canada 2015); and
- ON.20 (General Stationary Combustion) of the Ontario Guideline for Greenhouse Gas Emissions Reporting (MOECC 2015).

Table 6.2.2-6 summarizes the annual emission rates in tonnes per year for each activity at the Project. The global warming potential used to calculate GHG emissions in CO_2e correspond to ECCC's global warming potential (Environment Canada 2015).

Table 6.2.2-6: Summary of Annual Greenhouse Gas Emissions

Source	Annual GHG Emissions (tonnes CO_2e/year)			Annual GHG Emissions (tonnes CO_2e/year)
	CO_2	CH_4	N_2O	CO_2e
Mobile Equipment (Road and Non-Road)	11,886	17	693	12,595
Propane Combustion (including heating)	1,629	0.65	0.77	1,630
Emergency Power Generators	3	0.004	0.13	3
Total	13,517	17	694	**14,228**

Table 6.2.2-7 summarizes the annual overall emissions in tonnes of CO_2e for the Application Case. Project GHG emissions represent less than 0.01% of the Canada-wide total and less than 0.1% of the provincial total.

Table 6.2.2-7: Comparison of Greenhouse Gas Emissions from the Project to Manitoba and Canadian Emission Totals

Source	Annual GHG Emissions (tonnes CO_2e)
Project Emissions	14,228
Canada-wide GHG Emissions	716,000,000
Manitoba-wide GHG Emissions	22,000,000
Comparison of Project to Canada-wide GHG Emissions	<0.01%
Comparison of Project to Manitoba-wide GHG Emissions	<0.1%

Based on the comparison between the estimated annual emission to both the federal and provincial greenhouse gas emissions, the Project will result in minor releases of GHG emissions but is predicted to have a negligible residual effect on climate change and will not impact Canada's emissions reduction efforts.

[2] The ECCC National Inventory Report (1990-2013) was used as it presents a higher emission factor for N_2O from off-road diesel combustion.

6.2.2.6.2.3 Primary Pathways

No primary pathways are identified for the GHG assessment. Subsequently, there is no further residual effects classification and determination of significance.

6.2.2.7 Prediction Confidence and Uncertainty

The potential sources of uncertainty in the assessment of climate change are the accuracy and representativeness of the activity data and emission factors used to estimate GHG emissions.

- Combustion emissions from the propane-fired boiler based on an assumed maximum equipment firing rate and an assumed operating schedule.
- Combustion emissions from the WR-1 building heating using propane based on as assumed 8 month per year operating schedule. At the time of the assessment, it is unknown when the electric building heating systems will be taken offline for the WR-1 Building and replacement heating using propane has not been confirmed.
- Combustion emissions from diesel-fired emergency power generators based on assumed rating capacities, number of units, and operating schedule.
- Combustion emissions from diesel fueled mobile equipment (trucks, loaders, excavators etc.) based on assumed rating capacities, number of units, and operating schedules.

Uncertainty in the emissions estimates was reduced through continued discussion with knowledgeable personnel, comparison to similar projects, and using current (at the time of the assessment) emission factors.

6.2.2.8 Monitoring and Follow-up

CNL will implement an Environmental Assessment Follow-up Program for the Project to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. This monitoring will be integrated with that for the existing Environmental Assessment Follow-up Program for the WL site, where practical. The GHG monitoring activities will be incorporated into the Environmental Assessment Follow-up Program for the Project. Implementation of CNL's *Management and Monitoring of Emissions* (CNL 2018), which includes operational control monitoring, emissions verification monitoring and environmental monitoring, will continue for the Project (Table 6.2.2-8) .

In addition, air quality monitoring activities for the Project will be implemented as outlined in Section 6.2.1.9. It is noted that data generated by the monitoring program will be evaluated on an ongoing basis within an adaptive management framework. Within this framework, modifications to the program may be appropriate to confirm data continue to fulfill program objectives. For example, should a contaminant of potential concern reach concentrations outside the range predicted in the EIS, the frequency of sampling may be increased, and additional locations may be sampled to investigate the source of the increased concentrations. Conversely, cessation of a monitoring activity might be appropriate once it has been shown that an effect has stabilized, or has been reduced to a level where it is no longer considered significant with respect to regulatory requirements or community concerns. Any proposals for modifications to the monitoring program and the rationale for the modifications will be communicated to the CNSC prior to implementation. Additional information on the Environmental Assessment Follow-up Program for the Project can be found in Section 11.0 Summary of Monitoring and Follow-up Programs.

Table 6.2.2-8: Monitoring and Follow-up Programs for Greenhouse Gas Emissions

Valued Component	Project Phase, Potential Effect and Conceptual Monitoring Program	Monitoring Program Objective	Suggested Duration	Implementing Program
Greenhouse Gases	**Potential Source(s) of Effects:** ■ Closure activities will result in increased greenhouse gas emissions. **Proposed Monitoring:** ■ Fuel Usage – a record will be kept of the fuel usage related to the Project. **Trigger for Further Action:** ■ Investigation if parameters above applicable guidelines, thresholds or limits, or if actual number of vehicles/kilometres travelled exceeds the prediction on which emission estimates were based.	Verify that GHG emission rates used in the assessment are reasonable, but conservative. Monitoring results will be used for GHG reporting requirements.	Annual estimations and GHG reporting, as required during the closure phase.	Monitoring of GHG emissions is already completed as part of CNL's WL Effluent Verification and WL Environmental Monitoring Programs. No new monitoring is required for Project-specific GHG emissions.

6.2.2.9 Conclusions

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). Climate change was selected as a VC as there is a potential for the Project activities to release GHG emissions that could contribute incrementally to climate change. The measurement indicator for the assessment includes changes in emissions of CO_2e and comparison to provincial and national GHG totals.

Project activities will result in GHG emissions associated with the operation of vehicles and equipment during the closure phase, the GHG emissions are estimated to be less than 0.1% increase in total provincial GHG emissions and less than 0.01% increase in total national GHG emissions. Based on the comparison between the estimated annual emission to both the federal and provincial GHG emissions, the Project will result in minor releases of GHG emissions but is predicted to have a negligible residual effect on climate change and will not impact Canada's emissions reduction efforts.

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6.3 Geological and Hydrogeological Environment

6.3.1 Geology

This section of the Environmental Impact Statement (EIS) examines the potential residual effects of the Project on the geological environment (Section 6.3.1 Geology) and hydrogeological environment (Section 6.3.2 Hydrogeology).

6.3.1.1 Scope of the Assessment

This section focuses on geology, which includes bedrock, soils and geomorphology. The geology assessment follows the overall approach and methods described in Section 6.1 Environmental Assessment Approach. The assessment was completed in the following steps.

- **Step 1 – Identify Valued Components (VCs) and define the spatial boundaries, temporal boundaries and assessment cases** (refer to Section 6.3.1.3 Valued Components and Section 6.3.1.4 Assessment Boundaries) for the geology assessment. The VCs and measurement indicators used to assess Project-related changes to geology, the spatial and temporal boundaries at which the assessment occurred, and the assessment cases considered are described.
- **Step 2 – Describe the existing conditions** (refer to Section 6.3.1.5 Description of the Environment). Existing conditions in the local and regional areas are described, including the combined effects of previous and existing developments (Base Case). The existing environment represents the historical and current environmental pressures that have shaped the observed patterns in the environment (i.e., natural variation).
- **Step 3 – Evaluate Project interactions and mitigation** (refer to Section 6.3.1.6 Project Interactions and Mitigation). Project components and/or activities with the potential to affect geology are identified and mitigation options are presented to limit or avoid these effects. A pathways analysis is then used to focus on key interactions between the Project and the environment and determine if mitigation can limit or eliminate the predicted residual effects. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. Where effects are adequately mitigated and are not forwarded for further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are described.
- **Step 4 – Present the methods and results of the residual effects analysis**. This step was not required as no primary pathways were identified in the geology assessment.
- **Step 5 – Describe the level of certainty and management of uncertainty.** This step was not required as no primary pathways were identified in the geology assessment.
- **Step 6 – Classify and determine the significance of the predicted residual effects.** This step was not required as the geology VC is an intermediate component, which does not include an assessment endpoint to determine significance.
- **Step 7 – Identifying monitoring and follow-up** (refer to Section 6.3.1.7 Monitoring and Follow-up) required to confirm effects predictions and address uncertainty.
- **Step 8 – Present a consolidated summary of conclusions and outcomes of the assessment** (refer to Section 6.3.1.8 Conclusions) for geology.

6.3.1.2 Indigenous Engagement Feedback – Key Interests and Concerns

Interests and concerns raised by Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations during engagement related to the geological environment assessment are summarized in Table 6.3.1-1. Other general concerns and questions raised during Indigenous engagement are documented in Section 4 Indigenous Engagement.

Table 6.3.1-1: Summary of Key Interests and Concerns Raised During Indigenous Engagement Activities Related to the Geological Environment Assessment

Interest and Concern	Inclusion Status	Additional information and Rationale
How releases could be contained in the soil	Already included in the environmental assessment	Changes to soil quality from groundwater during the post-closure phase are assessed in Section 6.3.1.6.2 Results.
Spills of contaminants to soil	Already included in the environmental assessment	Accidental releases of liquid contaminants and potential to contaminate soil is discussed in Section 7.3.2 Spills and Leaks

6.3.1.3 Valued Components

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous people, or the public (The Agency 2018). Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations did not identify any additional valued components as it relates to the geological assessment. Geology, which includes bedrock, soils and geomorphology, is recognized as an important component of the environment that may be affected by the Project and changes to geology could, in turn, lead to effects on other VCs selected for assessment. For example, changes to the characteristics of geology, such as soil quality and quantity, have a large influence on the local and regional diversity, contributing to the abundance and distribution of plants and animals on the landscape. Changes to these characteristics by Project activities could affect terrestrial and aquatic ecosystem structure and function (Table 6.3.1-2).

Table 6.3.1-2: Valued Components for Geology Assessment

Valued Component	Rationale for Selection
Geology	Characteristics of geology, such as soil quality and quantity, bedrock and geomorphology, are important components that interact with other valued components (e.g., hydrogeology, hydrology and surface water quality) and if changed by Project activities could affect terrestrial and aquatic biodiversity.

Acknowledging that changes to geology are considered to be important aspects of the natural and human environment, geology is referred to as an intermediate component (i.e., it does not have an assessment endpoint). Changes to intermediate component VCs must be understood to facilitate assessment of Project interactions. The geology assessment, therefore, is analyzed for incremental and cumulative (if applicable) changes in the relevant measurement indicators associated with geology (Table 6.3.1-3). The assessment of geology focused on predicting changes in the concentrations of selected non-radiological compounds; radiological parameters are considered in Section 6.7 Human and Ecological Health. The changes are characterized in terms of magnitude, duration and geographic extent, but are not classified using rankings for effects criteria. The geology assessment also does not include the assessment of the significance of these changes; rather, results of the analysis of changes in measurement indicators for geology are provided to other disciplines for inclusion in their assessment (Table 6.3.1-3).

Table 6.3.1-3: Measurement Indicators for the Geology Assessment

Valued Component	Measurement Indicators	Discipline Assessments where Effects on Geology are Considered
Geology	■ Bedrock ■ Soil quality ■ Soil quantity ■ Geomorphology	■ Section 6.4.2 Surface Water Quality ■ Section 6.5 Aquatic Environment ■ Section 6.6 Terrestrial Environment ■ Section 6.8 Land and Resource Use

6.3.1.4 Assessment Boundaries

6.3.1.4.1 Spatial Boundaries

The spatial boundaries selected for the geology assessment are presented on Figure 6.3.1-1 and described below.

- **Site Study Area (SSA)** is the Whiteshell Reactor 1 (WR-1) Building and represents the Project footprint (i.e., where Project activities will be undertaken; 0.07 ha).
- **Local Study Area (LSA)** is defined as the area within which there is potential for measurable changes resulting from the proposed Project activities. The LSA is delineated by the boundaries of the groundwater model for the Project, which were selected based on groundwater elevation data and topography. The western boundary of the LSA is approximately 800 m west of the WR-1 Building and coincides with the inferred groundwater flow divide at the centre of the Winnipeg River. The northern boundary of the LSA is approximately 450 m north of the WR-1 Building and is parallel to the inferred direction of groundwater flow; the location of this boundary was selected as it follows a topographic divide and is south of the Lagoon Area. The southern boundary of the LSA is approximately 1,400 m south of the WR-1 Building and is parallel to the inferred direction of groundwater flow; the location of this boundary was selected as it coincides with a topographic divide and an inferred divide in groundwater flow. The eastern boundary of the LSA is located approximately 700 m east of the WR-1 Building and approximately 500 m east of the Whiteshell Laboratories (WL) main campus; this boundary is perpendicular to the inferred direction of groundwater flow and upgradient of the WR-1 Building (approximately 260 ha).
- **Regional Study Area (RSA)** is defined as the area within which the potential effects of the Project may interact with the effects of other existing or reasonably foreseeable projects. The RSA is delineated by the WL site boundary (approximately 4,375 ha; Figure 6.3.1-1).

6.3.1.4.2 Temporal Boundaries

The temporal boundary of the assessment is the timeframe during which Project activities are occurring and the duration of predicted residual effects. The duration of an effect is defined as the amount of time between the start and end of a Project activity or stressor (which is related to the Project phases) plus the time required for the residual effect to be reversed. In some cases, a residual effect may be irreversible within the temporal boundaries of the Project if the effects were predicted to last so far into the future that they could not be predicted with any level of certainty (e.g., residual effect lasts for thousands of years). The following phases were identified for the Project.

- **Closure Phase:** Preparation and implementation of in situ disposal (ISD), which includes preparation for ISD, grouting of below-grade structures and systems, removal of above-grade WR-1 structures and systems, installation of the concrete cap and engineered cover, and environmental controls and final site restoration. These activities last from 2022 to 2027.

  Post-closure Phase: The post-closure phase has two discrete periods: institutional control and post-institutional control. Institutional control is estimated to last 100 years during which long-term monitoring and maintenance activities will continue to demonstrate Whiteshell Reactor Disposal Facility (WRDF) performance is in compliance with the safety case assumptions and performance modelling. The 100-year timeframe is not related to the design life of the WRDF barriers. The 100-year active monitoring period was selected to ensure that sufficient opportunity is provided to verify the WRDF is performing as expected. Additionally, beyond 100 years, there is less confidence that institutional controls, like access restrictions, can be relied upon. Although the duration of institutional control is estimated at 100 years, it is recognized that it will continue until the CNSC, or the appropriate authority at the time, agrees it is no longer needed.

  Post-institutional control occurs after year 2127 and continues indefinitely. The post-closure phase will continue indefinitely; however, the timeframe defined for assessment of potential effects as part of the normal evolution of the Project is 10,000 years. This time period encompasses the phase in which peak effects are anticipated.

LEGEND

- WR-1 BUILDING (SITE STUDY AREA)
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- WASTE MANAGEMENT AREA
- WHITESHELL LABORATORIES MAIN CAMPUS
- LANDFILL

BASE FEATURES

- CITY/TOWN
- TRANSMISSION LINE

0 1,000 2,000

1:40,000 METRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY PROVIDED BY CNL (2016-11-22)
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT
CANADIAN NUCLEAR LABORATORIES

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
SPATIAL BOUNDARIES FOR THE GEOLOGY ASSESSMENT

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0009	2	**6.3.1-1**

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Path: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0009_EIS_Sec_6.3_1\20145046-0009-G-0001_Figure 6_3_1-1 Spatial Boundaries for the Geology Assessment.mxd

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6.3.1.4.3 Assessment Cases

The geology assessment has three assessment cases.

- **Base Case:** represents existing conditions and characterizes combined effects from previous and existing developments and activities. The Base Case reflects the effects of existing disturbances, such as forestry, transportation, agricultural and residential and recreational development. Current effects from the existing facilities and operations at the WL site, for example, are considered part of the Base Case. In addition, existing conditions of areas not affected by the WL site are also considered as part of the Base Case. Effects from the decommissioning and reclamation activities already completed at the WL site are also considered as part of the Base Case.
- **Application Case**: represents predictions of the effects of the Base Case combined with the effects that may result from the Project. The Application Case considers potential effects from the Project during closure and throughout the post-closure phase.
- **Reasonably Foreseeable Development (RFD) Case**: represents the predictions of the cumulative effects of the Application Case, plus projects that are currently under application review or that have officially entered a regulatory application process and which overlap with the geology RSA. There are no RFDs expected in the RSA other than the continued decommissioning of the remaining facilities at the WL site, as described in the Comprehensive Study Report (AECL 2001). The Comprehensive Study Report indicated that existing effects on soils are limited to contaminated soils within affected lands on the WL site (see Section 6.3.4 of AECL 2001). Affected lands and associated contaminated soils will be remediated during the WL site decommissioning. As such, decommissioning of these structures is anticipated to positively affect geology. The end-state plan for the WL site is to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-state. Because RFDs are likely to positively affect the geology, an RFD Case is not presented as part of this assessment (Table 6.3.1-4).

Table 6.3.1-4: Reasonably Foreseeable Developments considered in the Geology Assessment

Type of Project	Location	Description	Timeframe	Overlap with Valued Components
Infrastructure Decommissioning	WL	Decommissioning of remaining infrastructure on the WL site (includes in situ disposal of the low-level waste trenches).	2016 to 2027	Yes – however, effects are considered to be positive and therefore, are not assessed
Environmental Remediation	WL	Remediation of affected lands, with the exception of the low-level waste trenches.	2016 to 2027	Yes – however, effects are considered to be positive and therefore, are not assessed

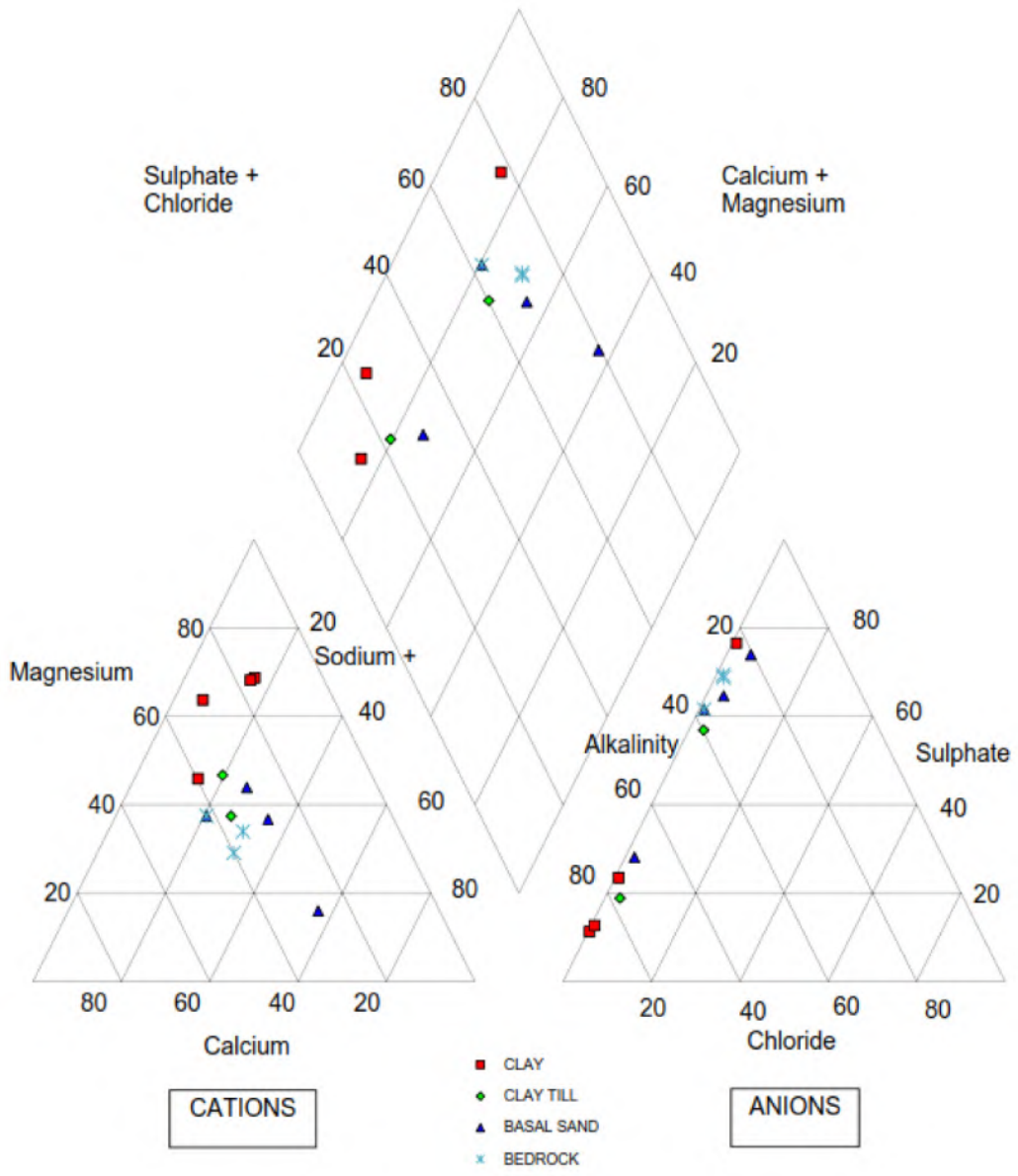
6.3.1.5 Description of the Environment

6.3.1.5.1 Methods

Baseline geology data were collected from the results of recent drilling and core logging at the WL main campus. Four new bedrock monitoring wells were installed in 2016 at depths ranging from 24 m to 42 m below-ground surface (10 m to 30 m below the top of the bedrock surface). Details on the drilling program, monitoring well installation and the borehole logs are described in the WR-1 Hydrogeological Study Report (Dillon 2018). The stratigraphic data collected from these boreholes were supplemented through the review of the following existing reports on the WL site:

- Geosynthesis for WR-1 Environmental Impact Statement (CNL 2022).
- Load Bearing Test on Glacial Till, Test Pile and Bench Mark Locations, Whiteshell Nuclear Research Establishment, D-901-A-1 (AECL 1961).
- Hydrogeologic Regime of the Environmental Control Area and Vicinity, Whiteshell Nuclear Research Establishment, Manitoba, Preliminary Progress Report (Cherry et al. 1970).
- Hydrogeological Studies at a Subsurface Radioactive-Waste-Management Site in West-Central Canada, (Cherry et al. 1973).
- Review of the Hydrogeology of the Radioactive Waste Management Site (Robertson and Cherry 1985).
- Whiteshell Laboratories Decommissioning Project, Comprehensive Study Report (AECL 2001).
- Hydrogeology of the Waste Management Area, Lagoon and Landfill-Enhanced Monitoring Program, WL Decommissioning (AECL 2008).
- Whiteshell Laboratories Projects Branch Comprehensive Final Report on Installation of 7 Groundwater Monitoring Wells Nests (KGS Group 2016).

Dillon (2018) provides details on recent geological and hydrogeological investigations of the LSA, which (in part) involved drilling and instrumentation of seven monitoring well nests and a single monitoring well (16-8) that encompass a total of 33 monitoring wells. The monitoring well nests are named numerically (i.e., monitoring well nest 1 through monitoring well nest 7). Each monitoring well nest includes between 4 and 6 monitoring wells. Individual monitoring wells are named using the installation year, the monitoring well nest number and a letter indicating the relative depth (with “A” assigned to the shallowest monitoring interval). In the following sections, the term monitoring well nest is used to refer to the conditions observed throughout the group of monitoring wells, while individual monitoring well names are used to refer to conditions at a specific depth interval. The monitoring well names and geological units for each monitoring well nest is summarized in Table 6.3.1-5. Monitoring well nest locations are shown on Figure 6.3.1-2.



REFERENCE(S)

1. OBTAINED FROM DILLON, 2018

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
TRI-LINEAR PLOT SHOWING GROUNDWATER COMPOSITION AT NESTED WELLS AT WR-1 (DILLON 2018)

CONSULTANT
WSP GOLDER

YYYY-MM-DD	DECEMBER 2022
DESIGNED	--
PREPARED	PR
REVIEWED	NR
APPROVED	NB

PROJECT NO.	CONTROL	REV.	FIGURE
20145046		1	**6.3.1-2**

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S:\Clients\Canadian Nuclear Laboratories\Manitoba\99 PRO\20145046\40 PROD\0009 EIS Sec 6.3.1\20145046-0009-G-0002 Figure 6 3 1-2 Well Nest Locations.mxd

Table 6.3.1-5: Monitoring Well Nest Details

Monitoring Well Nest	Monitoring Well	Hydrostratigraphic Unit
1	15-1A	Basal Sand
	15-1B	Clay Till
	15-1C	Clay
	15-1D	Clay
2	15-2A	Basal Sand
	15-2B	Clay Till
	15-2C	Clay Till
	15-2D	Clay
	16-2E	Bedrock
3	15-3A	Basal Sand
	15-3B	Clay Till
	15-3C	Clay
	15-3D	Clay
4	15-4A	Basal Sand
	15-4B	Clay Till
	15-4C	Clay Till
	15-4D	Clay
	15-4E	Clay
	16-4F	Bedrock
5	15-5A	Basal Sand
	15-5B	Clay Till
	15-5C	Clay
	15-5D	Clay
6	15-6A	Clay Till
	15-6B	Clay Till
	15-6C	Clay Till
	15-6D	Clay
7	15-7A	Clay Till
	15-7B	Clay Till
	15-7D	Clay
	16-7E	Bedrock
8	16-8A	Bedrock

General descriptions of the geological setting and hydrostratigraphic units were based on the information contained in these reports along with publicly available literature and subsequently refined based on a review of lithologic descriptions, grain size data, geological surface topography, groundwater elevation data and hydraulic conductivity data to maintain consistency in unit assignments throughout the LSA. Specific refinements are detailed in Section 2.3.4. of the Groundwater Flow and Solute Transport Modelling Report (Golder 2021a). The overall conceptual model presented in the aforementioned documents was unchanged. Borehole logs and cross sections contained in these reports were used to infer stratigraphic boundary points (i.e., contact elevations

between geological surfaces) and construct overburden and stratigraphic unit thickness maps (isopachs), and to construct a cross-section for the RSA (Figure 6.3.1-8).

6.3.1.5.2 Results

6.3.1.5.2.1 Regional Geological Conditions

The region surrounding the RSA is underlain by the Precambrian rock of the Lac du Bonnet Batholith, part of the Superior Province of the Canadian Shield. The Lac du Bonnet Batholith consists of undifferentiated and partly foliated porphyritic granite and granodiorite (Everitt et al. 1996). The batholith trends southwest to northeast. The upper 200 m of the batholith consists primarily of pink hematite-bearing granite, underlain by a grey magnetite-bearing granite (Everitt et al. 1996). The batholith covers an approximate area of 1,400 km² (Chandler 2003). At the northeastern extent of the Lac du Bonnet Batholith (approximately 20 km north of the RSA) there is a sharp contact with the metavolcanic and metasedimentary rocks of the Bird River Greenstone Belt. The southern boundary of the Lac du Bonnet Batholith (approximately 4 km south of the RSA) is a gradational transition to gneisses and migmatites of the Winnipeg River Subprovince of the Canadian Shield. Approximately 25 km west of the RSA, the batholith becomes overlain by Paleozoic sedimentary rocks of the Western Canadian Sedimentary Basin. The batholith extends westward under the Paleozoic rocks of the Williston Basin and to the east, it pinches out to the west of Savant Lake (Beakhouse 1991). Regional bedrock geology is shown on Figure 6.3.1-3.

The batholith is associated temporally and spatially with several other felsic intrusive bodies of roughly the same exposed size and age (approximately 2.65 billion years old) in the Winnipeg River Subprovince including the Betula Lake and Medika plutons to the southeast. The relatively sparsely fractured characteristics of large portions of these bodies and of the Lac du Bonnet Batholith, are attributed at least in part to their intrusion at or near the end of regional deformation, and to prolonged cooling, which delayed the onset of brittle deformation. This was in part due to the size of the intrusive bodies and their proximity to each other and to the distance separating the intrusions regionally from later tectonic events in the Superior Province at the end of the Kenoran Orogeny (Everitt et al. 1996). The batholith intruded at a depth of 10-12 km, based on a comparison of isobaric minima in the normative quartz-albite-alkali feldspar system (CNL 2022).

Faulting is known in the eastern end of the batholith, which is remote from the LSA. At site of the Underground Research Laboratory (URL) approximately 20 km from the WL site, extensive studies of the rock mass revealed the presence of shallow dipping (25° to 30°) short displacement thrust faults, which were termed fracture zones in the geologic investigations of the URL. Discolouration of the granite to deeper pink and red along with closely spaced subparallel fractures are characteristic of these zones (Brown et al. 1989).

Lineament studies were performed in the 1980s for the Lac du Bonnet Batholith, as was surface mapping of exposed outcrops (McCrank 1985; Tammemagi et al. 1980). Lineaments oriented in a northwest direction are noted to be present on the WL site; due to the amount of overburden it was not possible to discern other lineaments in the bedrock near WR-1. From rock outcrop mapping, the most common fracture set trends north-northeast (010° to 040°) and accounts for 28% of the sample population. The southeast set of fractures is oriented from 120° to 140° and accounts for 19% of the sample population. The east and south-southeast sets are less common and account for 12% and 13% of the sample population, respectively; they comprise fractures oriented from 080° to 100° and 160° to 180°, respectively.

Jointing and fracturing has been observed at various locations within the batholith and additional details are provided in the following sections pertaining to observations made in the LSA, with more detail provided in the Geosynthesis report (CNL 2022). Observations of outcrops on the Lac du Bonnet Batholith indicates that fracture intensity (based on 7517 mapped fractures, infilled or open) averaged for the entire batholith is 1.5 fractures per metre. The intensity is based on average fracture spacing and number of fractures per metre. Data on fracture spacings was not nearly as complete nor as uniformly distributed throughout the mapped areas as the fracture intensity data. Spacing values show the rock to be less intensely fractured than fracture intensity values. The average spacing value, based on limited data, is 3.5 m between fractures with a standard deviation of 3.4 m. The fracture spacing values range from 0.8 to 22.8 m.

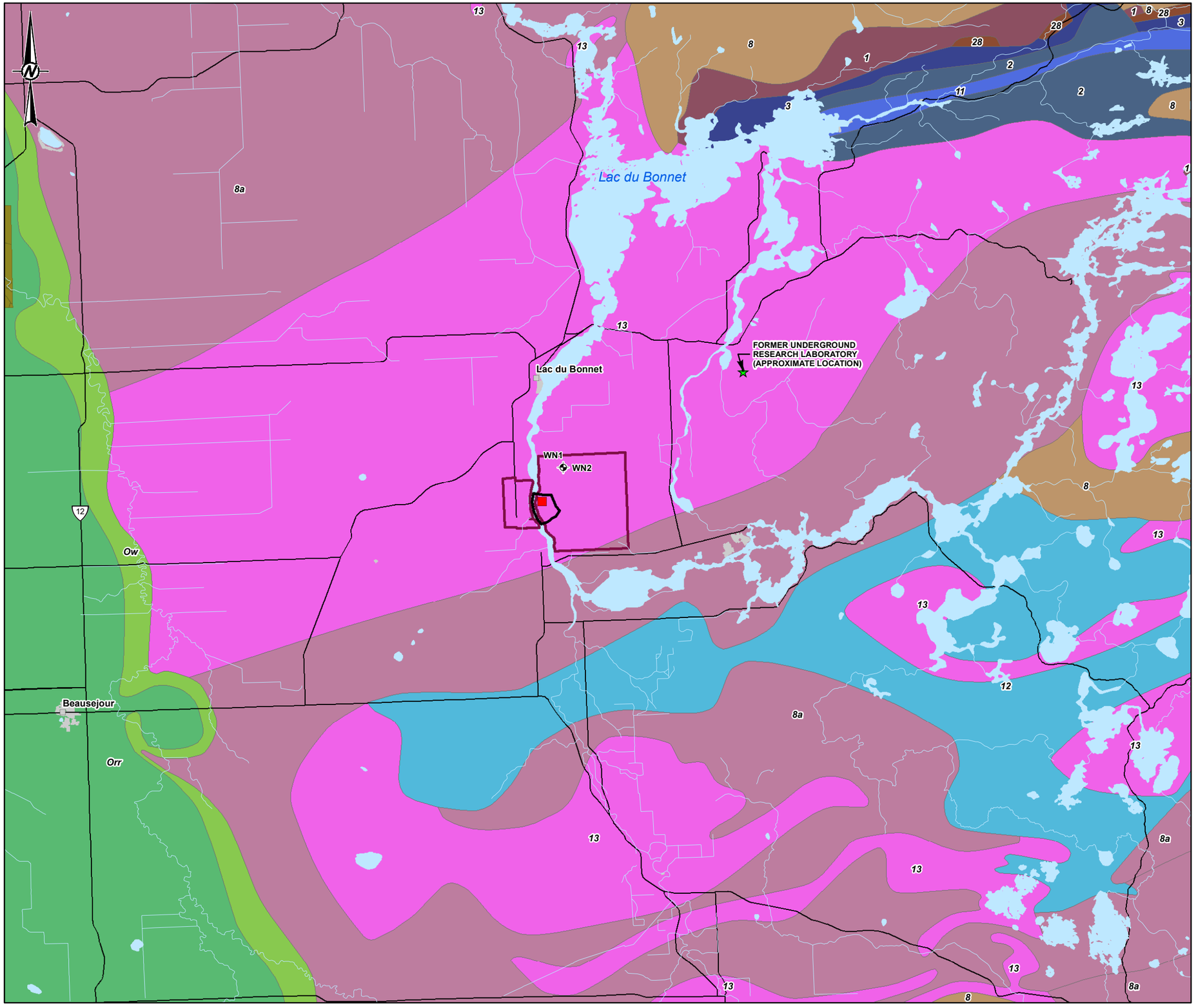
Everitt et al. (1996) noted that subvertical fractures are grouped into those striking north northeast (015° to 020°), those striking east southeast (110° to 130°) and those striking south southeast (160° to 170°). Locally significant groups strike south (180°) and northeast (035°). The first two groups show many characteristics of extension fractures, such as irregularity and lens-shaped infilling. Unequivocal right-hand strike-slip movement is visible on fractures striking south southeast; left-hand strike slip movement occurs on fractures striking northeast. These observations suggest a north northeast-trending compressive stress axis at the time of fracturing, similar to the stress field during the formation of later pegmatite dykes and quartz veins (Brown et al. 1989). In general, subvertical fractures are partially or completely filled with a combination of chlorite, iron oxides, carbonates and clay minerals.

There are no absolute dates between Early Proterozoic faults, pre-dating the epidotal alteration (2350 ± 60 million years [Ma]), and fracture infillings associated with Pleistocene (2.5 Ma to 11 thousand years before present [Ka]) glaciations, however dates from an unpublished report (Gascoyne et al. 1997) indicate dates of 404 ± 64 Ka ago and 475 ± 33 Ka ago. Illite (clay) from Fracture Zone 2 (approximately 400 m deep) at the URL gave an age of formation prior to 832 ± 1 Ma ago and an overprinted age post 510 ± 1 Ma ago.

Uranium dating of calcite contain older (but still largely Pleistocene calcite infillings) in major fracture zones, whereas near surface fractures contain mainly younger (<350 Ka) calcites. Ages commonly range from 20 Ka to 55 Ka but are more recent than 350 Ka ago. This demonstrates the long-term presence of water with elevated calcium levels slowly depositing calcium that lead to formation of calcium in pre-existing fractures.

The near surface mesoscopic fractures follow an orthogonal pattern in the upper tens of metres of the batholith implying a general extension of the ground. Many of the larger extension fractures also show evidence of normal movement, disrupting earlier low-temperature infillings such as calcite to form pathways for groundwater. The amount of water flow in these fractures will vary based of the amount of previous infilling, the degree of disruption of that infilling and local connectivity and local fracture frequency at a particular location on the batholith. As stated in Gascoyne et al (1997), all types of mesoscopic fractures studied appear to act as pathways for groundwater recharge to the main fracture zones at the URL site. It is not unreasonable to assume this is the case for fractures elsewhere within the batholith.

More geologically recent activity may relate to glacial deposition, with some glacial chatter marks having been filled by calcite, probably due to subglacial pressures (Gascoyne et al. 1997).



LEGEND

- WR-1 BUILDING (SITE STUDY AREA)
- FORMER UNDERGROUND RESEARCH LABORATORY (APPROXIMATE LOCATION)
- BOREHOLE LOCATION
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

BASE FEATURES

- CITY/TOWN

BASE FEATURES

- MAJOR ROAD
- WATERCOURSE
- WATERBODY
- MUNICIPAL BOUNDARY
- FIRST NATION RESERVE

BEDROCK GEOLOGY

- 1 MAFIC VOLCANICS
- 11 GREYWACKE, ARKOSE
- 12 GRANODIORITE, GNEISS
- 13 GRANITE
- 2 FELSIC VOLCANICS
- 28 ULTRAMAFIC INTRUSIVES
- 3 GREYWACKE
- 8 TONALITE
- 8A TONALITE GNEISS
- ORR LIMESTONE, DOLOMITE
- OW SANDSTONE

0 10 20
1:260,000 KILOMETRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY (RSA) PROVIDED BY CNL (2016-11-22)
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT
CANADIAN NUCLEAR LABORATORIES

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
BEDROCK GEOLOGY

CONSULTANT
wsp GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0009	2	**6.3.1-3**

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Path: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0009_EIS_Sec_6.3.1\20145046-0009-G-0003_Figure 6_3_1-3 Bedrock Geology.mxd

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The surficial geology in the RSA consists of glaciofluvial tills and outwash deposits and glacial lacustrine deposits associated with Glacial Lake Agassiz. Surficial deposits have been documented to be up to 25 m thick (AECL 2008). In the area surrounding the Winnipeg River, these deposits have been regionally subdivided into three main stratigraphic units (based on McPherson 1968). The units are listed from the top of bedrock, with the description used in the LSA in parenthesis, as follows:

- Glacial Till (also referred to as Basal Sand and Basal Till);
- Glacio-Lacustrine Clay (also referred to as Clay Till as the lower portion of this unit is derived from the Glacial Till); and
- Transitional Glacio-Lacustrine Clay (Clay) and Glacio-Fluvial and Glacio-Lacustrine Sandy Silt (Interbedded Silt and Clay).

Organic deposits are present at surface over much of the RSA (Figure 6.3.1-4) and range in thickness from 0.25 m to 2 m (AECL 2008). The thickness of the overburden deposits decreases to the east of the RSA where bedrock outcrops become more prevalent (near Pinawa), and glacial till is present at surface in some areas (approximately 15 km east of the eastern boundary of the LSA) (Figure 6.3.1-4). The units described above within the RSA are consistent in composition with those observed during the recent drilling program within the LSA as refined and described in the following sections; however, the thickness of these units can vary as a function of bedrock topography.

6.3.1.5.2.2 Local Geological Conditions

Local geological conditions are described generally for the RSA (based on historical information) to provide context and are described in more detail for the LSA (based on site-specific data from recent boreholes).

Bedrock Geology

Detailed information on bedrock lithology is available from the area adjacent to the Waste Management Area (WMA) and north of the WL main campus. As the bedrock lithology within the LSA is expected to be consistent with the lithology observed near the WMA, this detailed information is presented here to supplement the information from the LSA. In this area bedrock lithology has been generalized based on borehole observations at WN-1 and WN-2 (Figure 6.3.1-3). At these locations the bedrock is predominately a medium to coarse grained pink granite (typical of the upper surface of the Lac du Bonnet Batholith) to a depth of approximately 300 m, where it transitions to a pink granite to granodiorite. At both locations a zone of mixed granodiorite, granite and pegmatite with xenoliths of tonalite was noted between depths of approximately 50 m to 100 m (Lau and Bisson 1980a,b,c; Lau, Bisson and Auger 1982; Lau, Auger and Bisson 1985a,b). Borehole logs for the WN-series wells are shown on Figure 6.3.1-5.

At the WN boreholes, fracture zones were noted between 20 m and 150 m and between 395 m to 400 m. Fracture frequency for the WN-1 borehole is shown on Figure 6.3.1-5. Fractures encountered have dips, which range anywhere from subvertical to subhorizontal. All of the fractures in the interval 150 m to 375 m in WN-1 have dip angles ranging from 10° to 50°, and no subvertical fractures were intersected in this zone (Davison 1980). The decreasing number and frequency of fractures with depth is similar to what was found in investigations into the rock mass at the former AECL URL[1] (Brown et al. 1989). The similarities between the WN and URL portions of the Lac du Bonnet Batholith suggest that similar fracture patterns exist in at least the main portion of the batholith.

[1] The approximate location of the former AECL URL is shown on Figures 6.3.1-3 and 6.3.1-4. The URL has since been decommissioned.

Recent boreholes drilled in the vicinity of WR-1, extended several metres into the underlying bedrock. The core logs indicated that the shallow bedrock near WR-1 is dominated by pink to red-pink granite with mafic granolithic dykes and possibly layered xenolithic structures. Pegmatitic (larger grain size) granite was also encountered. Areas of the pink granite include altered red granite similar to more heavily altered and oxidized fractures similar to those found in fracture zones at the URL (Brown et al. 1989). This indicates some of the fractures encountered underwent hydrothermal alteration in the geologic past and have undergone extensive weathering alteration. The presence of clay infilling and drill core smoothed rock fragments from fractured rock in the cores further suggests potential water bearing fractures exist in the bedrock on the WL site.

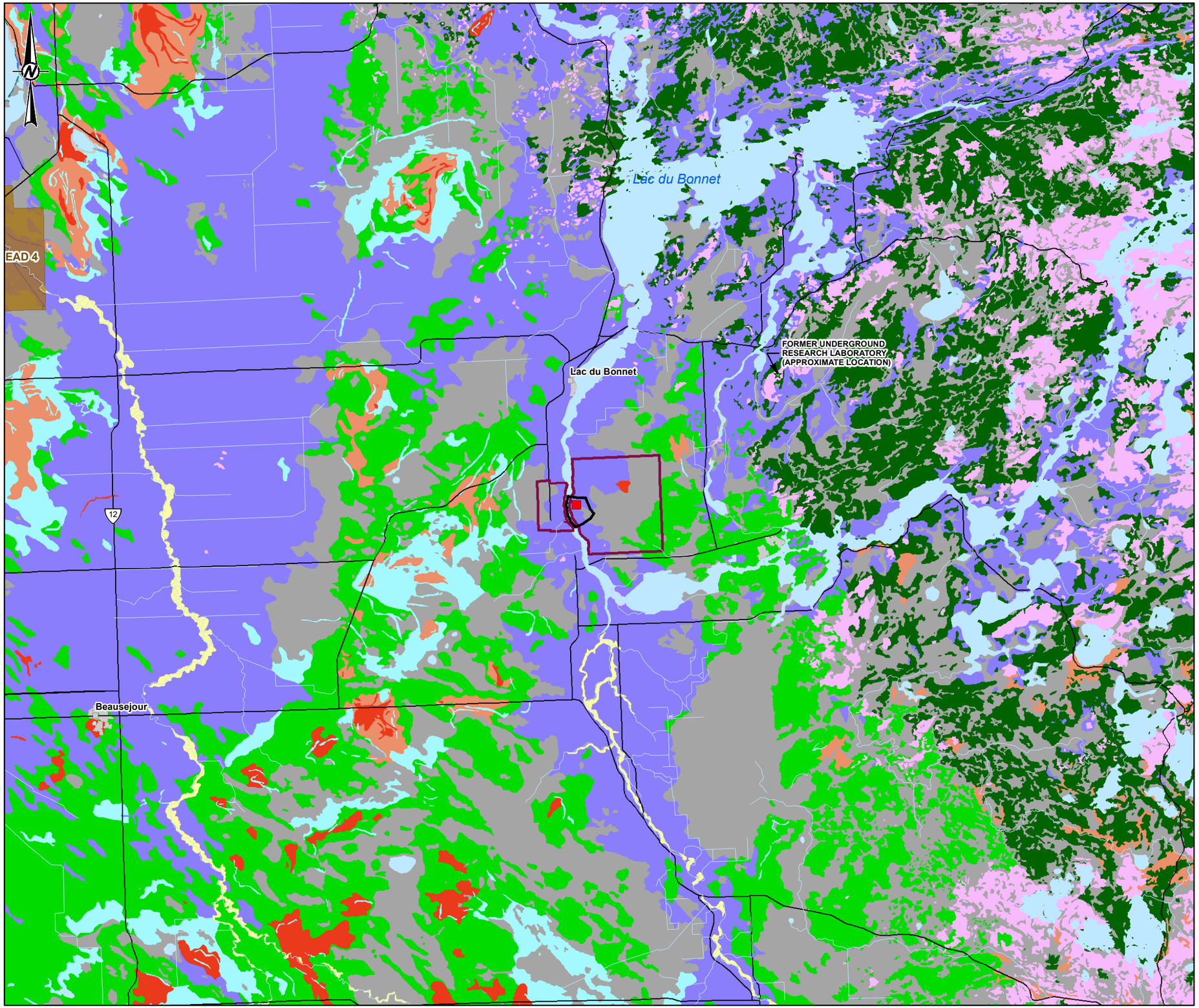
Borehole 16-2E is to the east of WR-1, the borehole encountered bedrock at approximately 16 m, the rock type is a pink coloured syenogranite, monzogranite to tonalite with a granodioite dyke present from approximately 17 m depth below surface 20.5 m and a second dyke from approximately 22 m depth to the end of the borehole at 24 m. The upper surface of the rock appears heavily weathered at the unconformity of the rock and overlying sediments.

Borehole 16-4F is to the northwest of WR-1. The borehole encountered bedrock at 16.9 m and the rock type is largely a coarse-grained mafic dyke (identified as diorite) to the bottom of the borehole at approximately 26 m depth. There are approximately 26 fractures, in the 10 m of core, many of the core breaks and fractures are steeply oriented indicating the presence or past presence of sub-vertical fracturing in the dyke. The difference in rock type is an indication of the local variability found elsewhere in the batholith.

Borehole 16-7 is to the southwest of WR-1, the borehole encountered bedrock at 20.78 m. The rock is heavily weathered red-pink granite with red clay and gravel present in fractures. There are heavily fractured zones encountered at 21.13 m, at 22.71 m and 23.12 m depth. It is unknown from current drilling if these represent splays of a larger fracture zone, or are separate fractures, but their relatively close vertical distances suggest that they are part of an interrelated fracture zone structure. Below that the granite is K-feldspar rich with many healed fractures to the bottom of the borehole at 25.81 m. The composition of the fractures reflects similarities to the fracture zones encountered at the URL in terms of appearance and colouration/alteration.

Borehole 16-8A is to the northwest of WR-1, the borehole encountered bedrock at 12.19 m with alkali feldspar granite, red, porphyritic structure, deformation of structures and vertical fractures. The upper few metres of the borehole present vertical fractures and fractures with sand sized particles and clay. At approximately 29 m, the rock is syenogranite, red, medium-grained, with phanertic texture, deformation of structures, microvertical fractures throughout, the presence of vertical fractures decreases and quartz content increases. Borehole bottom is at 42.6 m.

Both open and closed factures were noted throughout the length of core logged for each borehole. Areas of the pink granite include altered red granite similar to more heavily altered and oxidized fractures similar to those found in fracture zones logged in WN-1 and WN-2. This indicates some of the fractures encountered were water bearing in the geologic past having undergone hydrothermal alteration and have undergone extensive weathering alteration. The presence of clay infilling and drill core smoothed rock fragments in the cores further suggests potential water bearing fractures exist in the bedrock on the WL site. The clay may represent alteration of early chlorite and epidote fracture fillings (Gascoyne et al. 1997).



LEGEND

- WR-1 BUILDING (SITE STUDY AREA)
- FORMER UNDERGROUND RESEARCH LABORATORY (APPROXIMATE LOCATION)
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

BASE FEATURES

- CITY/TOWN
- MAJOR ROAD
- WATERCOURSE
- WATERBODY
- MUNICIPAL BOUNDARY
- FIRST NATION RESERVE

SURFICIAL GEOLOGY

- ORGANIC
- LACUSTRINE - MODERN SHORELINE
- ALLUVIUM
- GLACIOLACUSTRINE - LITTORAL
- GLACIOLACUSTRINE - SILT AND CLAY
- GLACIOFLUVIAL - OUTWASH
- GLACIOFLUVIAL - ICE CONTACT
- TILL - SAND-RICH
- TILL - SILT-RICH
- ROCK - PRECAMBRIAN

0 10 20

1:260,000 KILOMETRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY (RSA) PROVIDED BY CNL (2016-11-22)
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT
CANADIAN NUCLEAR LABORATORIES

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
SURFICIAL GEOLOGY

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0009	2	**6.3.1-4**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm 0

Path: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0009_EIS_Sec_6.3.1\20145046-0009-G-0004_Figure 6_3_1-4 Surficial Geology.mxd

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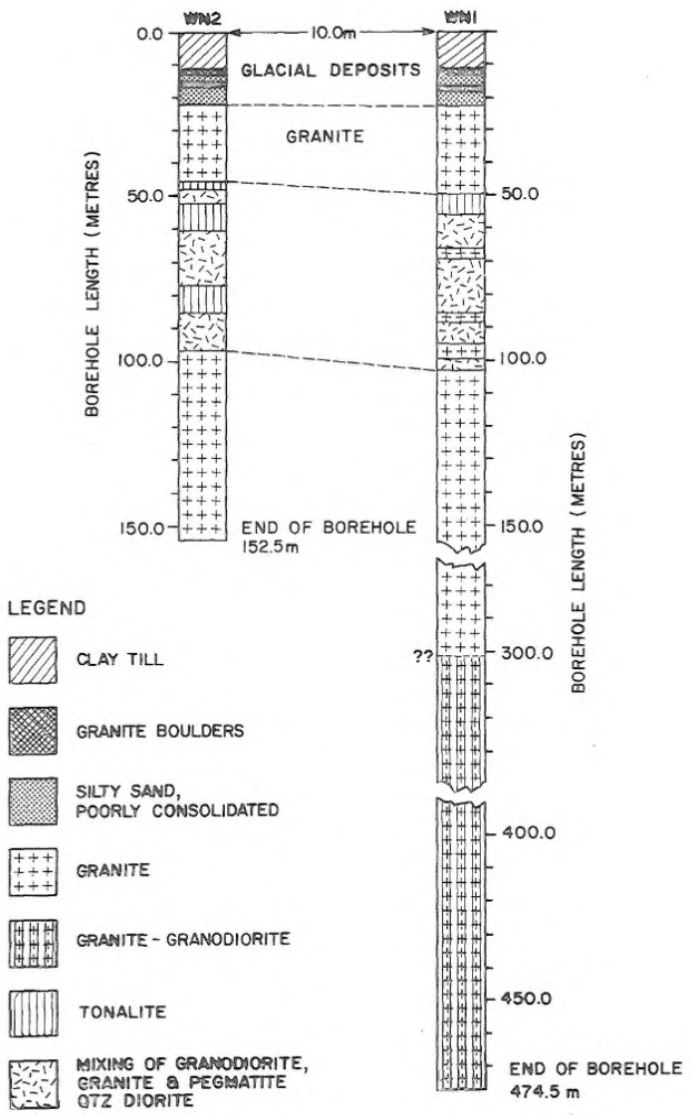
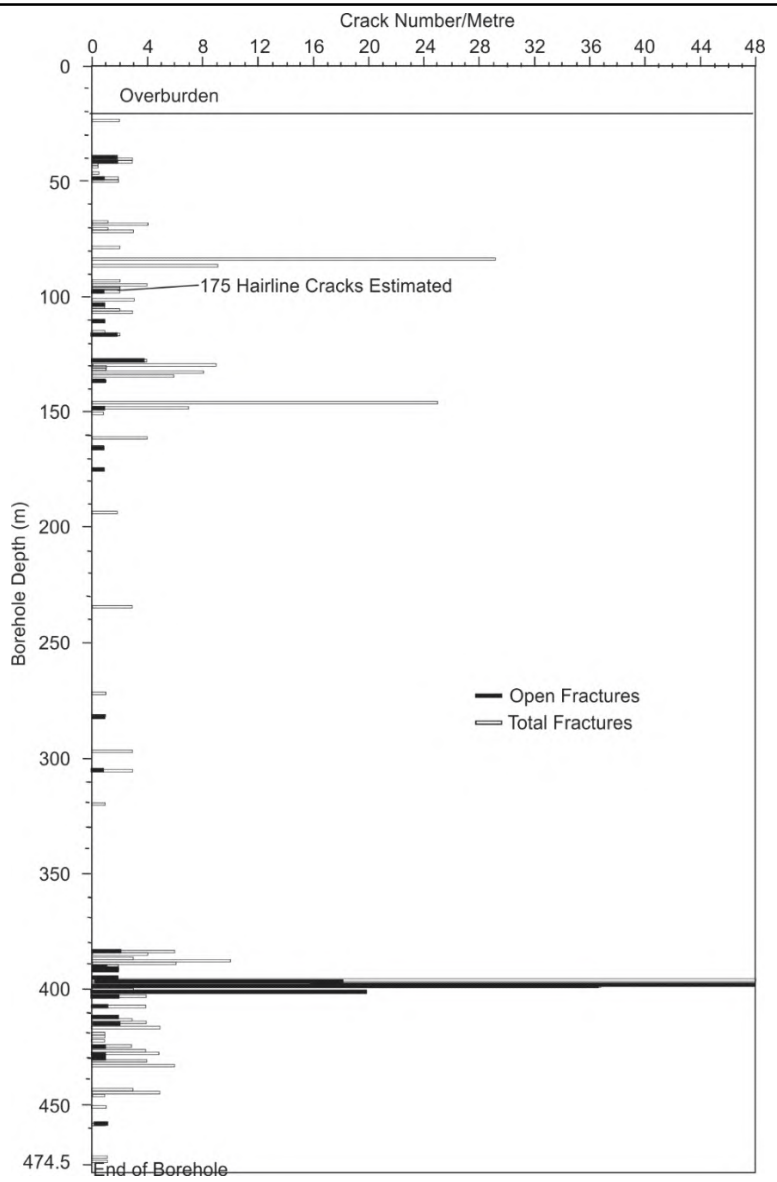
PATH: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0009_EIS_Sec_6.3.1\20145046-0009-G-0005_Figure 6_3_1-5 - WN-Series Well Details.mxd PRINTED ON: 2022-12-06 AT: 9:09:55 PM





NOTE(S)

CNL. 2022. GEOSYNTHESIS FOR WR-1 ENVIRONMENTAL IMPACT STATEMENT. WLDP-26400-041-000. REVISION 3. JANUARY 2022.

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	ST
PREPARED	RRD
REVIEWED	KL
APPROVED	MM

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

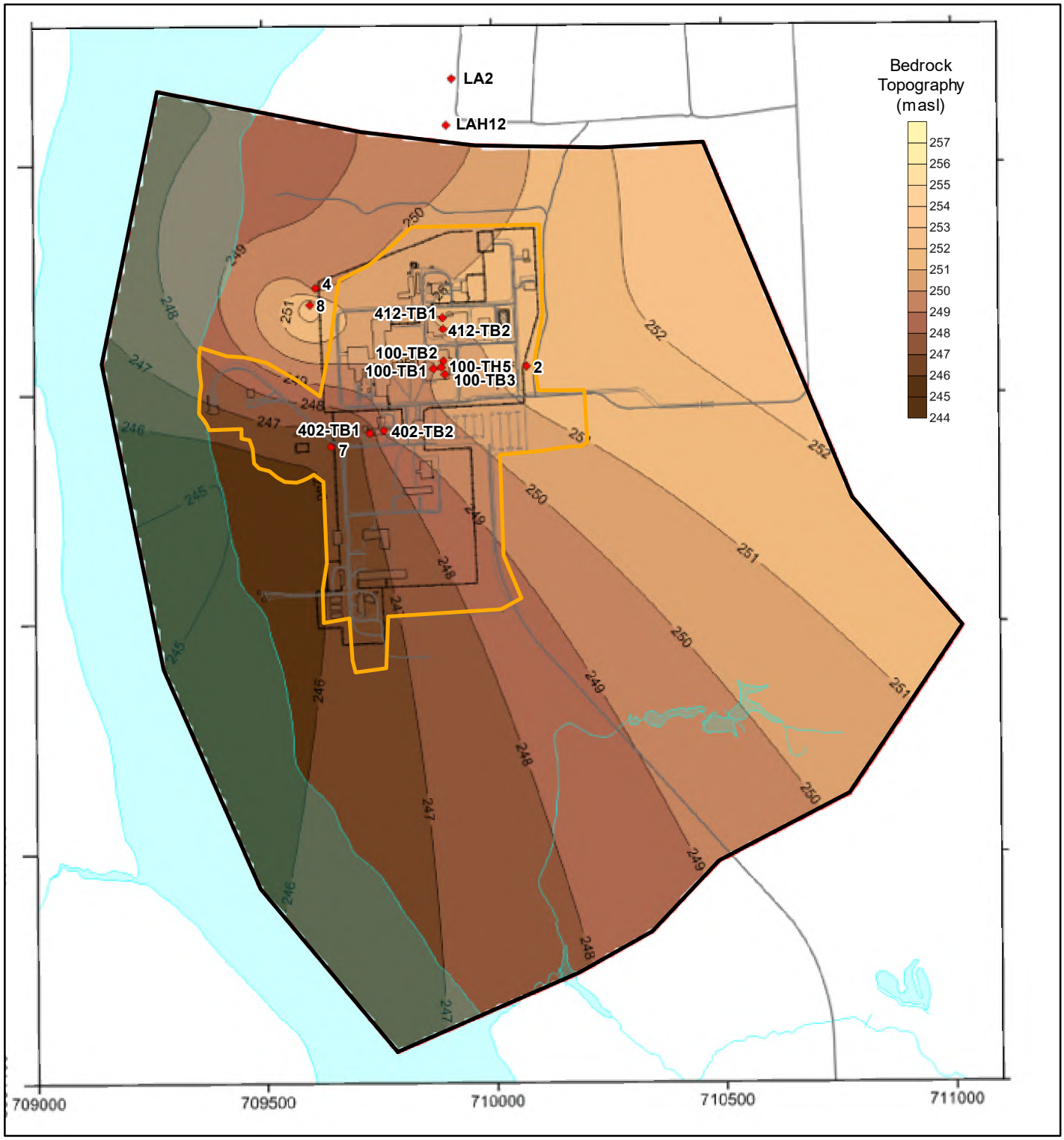
TITLE
DETAILS FOR WN-SERIES BOREHOLES

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0009	2	6.3.1-5

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A
25mm
0

Bedrock Topography

Bedrock topography at the LSA has been determined based on boreholes extended through the full overburden thickness to confirmed bedrock. These boreholes include the BHS 500-series wells in the Lagoon Area (AECL 2008) and the recently drilled boreholes in the WL main campus area (Dillon, 2018), supplemented with the historical data (AECL 1961). Depth to auger refusal has not been found to be a reliable surrogate for depth to the bedrock surface at the WL site given the prevalence of large boulders in the basal overburden unit (Robertson and Cherry 1985). Bedrock topography varies from 245 to 257 metres above sea level and is generally gradually sloped towards the south west (and the Winnipeg River). A local bedrock high in the vicinity of boreholes 16-8 and 15-4 has been identified though recent coring. Bedrock topography mapping for the LSA is shown on Figure 6.3.1-6.



LEGEND

- GEOLOGICAL SURFACE DATA POINT
- LOCAL STUDY AREA
- WHITESHELL LABORATORIES MAIN CAMPUS
- STREAM
- WATERBODY

REFERENCE(S)

GOLDER. 2021. WR-1 GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELLING. CANADIAN NUCLEAR LABORATORIES DOCUMENT NO. WLDP-26000-REPT-005. REVISION 4. DECEMBER 2021.

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
BEDROCK TOPOGRAPHY

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	--
PREPARED	RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046		2	6.3.1-6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

Document Path: S:\Clients\Canadian Nuclear Laboratories\Manitoba\89 PROJ\20145046\40 PROD\0009 EIS Sec 6.3.1\20145046-0009-G-0006 Figure 6.3.1-6 - Bedrock Topography.mxd

Surficial Soils

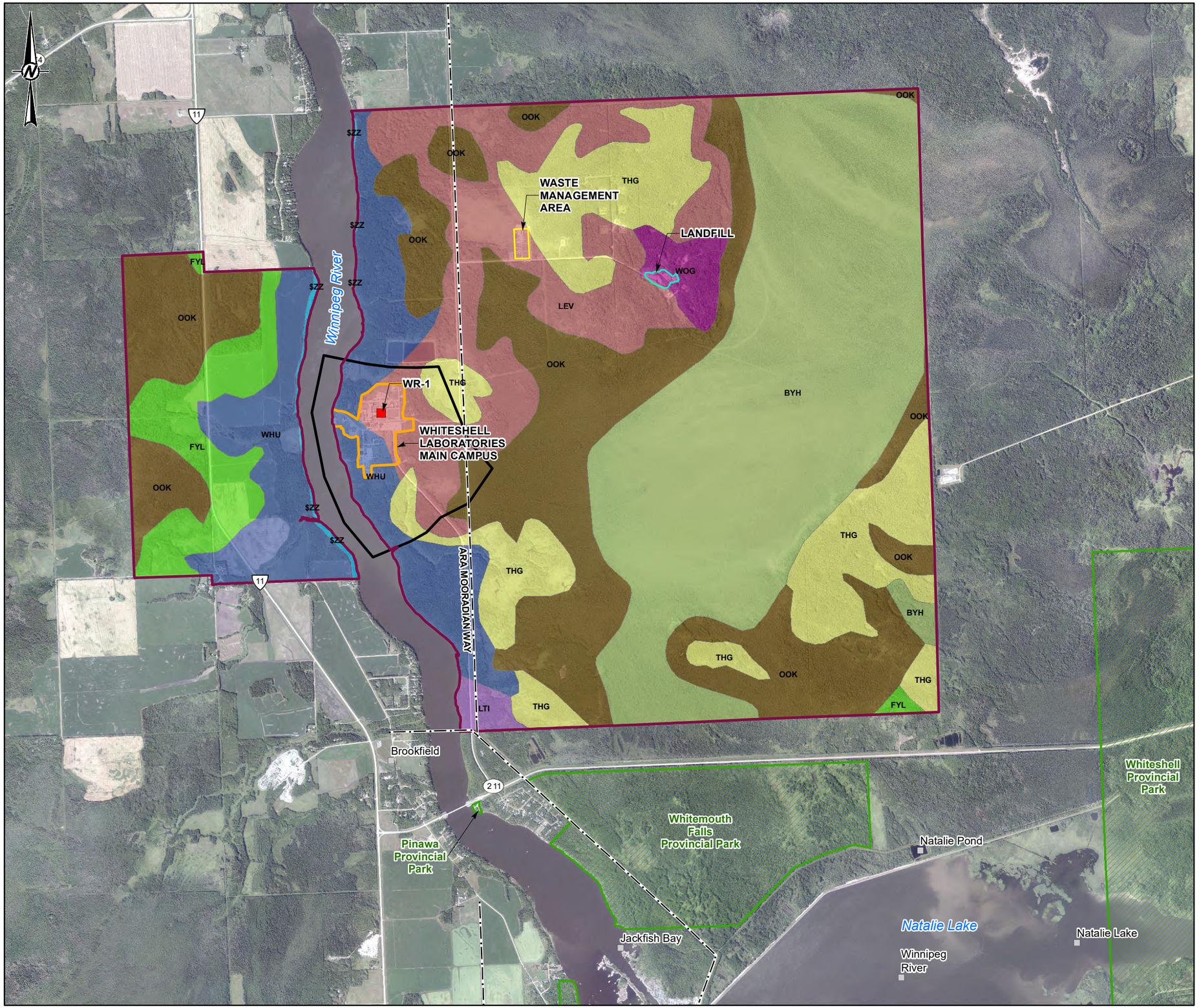
The LSA and RSA are located largely within the Agriculture Interpretation Block Area of Pinawa and a small portion within the Lac du Bonnet Block Area (MLI 2003). In general, the historical surficial soil distribution within the LSA and RSA is comprised of organics in areas of poor drainage and Glysolic and Chernozemic soils in areas with improved drainage. Soils developed on outwash sands and alluvial materials are typically Luvisolic (MLI 2003). Precambrian bedrock outcrops generally only have partial lichen and moss cover, although peat soil is common in depressions (AECL 2001). Most of the soils within the LSA have been disturbed. A summary of the dominant baseline soil types and substrates within the LSA and RSA are outlined in Table 6.3.1-6 and presented on Figure 6.3.1-7.

Table 6.3.1-6: Baseline Soil Types and Substrates within the Local Study Area and Regional Study Area

Soil Series	Soil Subgroup	Substrate/Parent Material	Area (ha)
Local Study Area			
$ZZ	Undifferentiated	Active Fluvial River Bed	35.0
LEV	Peaty Humic Luvic Gleysol	Moderately Calcareous Lacustrine Clay	98.6
OOK	Terric Mesisol	Shallow Organic	14.7
THG	Gleyed Solinetzic Dark Gray Chernozem	Weakly Calcareous Lacustrine Clay	28.5
WHU	Dark Gray Luvisol	Strongly Calcareous, Moderately Fine Textured Alluvial Sediments	83.3
Regional Study Area			
$ZZ	Undifferentiated	Active Fluvial River Bed	16.2
BYH	Typic Mesisol	Deep Organic	1,290.5
FYL	Peaty Rego Humic Gleysols	Weakly to Moderately Calcareous Lacustrine Clay	206.1
LEV	Peaty Humic Luvic Gleysol	Moderately Calcareous Lacustrine Clay	574.2
LTI	Solinetzic Gray Luvisol	Moderately to Strongly Calcareous Lacustrine Clay	27.3
OOK	Terric Mesisol	Shallow Organic	1,084.5
THG	Gleyed Solinetzic Dark Gray Chernozem	Weakly Calcareous Lacustrine Clay	590.8
WHU	Dark Gray Luvisol	Strongly Calcareous, Moderately Fine Textured Alluvial Sediments	491.1
WOG	Orthic Gray Luvisol	Coarse Grained Outwash	60.7

Source: MLI 2003.

Drainage ranges from well-drained, coarse-textured soils to poorly and very poorly-drained organic soils in lower elevation positions. Coarse-textured soils, with higher initial total porosity (e.g., WOG – Orthic Gravy Luvisol), are relatively resistant to compaction compared to finer textured soils (e.g., THG - Gleyed Solinetzic Dark Gray Chernozem, LEV - Peaty Humic Luvic Gleysol, WHU - Dark Gray Luvisol); these soils are, however, prone to wind erosion. Soil erosion risk is a concern for disturbed soils because the sparse vegetation cover exposes soil materials to the elements (e.g., wind and water). In areas of organic soils that are not deep (e.g., OOK - Terric Mesisol) and organic surface horizons are removed and subsurface materials and exposed, the water erosion potential of the underlying material would be low if sandy and moderate if silty. Areas containing organic materials will have a low sensitivity to wind erosion.



LEGEND

- WR-1 BUILDING (SITE STUDY AREA)
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- WASTE MANAGEMENT AREA
- WHITESHELL LABORATORIES MAIN CAMPUS
- LANDFILL

BASE FEATURES

- CITY/TOWN
- TRANSMISSION LINE
- PROVINCIAL PARK

SOIL SERIES, SUBSTRATE/PARENT MATERIAL

- $ZZ, ACTIVE FLUVIAL RIVER BED
- LEV, MODERATELY CALCAREOUS LACUSTRINE CLAY
- OOK, SHALLOW ORGANIC
- THG, WEAKLY CALCAREOUS LACUSTRINE CLAY
- WHU, STRONGLY CALCAREOUS, MODERATELY FINE TEXTURED ALLUVIAL SEDIMENTS
- BYH, DEEP ORGANIC
- FYL, WEAKLY TO MODERATELY CALCAREOUS LACUSTRINE CLAY
- LTI, MODERATELY TO STRONGLY CALCAREOUS LACUSTRINE CLAY
- WOG, COARSE GRAINED OUTWASH

0 1,000 2,000

1:40,000 METRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY (RSA) PROVIDED BY CNL (2016-11-22)
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT
CANADIAN NUCLEAR LABORATORIES

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
SOIL SERIES AND PARENT MATERIAL TYPES WITHIN THE LOCAL AND REGIONAL STUDY AREAS

CONSULTANT

WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0009	2	6.3.1-7

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm 0

Path: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0009_EIS_Sec_6.3.1\20145046-0009-G-0007_Figure 6_3_1-7 SOIL SERIES AND PARENT MATERIAL TYPES WITHIN THE.mxd

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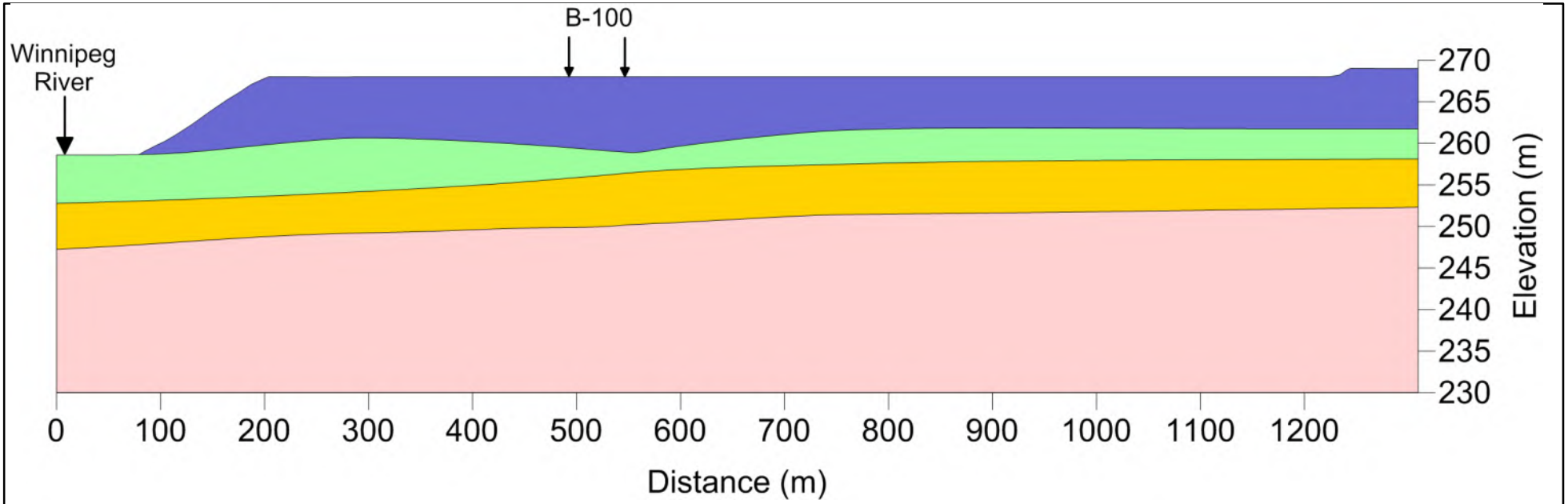
Surficial Geology

The surficial geology of the LSA is similar to that observed in the RSA, consisting of (from the bedrock upwards):

- Glacial Till (also referred to as Basal Sand and Basal Till);
- Glacio-Lacustrine Clay (also referred to as Clay Till as the lower portion of this unit is derived from the Glacial Till); and
- Transitional Glacio-Lacustrine Clay (Clay) and Glacio-Fluvial and Glacio-Lacustrine Sandy Silt (Surficial Interbedded Silt and Clay).

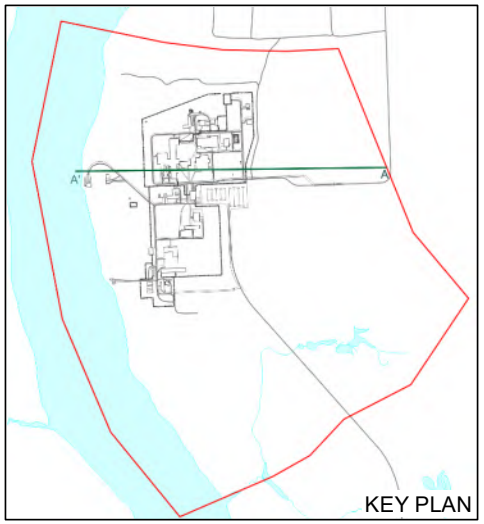
A cross-section through the LSA is shown on Figure 6.3.1-8.

PATH: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0009_EIS_Sec_6.3.1\20145046-0009-G-0008_Figure 6_3_1-8 - Geological Cross Section.mxd PRINTED ON: 2022-12-06 AT: 9:10:16 PM



LEGEND

- Bedrock
- Basal Sand
- Clay Till
- Lacustrine Clay / Interbedded Silt and Clay



REFERENCE(S)

GOLDER. 2021. WR-1 GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELLING. CANADIAN NUCLEAR LABORATORIES DOCUMENT NO. WLDP-26000-REPT-005. REVISION 4. DECEMBER 2021.

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	ST
PREPARED	RRD
REVIEWED	NB
APPROVED	MM

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
GEOLOGICAL CROSS SECTION

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0009	2	6.3.1-8

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A
25mm
0

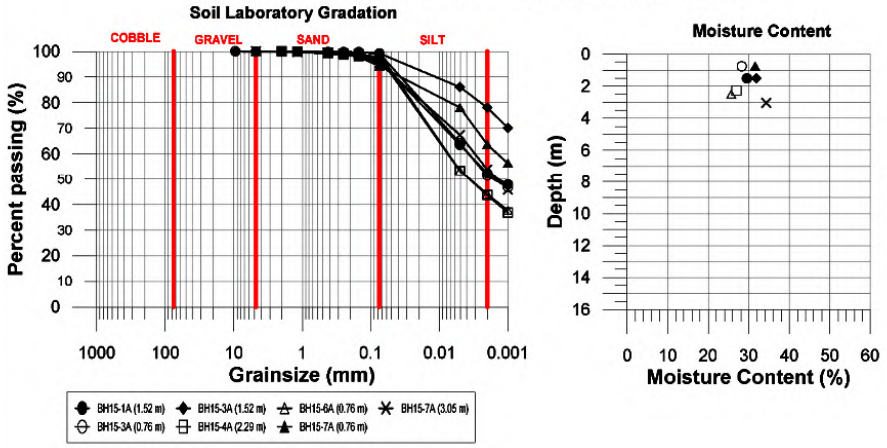
Glacial Till (also referred to as Basal Sand or Basal Till)

Bedrock is overlain by a glacial till (referred to also as basal sand, silty sand till or basal till in other WR-1 in situ disposal documents) throughout the majority of the RSA. The till varies from a silty coarse sand till to a clean medium to coarse sand (Cherry et al. 1970) and boulders are common above the bedrock surface. This unit is referred to as the “basal sand” in the area of the WR-1 Building (Dillon 2018) due to the increased sand content observed in this unit in other areas of the SSA (primarily the WMA). Based on its grain-size distribution and hydraulic conductivity characteristics within the area of WR-1 it is not considered to be representative of sand.

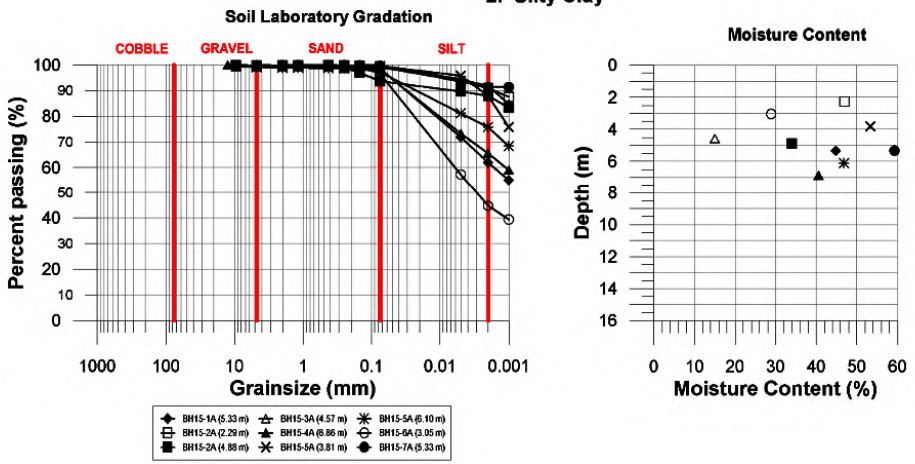
Based on the descriptions provided by McPherson (1968) and Robertson and Cherry (1985), the basal unit is characterized by variability in grain size. Results of grain size analysis on samples of this unit taken from the recently drilled boreholes in the vicinity of WR-1 (KGS Group 2016; plotted on Figure 6.3.1-9) indicated that this unit is primarily comprised of silt (content ranged from 26% to 56%), with most remaining particles categorized as fine sand (15% to 32%) and clay (5% to 24%). Water content for this unit ranged from 9% to 27%.

In the WMA to the north of the LSA, this unit has been found to vary in thickness from 1 m to 7 m thick (AECL 2008). At the LSA, this unit varies in thickness from 3.6 m to 8.3 m. In other areas of the RSA this unit appears to thin towards the Winnipeg River; however, surrounding the SSA this unit appears to be thickest to the southwest and thins to the north. This unit is thinnest over the local bedrock high in the vicinity of monitoring well nest 4 and borehole 16-8. A basal sand isopach is shown on Figure 6.3.1-10.

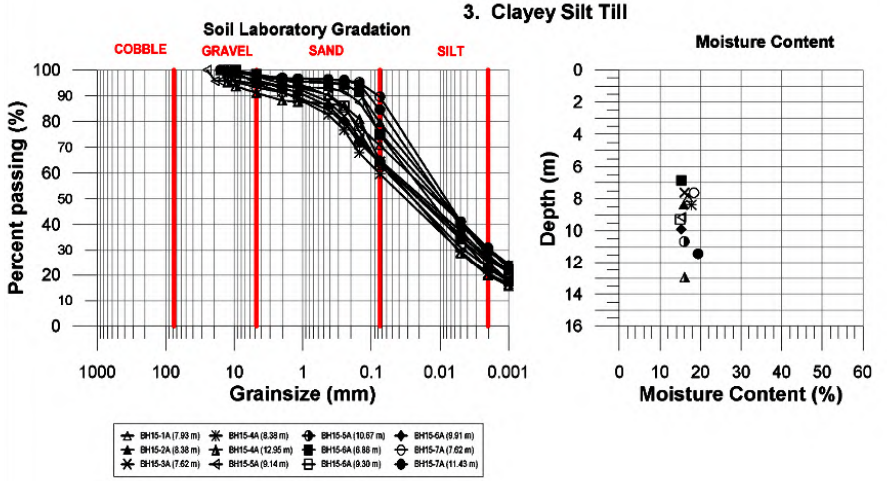
1. Upper Laminated Silty Clay (Complex Zone)



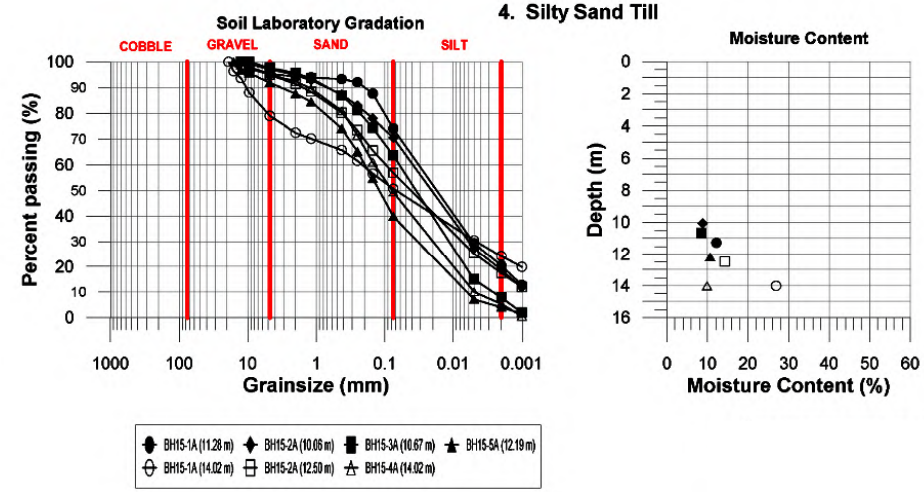
2. Silty Clay



3. Clayey Silt Till



4. Silty Sand Till



REFERENCE(S):

KGS GROUP. 2016. WHITESHELL LABORATORIES PROJECTS BRANCH COMPREHENSIVE FINAL REPORT ON INSTALLATION OF 7 GROUNDWATER MONITORING WELL NESTS. CANADIAN NUCLEAR LABORATORIES DOCUMENT NO. WLDP-35000-041-000-0014. MARCH 2017.

CONSULTANT

WSP GOLDER

CLIENT

CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT

EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE

GRAIN SIZE DISTRIBUTION PLOTS

MM-YYYY	DECEMBER 2022
DESIGNED	ST
PREPARED	RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0009	2	6.3.1-9

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A
25mm
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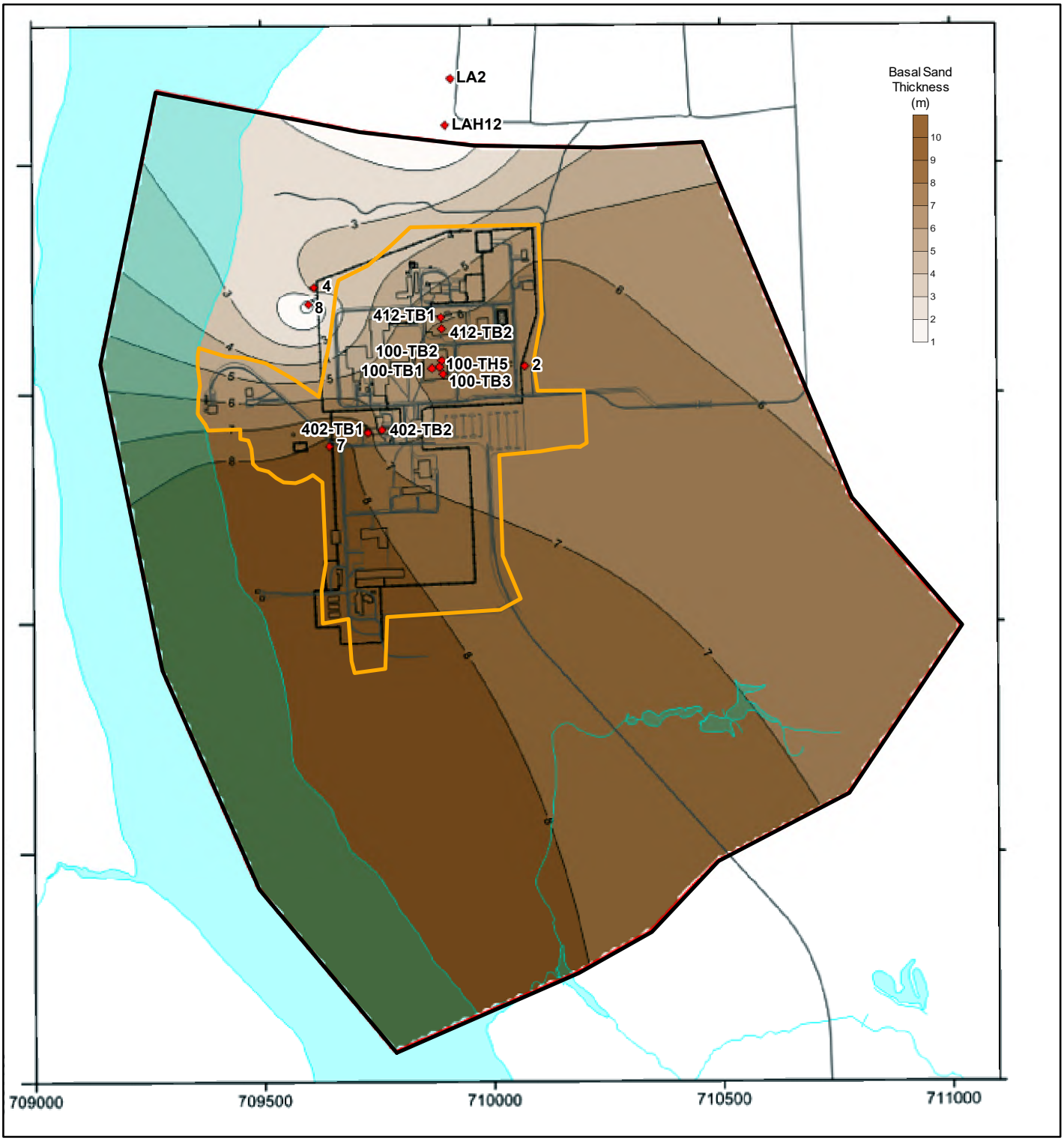


LEGEND

- GEOLOGICAL SURFACE DATA POINT
- LOCAL STUDY AREA
- WHITESHELL LABORATORIES MAIN CAMPUS
- STREAM
- WATERBODY

REFERENCE(S)

CNL. 2022. GEOSYNTHESIS FOR WR-1 ENVIRONMENTAL IMPACT STATEMENT. WLDP-26400-041-000. REVISION 3. JANUARY 2022.

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
ISOPACH MAP - BASAL SAND

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	--
PREPARED	RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO. 20145046 | CONTROL | REV. 2 | FIGURE **6.3.1-10**

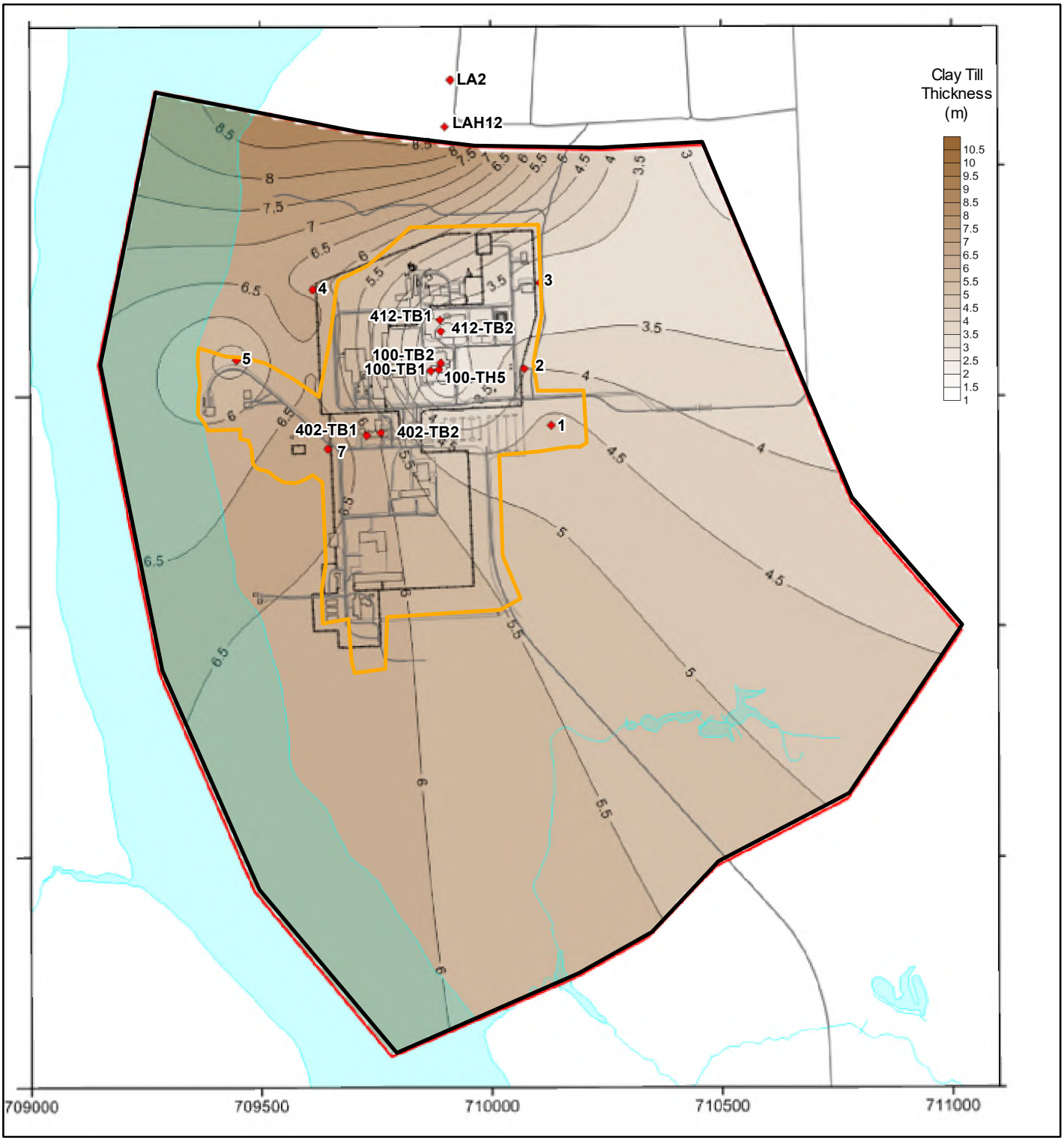
S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\09_PRO\20145046\40_PROD\0009_EIS_Sec_6-3_\20145046-0009-G-0010_Figure_6_3_1-10_-_Basal_Sand_Isp.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
25mm
0

Glacio-Lacustrine Clay (also referred to as Clay Till)

The basal sand is overlain by a clay till unit containing sand and silty sand seams. The bulk porosity of this unit in the WMA was determined to be 0.23 indicating a high degree of consolidation (Robertson and Cherry 1985). This value is based on three samples of “clay loam” collected near the WMA as documented in Gillham et al. (1981). No porosity measurements have been completed in the LSA. Results of grain size analysis on samples of this unit taken from the recently drilled boreholes in the vicinity of WR-1 (KGS Group 2016; plotted on Figure 6.3.1-9) indicated that this unit is primarily comprised of clay (content ranged from 4% to 76%) and silt (21% to 57%) with most remaining particles categorized as fine sand (6% to 55%). Gravel content in upwards of 7% to 9% was noted in some samples. Water content for this unit ranged from 26% to 59%.

In the WMA, this unit has been found to vary in thickness from 2 m to 5 m (AECL 2008). In the LSA, this unit varies in thickness from 3 m to 7 m. The clay till is generally thinnest in the central portion of the LSA and thickens to the northwest and southwest towards the Winnipeg River. A clay till isopach is shown on Figure 6.3.1-11.



LEGEND

- GEOLOGICAL SURFACE DATA POINT
- LOCAL STUDY AREA
- WHITESHELL LABORATORIES MAIN CAMPUS
- STREAM
- WATERBODY

REFERENCE(S)

CNL. 2022. GEOSYNTHESIS FOR WR-1 ENVIRONMENTAL IMPACT STATEMENT. WLDP-26400-041-000. REVISION 3. JANUARY 2022.

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
ISOPACH MAP - CLAY TILL

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	--
PREPARED	RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046		2	**6.3.1-11**

S:\Clients\Canadian Nuclear Laboratories\Manitoba\99 PROJ\20145046\40 PROD\0009 EIS Sec 6.3 \\20145046-0009-G-0011 Figure 6 3 1-11- Clay Till Iso.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
25mm
0

Transitional Glacio-Lacustrine Clay (Clay) and Glacio-Fluvial and Glacio-Lacustrine Sandy Silt (Surficial Interbedded Silt and Clay)

A glacio-lacustrine clay unit has been found to overlie the clay till unit throughout the LSA. This unit is transitional, with the lower portion more laminated with silty interbeds, and the upper portion more massive. A thin surficial interbedded silt and clay unit overlies these clays. These units have been grouped given their similar properties and relative thinness of the surficial unit.

Results of grain size analysis on samples of this unit taken from the recently drilled boreholes in the vicinity of WR-1 (KGS Group 2016; plotted on Figure 6.3.1-9) indicated that this unit is primarily comprised of clay (content ranged from 44% to 92%), with the majority of remaining particles categorized as silt (6% to 55%). In all samples less than 5% of the material was categorized as having a grain size equivalent to fine sand or larger. Water content for this unit ranged from 26% to 59%.

In the WMA this unit has been found to vary in thickness from 2 m to 8 m and is thickest in the Lagoon Area (AECL 2008). In the LSA, this unit is relatively uniform in thickness, varying from 5.5 m to 7.3 m. This unit is inferred to be absent adjacent to the Winnipeg River due to the erosional drop in topography towards the river. An isopach of the clay till and surficial silt and clay unit is shown on Figure 6.3.1-12. Contouring of this isopach is affected by the nature of the Digital Elevation Model for the LSA.

Geomorphology

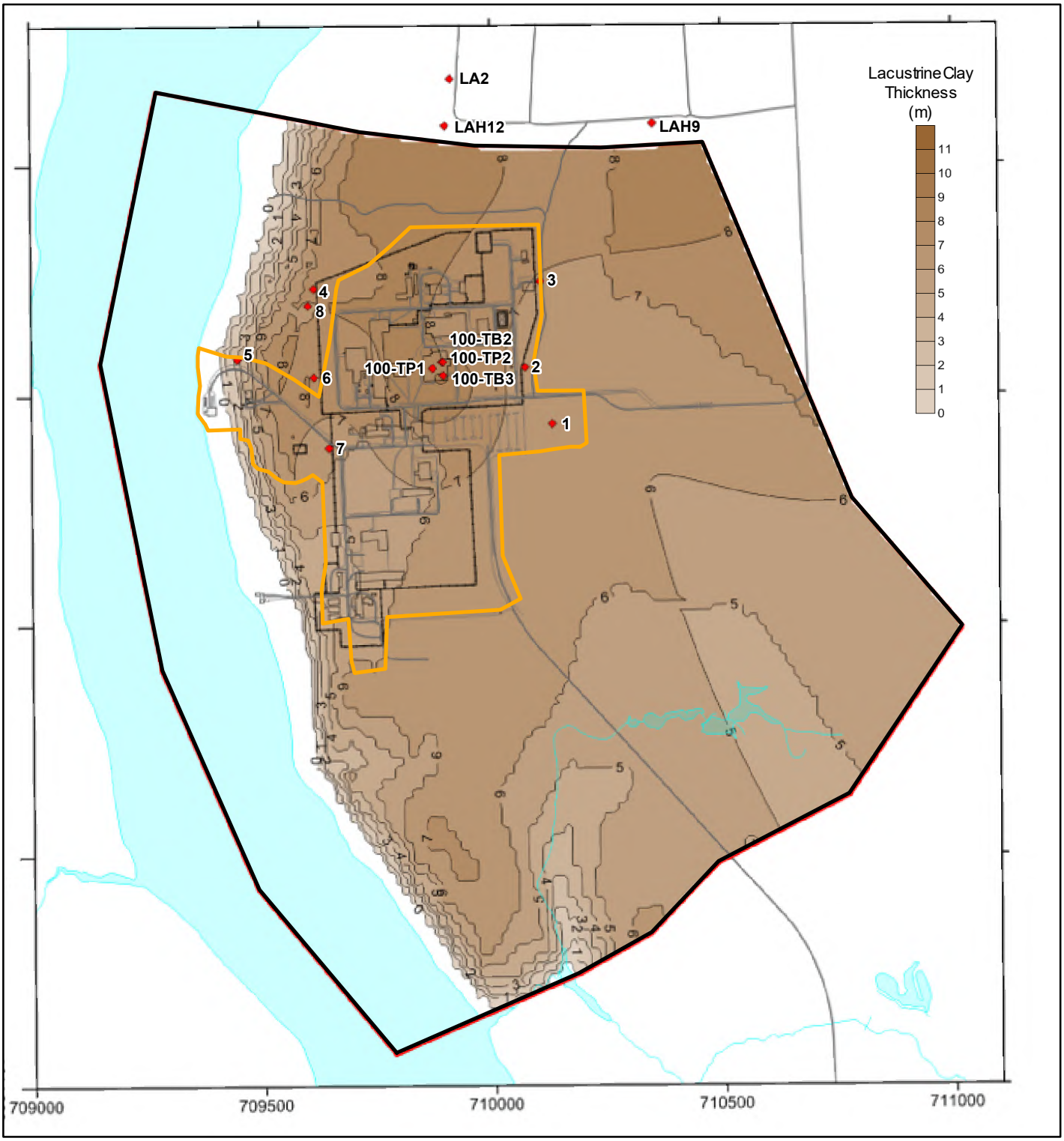
The surficial deposits in the RSA consist of glaciofluvial tills, outwash deposits and glacial lacustrine deposits that originated from Wisconsin glaciations of the Pleistocene epoch and associated stages of the Glacial Lake Agassiz (McPherson 1968; Cherry et. al 1970). The basal overburden unit was deposited near the glacier front during glaciation, whereas the overlying clay till was deposited during an episode of glacial advance from the northwest (McPherson 1968; Robertson and Cherry 1985). Final deglaciation in the RSA occurred between 12,000 and 13,000 years before present. Glacial Lake Agassiz, which formed during deglaciation, inundated the RSA until approximately 9,500 years before present. The lacustrine clay unit was deposited in an early deep water phase of Glacial Lake Agassiz. Surficial silt, sand and gravel materials were formed during a late shallow water phase of Glacial Lake Agassiz (Robertson and Cherry 1985). After the final drainage of Glacial Lake Agassiz, there has been some aeolian reworking of the uppermost sediments, though the overall stratigraphic sequence remains unchanged.

To the west of the LSA the overburden sequence has been partially incised by the Winnipeg River. Based on the available mapping of surficial geology, fluvial deposits associated with the Winnipeg River are not known to be found in the RSA indicating a relatively consistent lateral position of the river following drainage of Glacial Lake Agassiz. The current river level (which is controlled upstream via the Seven Sisters Generating Station) is approximately 10 m below the top of the adjacent eastern riverbank near the WL site.

Erosion potential for the WL site and surrounding area has been mapped based on the universal soil loss equation as being moderate for the gently sloped region near the Winnipeg River, and negligible for remaining portions of the WL site (Agriculture and Agri-Food Canada 1999). It is noted that this method applies to sheet erosion (i.e., rain-derived) and does not necessarily apply to riverbank erosion. Erosional features have been found along the banks of the Winnipeg River.

The Winnipeg River hosts six hydroelectric dams, as well as many lakes, with flows controlled by the Lake of the Woods Control Board. This watercourse is highly controlled and monitored and will be for the foreseeable future. Thus, the position of the Winnipeg River is assumed to remain close to its current placement on the landscape for the foreseeable future (Golder 2021b).

The uncertainty in future erosional changes in the Winnipeg River was identified in the Geosynthesis Report (CNL 2022) Table 12 – Geoscience Verification Plan. To address the uncertainty in future geomorphological changes to the river and dam a simulation was completed to evaluate the potential changes to mass loadings resulting from a low river stage condition (i.e., higher hydraulic gradient between the WRDF and Winnipeg River due to lowering of the downstream river head boundary, which controls outflow in the model). The low river stage simulation had a minor influence on the simulated groundwater flow rates through the WRDF and local geosphere, though the change in hydraulic gradient in the bedrock pathway resulted in higher groundwater velocities and increased peak mass loading rates. The increases in peak mass loading rates were greatest for those solutes found outside of the reactor core (i.e., those not released through corrosion). Details of the simulation are provided in Section 6.5 Local Hydrogeology of the Decommissioning Safety Assessment Report (Golder 2021b).



LEGEND

- GEOLOGICAL SURFACE DATA POINT
- LOCAL STUDY AREA
- WHITESHELL LABORATORIES MAIN CAMPUS
- STREAM
- WATERBODY

REFERENCE(S)

CNL. 2022. GEOSYNTHESIS FOR WR-1 ENVIRONMENTAL IMPACT STATEMENT. WLDP-26400-041-000. REVISION 3. JANUARY 2022.

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
ISOPACH MAP - LACUSTRINE CLAY

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	--
PREPARED	RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO. 20145046 | CONTROL | REV. 2 | FIGURE **6.3.1-12**

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6.3.1.5.2.3 Seismic

The Lac du Bonnet batholith remained distant from tectonic events in the Superior Province at the end of the Kenoran Orogeny (approximately 2.65 billion years ago; Gascoyne et al. 1997). Faulting is known in the eastern end of the batholith, which are attributed to this event and that may contribute to local features and perhaps river orientation; however, there is no recent activity in the region. Based on a detection level of 2.5 on the Richter scale, the WL area and the southern two-thirds of Manitoba are aseismic. Detailed information on earthquakes that have occurred in Canada is contained in publications of Earthquakes Canada of Natural Resources Canada and their predecessor organizations.

A seismic zoning map for Canada has been developed on the basis of these studies and is used in the National Building Code of Canada (NBCC) 2015 (NRCan 2019). The seismic hazard maps are derived from statistical analysis of past earthquakes and from advancing knowledge of Canada's tectonic and geological structure. On the maps, seismic hazard is expressed as the most powerful ground motion that is expected to occur in an area for a given probability level. Contours delineation regions likely to experience similarly strong ground motions. Earthquakes Canada provides information on recent and historical earthquakes. The results support the NBCC classification that seismic activity has not been noted or recorded in Manitoba over nearly a 400-year period.

A seismic hazard analysis was completed for the WL site. In 1995, the NBCC placed the WL site (and all of Manitoba) within a Seismic Zone 0, a zone that has a probability of exceedance of 0.0021. The peak ground acceleration (i.e., the maximum acceleration that a rigid structure would experience if it was located on bedrock) data from NBCC was considered for the years 2005, 2010 and 2015. The trend since 2005 is that for every probability of exceedance, the seismic hazard at the WL site has decreased (NBCC 2015). For the 1 in 10,000-year probability of exceedance, the peak ground acceleration is approximately 0.10. Comparatively, the 0.10 peak ground acceleration represents a light (almost moderate) earthquake for which one wouldn't normally expect structural damage for NBCC designed building and components. There could be some non-structural damage such as fine cracking on non-ductile non-structural elements (e.g., plaster or drywall). Structures that could experience damage due to this size of earthquake are those located on soils that are susceptible to amplification and/or have quite low natural frequencies. These structures man have characteristics that make them susceptible to earthquakes (e.g., tall structures will no bracing or shear walls). Conventionally designed structures using ductile materials (e.g., steel or reinforced concrete) following good engineering practices that incorporate bracing/shear walls, symmetric geometry, low horizontal eccentricity are not likely to be damaged by this level of earthquake (CNL 2022).

6.3.1.5.2.4 Liquefaction

Liquefaction occurs when vibrations or water pressure within a mass of soil cause the soil particles to lose contact with one another. As a result, the soil behaves like a liquid, has an inability to support weight and can flow down even gently slopes. This condition is usually temporary and is most often caused by an earthquake vibrating water-saturated fill or unconsolidated soil. Liquefaction is possible for cohesionless soils for M=4 to 6 earthquakes, which can produce ground shaking levels up to VIII on the Modified Mercalli Intensity. Liquefaction is therefore not deemed to be an issue for the WL site due to the aseismic conditions of Eastern Manitoba. The soil properties of the WL site also indicate that liquefaction would not be an issue. Cone penetration testing has been completed at site to assess the liquefaction potential of the overburden soils at the WL site. In general, the high plastic clayey overburden soils present at the site are not susceptible to cyclic liquefaction (KGS Group 2019).

6.3.1.6 Project Interactions and Mitigation

6.3.1.6.1 Methods

This section describes the process by which interactions between Project components and activities and geology were identified and evaluated. Potential effect pathways are identified, and mitigation developed to eliminate and/or reduce effects is presented. A pathways analysis is then used to focus the assessment on key interactions between the Project and the environment by evaluating the different effect pathways to determine if, after incorporation of mitigation, there is still potential to cause residual effects. Where effects will be adequately mitigated and are not forwarded for further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are articulated. Primary pathways that may lead to residual effects after incorporation of mitigation are further characterized in subsequent subsections of the assessment. As such, this section helps to focus the remainder of the assessment on those interactions (effects pathways) likely to result in residual adverse effects.

The first part of the analysis was to identify the potential effects pathways for all phases of the Project. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. The next step in the analysis was the development of environmental design features and mitigation that could be incorporated into the Project to eliminate and/or reduce adverse effects to geology. Environmental design features included Project design elements, environmental best practices and management policies and procedures. Environmental design features and mitigation were developed through an iterative process between the Project's engineering and environmental teams, combined with input from Project-specific or regional engagement with other interested parties. The environmental design features and/or mitigation were selected considering their effectiveness for implementation and maintenance, and their appropriateness within the context of the identified effect pathways.

After incorporation of mitigation, potential pathways were evaluated into the following categories using scientific knowledge, logic, experience with similar developments and the effectiveness of environmental design features and mitigation.

- **No linkage pathway –** pathway is removed by environmental design features or mitigation such that the Project would not be expected to result in a measurable environmental change relative to Base Case values and therefore would have no residual effects to geology.
- **Secondary pathway –** the pathway could result in a measurable minor environmental change, but would have a negligible residual effect on geology relative to Base Case and/or guideline values and is not expected to contribute cumulatively to other Project effects or to the effects of other past, present or reasonably foreseeable developments to cause a significant effect.
- **Primary pathway –** the pathway is likely to result in an environmental change relative to the Base Case and/or guideline values that could contribute to residual effects to geology.

Environmental design features and mitigation that have been or could be incorporated into the Project to eliminate and/or reduce adverse effects were considered. Potential pathways that were completely removed due to implementation of environmental design or mitigation were not assessed further. Pathways that were assessed to be secondary and demonstrated to have a negligible residual effect to geology through simple qualitative or semi-quantitative evaluation of the pathway were also not advanced for further assessment. Primary pathways are carried forward for more detailed quantitative and/or qualitative effects analysis to characterize the residual effects of the Project.

6.3.1.6.2 Results

Pathways through which all stages of the Project may interact with and result in changes to measurement indicators for geology is provided in Table 6.3.1-7. As mentioned previously, geology includes bedrock, soils and geomorphology. Below-ground, no decommissioning activities will extend beyond the outer wall of the WR-1 Building. As such, the Project is not expected to interact with bedrock or geomorphology; therefore, no pathways are identified in Table 6.3.1-7 for bedrock or geomorphology.

Table 6.3.1-7: Pathways Analysis for Geology Valued Components

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
Construction of temporary supporting infrastructure during decommissioning (e.g., batch mixing plant or other similar equipment for preparation of grout)	Loss or alteration of soil quantity and quality from construction of temporary supporting infrastructure.	■ Temporary supporting infrastructure will be located within the WL main campus (i.e., previously disturbed and developed). ■ Erosion and sediment control practices (e.g., silt fences, runoff management) applicable to the region and already in place at the WL site will be used during decommissioning activities around disturbed areas, where appropriate.	Secondary
General Project activities during the closure phase	Changes in soil quality from changes in air quality. General activities that require the use of vehicles and equipment that combust fuel and emit criteria air contaminants. These activities involve material handling, vehicles travelling on roads and wind erosion of stockpiles that will result in fugitive dust emissions.	■ Implementation of CNL's *Management and Monitoring of Emissions*, which includes operational control monitoring, air verification monitoring and environmental monitoring. ■ Implementation of the dust management techniques for the Project. ■ On-site vehicles and equipment engines will meet a minimum of Tier 3 emission standards, where possible, and be maintained in good working order. ■ Limit idling of vehicles on-site. ■ Use enclosure for the raw material handling.	Secondary
Long-term performance during the post-closure phase	Changes to groundwater quality during the post-closure phase may affect soil quality.	■ The concrete cap and engineered cover to be placed over the decommissioned WR-1 Building is designed to limit infiltration.	Secondary

6.3.1.6.2.1 No Linkage Pathway

There were no “no linkage” pathways identified to effects on geology.

6.3.1.6.2.2 Secondary Pathways

- **Changes to groundwater quality during the post-closure phase may affect soil quality.**

After below-grade grouting has been completed, a concrete cap and engineered cover will be installed over the footprint of the WRDF. The concrete cap and engineered cover design will include an appropriate slope to achieve drainage off the surface, which will limit infiltration, surficial erosion and enhance the stability of the concrete cap and engineered cover. The concrete cap and engineered cover will be designed to mitigate moisture infiltration into the WRDF and hence limit leakage through the grouting to groundwater, and subsequent changes in soil quality. Environmental monitoring will be completed throughout the institutional control period to confirm that the WRDF barriers are functioning as intended. This monitoring will be integrated into the overall CNL WL Groundwater Monitoring Program and will be compliant with *CSA N288.7-15: Groundwater Protection Programs at Class 1 Nuclear Facilities and Uranium Mines and Mills* (CSA Group 2015). Overall, changes to soil quality from groundwater quality are predicted to have a negligible residual effect on geology.

- **Loss or alteration of soil quantity and quality from construction of temporary supporting infrastructure.**

The Project will require the construction of temporary infrastructure (e.g., batch mixing plant or other similar equipment for preparation of grout) to support the ISD of the WR-1 Building. Temporary infrastructure will be located within the WL main campus that is previously disturbed and developed, limiting potential effects to soil quality and quantity. Erosion and sediment control practices (e.g., silt fences, runoff management) already in place at the WL site will be used during decommissioning activities around disturbed areas, where appropriate. As such, changes to soil quality and quantity from construction outside the WR-1 Building are predicted to have a negligible residual effect on geology.

- **Changes in soil quality from changes in air quality. General activities that require the use of vehicles and equipment that combust fuel and emit criteria air contaminants. These activities involve material handling, vehicles travelling on roads and wind erosion of stockpiles that will result in fugitive dust emissions.**

Deposition of particulates has the potential to affect local soil quality. Decommissioning activities from the Project will generate air and dust emissions such as carbon monoxide (CO), oxides of sulphur (SO_x includes sulphur dioxide [SO_2]), oxides of nitrogen (NO_x includes nitrogen dioxide NO_2), particulate matter ($PM_{2.5}$) and suspended particulate matter (SPM). Air emissions such as SOx and NOx can result from the use of fossil fuels in generators, vehicles and machinery. Vehicle exhaust and fugitive dust from roads is the largest contributor to particulate matter (SPM, PM_{10} and $PM_{2.5}$) during decommissioning activities.

Examples of mitigation practices implemented to limit predicted residual effects to air quality (and subsequently soil quality) include:

- implementation of CNL's *Environmental Protection* (CNL 2021a) and *Management and Monitoring of Emissions* (CNL 2018), which includes operational control monitoring, air verification monitoring and environmental monitoring;
- implementation of the dust management techniques;
- on-site vehicles and equipment engines will meet a minimum of Tier 3 emission standards, where possible, and be maintained in good working order;
- limit idling of vehicles on-site and limit speed on roads; and
- use of tarps or 3-sided enclosures for raw material storage.

With the implementation of CNL's *Management and Monitoring of Emissions* and through the implementation of the dust management techniques for the Project, concentrations of particulate matter (SPM, PM_{10}, $PM_{2.5}$), SO_2, NO_2 and carbon monoxide are all predicted to be lower than applicable air quality guidelines/standards during the closure phase of the Project (Section 6.2.1.6.2 Application Case Results). As such, air and dust emissions and subsequent deposition are expected to result in minor and local changes to soil quality relative to Base Case conditions. Therefore, this pathway was determined to have a negligible residual effect on geology.

6.3.1.6.2.3 Primary Pathways

No primary pathways were identified as having residual effect on geology. As such, the residual effects analysis and determination of significance is not completed for the assessment of geology.

6.3.1.7 Monitoring and Follow-up

CNL will implement an Environmental Assessment Follow-up Program for the Project to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. This monitoring will be integrated with that for the existing Environmental Assessment Follow-up Program for the WL site, where practical. Monitoring and follow-up programs specific to soil quality are not identified for the Project as there are no predicted residual effects to soil quality; rather, monitoring will be implemented for other disciplines to verify effects predictions for soil quality. For example, environmental monitoring will be completed throughout the institutional control period to confirm that the WRDF barriers are functioning as intended. This monitoring will be integrated into the overall CNL WL Groundwater Monitoring Program to verify that changes to soil quality as a result of groundwater are negligible. In addition, CNL's *Management and Monitoring of Emissions* will include monitoring objectives air quality to verify that air emissions during closure have a negligible effect on soil quality.

It is noted that data generated by the monitoring program will be evaluated on an ongoing basis within an adaptive management framework. Within this framework, modifications to the program may be appropriate to confirm data continue to fulfill program objectives. For example, should a contaminant of potential concern reach concentrations outside the range predicted in the EIS, the frequency of sampling may be increased and additional locations may be sampled to investigate the source of the increased concentrations. Conversely, cessation of a monitoring activity might be appropriate once it has been shown that an effect has stabilized or has been reduced to a level where it is no longer considered relevant with respect to regulatory requirements or community concerns. Any proposals for modifications to the monitoring program and the rationale for the modifications will be

communicated to the CNSC prior to implementation. Additional information on the Environmental Assessment Follow-up Program for the Project can be found in Section 11.0 Summary of Monitoring and Follow-up Programs.

6.3.1.8 Conclusions

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous people, or the public (The Agency 2018). Geology, which includes bedrock, soils and geomorphology, is recognized as an important component of the environment that may be affected by the Project and changes to geology could, in turn, lead to effects on other VCs selected for assessment. Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations did not identify any additional VCs as it relates to the geological assessment. Acknowledging that changes to geology are considered to be important aspects of the natural and human environment, geology is referred to as an intermediate component. Results of the analysis of changes in measurement indicators for geology are provided to other disciplines for inclusion in their assessment.

Potential effects on geology are limited to changes in soil quantity and quality as a result of construction of temporary supporting infrastructure (e.g., batch mixing plant or other similar equipment for preparation of grout) for the Project, and changes to soil quality from air emissions and groundwater transport from the WRDF. Mitigation and environmental design features implemented for the Project are well-understood and include existing practices at the WL site. In addition, monitoring will be implemented for air quality and hydrogeology to verify effects predictions for soil quality. Consequently, no residual effects on geology are predicted as a result of the Project.

6.3.2 Hydrogeology

This section of the Environmental Impact Statement (EIS) examines the potential residual effects of the Project on the hydrogeological environment.

6.3.2.1 Scope of the Assessment

This section focuses on hydrogeology and follows the overall approach and methods described in Section 6.1 Environmental Assessment Approach. The assessment was completed in the following steps.

- **Step 1 – Identify Valued Components (VCs) and defines the spatial boundaries, temporal boundaries and assessment cases** (refer to Sections 6.3.2.3 Valued Components and 6.3.2.4 Assessment Boundaries) for the hydrogeology assessment. The VCs and measurement indicators used to assess Project-related changes to hydrogeology; the spatial and temporal boundaries at which the assessment occurred; and the assessment cases considered are described.
- **Step 2 – Describe the existing conditions** (refer to Section 6.3.2.5 Description of the Environment). Existing conditions in the local and regional areas are described, including the combined effects of previous and existing developments (Base Case). The existing environment represents the historical and current environmental pressures that have shaped the observed patterns in the environment (i.e., natural variation).
- **Step 3 – Evaluate Project interactions and mitigation** (refer to Section 6.3.2.6 Project Interactions and Mitigation). Project components and/or activities with the potential to affect hydrogeology are identified and mitigation options are presented to limit or avoid these effects. A pathways analysis is then used to focus on key interactions between the Project and determine if mitigation, can limit or eliminate the predicted residual effects. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. Where effects are adequately mitigated and are not forwarded for further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are described. Primary pathways that may lead to residual effects to hydrogeology after incorporating mitigation are carried forward to Steps 4 for further analysis and residual effects characterization.
- **Step 4 – Present the methods and results of the residual effects analysis** (refer to Section 6.3.2.7 Residual Effects Analysis). This section outlines the methods used to predict and characterize residual effects to hydrogeology from primary effect pathways. The analysis results are presented, including the characterization of: (i) residual incremental effects of the Project and the effects of the Project in combination with past and present developments on hydrogeology (Application Case); and (ii) residual effects of the Project in combination with past and present developments, as well as other reasonably foreseeable developments (Reasonably Foreseeable Development Case). A key outcome of this section is the predicted effects to hydrogeology that are passed on to other VCs for inclusion in their assessment.
- **Step 5 – Describe the level of certainty and management of uncertainty** (refer to Section 6.3.2.8 Prediction Confidence and Uncertainty). Evaluate the available literature, data and models used for the assessment, and describe the level of certainty that can be placed on predicted residual effects. This section will also identify how the uncertainty has been managed so that the effects are not underestimated.

- **Step 6 – Classify and determine the significance of the predicted residual effects.** This step was not required as the hydrogeology VC is an intermediate component which does not include an assessment endpoint to determine significance.
- **Step 7 – Identifying monitoring and follow-up** required to confirm effects predictions and address uncertainty (refer to Section 6.3.2.9 Monitoring and Follow-up).
- **Step 8 – Present a consolidated summary of conclusions and outcomes of the assessment** of residual effects on hydrogeology (refer to Section 6.3.2.10 Conclusions).

6.3.2.2 Indigenous Engagement Feedback – Key Interests and Concerns

Interests and concerns raised by Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations during engagement related to the hydrogeology assessment are summarized in Table 6.3.2-1. Other general concerns and questions raised during Indigenous engagement activities are documented in Section 4 Indigenous Engagement.

Table 6.3.2-1: Summary of Key Interests and Concerns Raised During Indigenous Engagement Activities Related to the Hydrogeology Assessment

Interest and Concern	Inclusion Status	Additional information and Rationale
Effects on Groundwater ■ Groundwater releases to surface water ■ How groundwater releases could be contained in the soil ■ Long-term effect on surface water quality ■ Future releases of hazardous and radioactive material	Already included in the environmental assessment	Effects on groundwater quality are described in Section 6.3.2.7 Residual Effects Analysis. Long-term effects of groundwater on the Winnipeg River are considered under Surface Water Quality (Section 6.4.2.7 Residual Effects Analysis).
Effects on the Winnipeg River ■ Discharges that relate to the Winnipeg River ■ Potential for future releases of hazardous and radioactive material into the Winnipeg River through groundwater	Already included in the environmental assessment	Effects of groundwater on the Winnipeg River are considered under Surface Water Quality (Section 6.4.2.7 Residual Effects Analysis).
Monitoring ■ Monitoring after decommissioning	Already included in the environmental assessment As a result of engagement on the Project's follow-up monitoring program thus far, CNL has committed to adding additional ground monitoring well(s) between the WR-1 reactor and the Winnipeg River as requested by the Red River Métis	Information on the monitoring program is available in Section 6.3.2.9 Monitoring and Follow-up. This commitment has been added to Section 6.3.2.9 Monitoring and Follow-up and Section 11.0 Summary of Monitoring and Follow-up Programs.

6.3.2.3 Valued Components

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). Hydrogeology is recognized as an important component of the environment that may be affected by the Project. Acknowledging that changes to hydrogeology could lead to effects on other VCs, hydrogeology is referred to as an intermediate VC (i.e., it does not have an assessment endpoint). For example, changes to the characteristics of groundwater quality from release of solutes as the grout and reactor components gradually deteriorate may have a influence on surface water quality, which in turn can affect terrestrial and aquatic biodiversity and human health (Table 6.3.2-2). Indigenous engagement confirmed the importance of effects to hydrogeology. Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations were concerned that the Project may affect groundwater quality.

Table 6.3.2-2: Valued Components for Hydrogeology Assessment

Valued Component	Rationale for Selection
Hydrogeology (groundwater quality and quantity)	Characteristics of hydrogeology, such as groundwater quantity and quality are important components that interact with other valued components (e.g., hydrology and surface water quality) and if changed by Project activities could affect terrestrial and aquatic biodiversity and human health.

Changes to intermediate VCs must be understood to facilitate assessment of Project interactions. The hydrogeology assessment, therefore, is analyzed for incremental and cumulative (if applicable) changes in the relevant measurement indicators associated with hydrogeology (Table 6.3.2-3). The changes are characterized in terms of magnitude, duration and geographic extent, but are not classified using rankings for effects criteria. The hydrogeology assessment also does not include the assessment of the significance of these changes; rather, results of the analysis of changes in measurement indicators for hydrogeology are provided to other disciplines for inclusion in their assessment (Table 6.3.2-3).

Table 6.3.2-3: Assessment Endpoints and Measurement Indicators for the Hydrogeology Assessment

Valued Component	Measurement Indicators	Discipline Assessments where Effects on Hydrogeology are Considered
Hydrogeology	■ Groundwater flow patterns and discharge rates (groundwater quantity). ■ Groundwater table elevations (groundwater quantity). ■ Peak solute mass loadings of contaminants in groundwater to the Winnipeg River (groundwater quality).	■ Section 6.4 Surface Water Environment. ■ Section 6.5 Aquatic Environment. ■ Section 6.6 Terrestrial Environment. ■ Section 6.7 Human and Ecological Health.

6.3.2.4 Assessment Boundaries

6.3.2.4.1 Spatial Boundaries

The spatial boundaries selected for the hydrogeology assessment are presented on Figure 6.3.2-1. These boundaries coincide with those used in the geology assessment and are described below.

- **Site Study Area (SSA)** is the Whiteshell Reactor 1 (WR-1) Building and represents the Project footprint (i.e., where project activities will be undertaken; 0.07 ha).
- **Local Study Area (LSA)** is defined as the area within which there is potential for measurable changes resulting from the proposed Project activities. The LSA is delineated by the boundaries of the groundwater model for the Project, which were selected based on groundwater elevation data and topography. The western boundary of the LSA is approximately 800 m west of the WR-1 Building and coincides with the inferred groundwater flow divide at the centre of the Winnipeg River. The northern boundary of the LSA is approximately 450 m) north of the WR-1 Building and is parallel to the inferred direction of groundwater flow. The location of this boundary was selected as it follows a topographic divide and is south of the Lagoon Area. The southern boundary of the LSA is approximately 1,400 m south of the WR-1 Building and is parallel to the inferred direction of groundwater flow. The location of this boundary was selected as it coincides with a topographic divide and an inferred divide in groundwater flow. The eastern boundary of the LSA is located approximately 700 m east of the WR-1 Building and approximately 500 m east of the WL main campus (approximately 260 ha). This boundary is perpendicular to the inferred direction of groundwater flow and upgradient of the WR-1 Building.
- **Regional Study Area (RSA)** is defined as the area within which the potential effects of the Project may interact with the effects of other existing or reasonably foreseeable projects. The RSA is delineated by the Whiteshell Laboratories (WL) site boundary (approximately 4,375 ha).

LEGEND

- WR-1 BUILDING (SITE STUDY AREA)
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- WASTE MANAGEMENT AREA
- WHITESHELL LABORATORIES MAIN CAMPUS
- LANDFILL

BASE FEATURES

- CITY/TOWN
- TRANSMISSION LINE
- PROVINCIAL PARK

0 1,000 2,000

1:40,000 METRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY (RSA) PROVIDED BY CNL (2016-11-22)
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT
CANADIAN NUCLEAR LABORATORIES

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
SPATIAL BOUNDARIES FOR THE HYDROGEOLOGY ASSESSMENT

CONSULTANT

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0010	2	**6.3.2-1**

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Path: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0010_EIS_Sec_6.3.2\20145046-0010-G-0001_Figure 6_3_2-1 Spatial Boundaries Selected for the Hydrogeology Assessment.mxd

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6.3.2.4.2 Temporal Boundaries

The temporal boundary of the assessment is the timeframe during which Project activities are occurring and the duration of predicted residual effects. The duration of an effect is defined as the amount of time between the start and end of a Project activity or stressor (which is related to the Project phases) plus the time required for the residual effect to be reversed. In some cases, a residual effect may be irreversible within the temporal boundaries of the Project if the effects were predicted to last so far into the future that they could not be predicted with any level of certainty (e.g., residual effect lasts for thousands of years). The following phases were identified for the Project:

- **Closure Phase:** Preparation and implementation of in situ disposal (ISD), which includes preparation for ISD, grouting of below-grade structures and systems, removal of above-grade WR-1 structures and systems, installation of the concrete cap and engineered cover, and environmental controls, and final site restoration. These activities last from 2022 to 2027.
- **Post-closure Phase:** The post closure phase has two discrete periods: institutional control and post institutional control. Institutional control is estimated to last 100 years during which long-term monitoring and maintenance activities will continue to demonstrate Whiteshell Reactor Disposal Facility (WRDF) performance is in compliance with the safety case assumptions and performance modelling. The 100 year timeframe is not related to the design life of the WRDF barriers. The 100-year active monitoring period was selected to ensure that sufficient opportunity is provided to verify the WRDF is performing as expected. Additionally, beyond 100 years, there is less confidence that institutional controls, like access restrictions, can be relied upon. Although the duration of institutional control is estimated at 100 years, it is recognized that it will continue until the CNSC, or the appropriate authority at the time, agrees it is no longer needed.

  Post-institutional control occurs after year 2127 and continues indefinitely. The post-closure phase will continue indefinitely; however, the timeframe defined for assessment of potential effects as part of the normal evolution of the Project is 10,000 years. This time period encompasses the phase in which peak effects are anticipated.

6.3.2.4.3 Assessment Cases

The hydrogeology assessment has three assessment cases:

- **Base Case:** represents existing conditions and characterizes combined effects from previous and existing developments and activities. The Base Case reflects the effects of existing disturbances, such as forestry, transportation, agricultural and residential and recreational development. Current effects from the existing facilities and operations at the WL site, for example, are considered part of the Base Case. In addition, existing conditions of areas not affected by the WL site are also considered as part of the Base Case. Effects from the decommissioning and reclamation activities already completed at the WL site are also considered as part of the Base Case.
- **Application Case**: represents predictions of the effects of the Base Case combined with the effects that may result from the Project. The Application Case considers potential effects from the Project during closure through to the post-closure phase.

- **Reasonably Foreseeable Developments (RFD) Case**: represents the predictions of the cumulative effects of the Application Case, plus projects that are currently under application review or that have officially entered a regulatory application process and which overlap with the RSA. Foreseeable developments in the RSA that are expected to overlap with residual effects on groundwater quality from the Project includes the decommissioning of the remaining infrastructure and support facilities and remediation of affected lands at the WL site as per the existing decommissioning licence. A Comprehensive Study Report (AECL 2001) under the *Canadian Environmental Assessment Act, 1992* was completed for the decommissioning of the WL site. The Environmental Assessment decision to approve the Project was announced by the Minister of the Environment in March 2002 and a decommissioning licence was issued to Atomic Energy of Canada Limited (AECL) and subsequently to Canadian Nuclear Laboratories (CNL). There are no other foreseeable developments in the RSA that are expected to overlap with changes to groundwater quality (Table 6.3.2-4).

Table 6.3.2-4: Reasonably Foreseeable Developments considered in the Hydrogeology Assessment

Type of Project	Location	Description	Timeframe	Overlap with Valued Components
Infrastructure Decommissioning	WL	Decommissioning of remaining infrastructure on the WL site (includes in situ disposal of the low-level waste trenches).	2016 to 2027	Yes – there is both spatial and temporal overlap of effects with the Project
Environmental Remediation	WL	Remediation of affected lands, with the exception of some low-level waste trenches.	2016 to 2027	Yes – there is both spatial and temporal overlap of effects with the Project

6.3.2.5 Description of the Environment

6.3.2.5.1 Methods

Baseline hydrogeological data were summarized from the review of the following reports:

- Hydrogeologic Regime of the Environmental Control Area and Vicinity, Whiteshell Nuclear Research Establishment, Manitoba, Preliminary Progress Report (Cherry et al. 1970).
- Hydrogeological Studies at a Subsurface Radioactive-Waste-Management Site in West-Central Canada (Cherry et al. 1973).
- Review of hydrogeology of the radioactive waste management site, Final Report, Prepared for: Atomic Energy of Canada Limited (Robertson and Cherry 1985).
- Whiteshell Laboratories Decommissioning Project, Comprehensive Study Report (AECL 2001).
- Follow-Up Program, Summary Report: Hydrogeology of the WMA, Lagoon and Landfill-Enhanced Monitoring Program (AECL 2008).
- Whiteshell Laboratories Projects Branch Comprehensive Final Report on Installation of 7 Groundwater Monitoring Wells Nests (KGS Group 2016).
- Canadian Nuclear Laboratories WR-1 Hydrogeological Study Report (Dillon 2018).

Dillon (2018) provides details on recent geological and hydrogeological investigations of the LSA, which (in part) involved drilling and instrumentation of 7 monitoring well nests and a single monitoring well (16-8A) that encompass a total of 33 monitoring wells. The monitoring wells are named numerically (i.e., monitoring well nest 1 through monitoring well nest 7). Each monitoring well nest includes between 4 and 6 monitoring wells. Individual monitoring wells are named using the installation year, the monitoring well nest number and a letter generally indicating the relative depth (with A assigned to the deepest monitoring well within the overburden and the final letter assigned to the bedrock interval). In the following sections, the term monitoring well nest is used to refer to the conditions observed throughout the group of monitoring wells, while individual monitoring well names are used to refer to conditions at a specific depth interval. The monitoring well names and geological units and the inferred top and bottom of each unit for each monitoring well nest are summarized in Table 6.3.2-5 with information from Dillon (2018). The locations of the monitoring wells nests are shown on Figure 6.3.2-2.

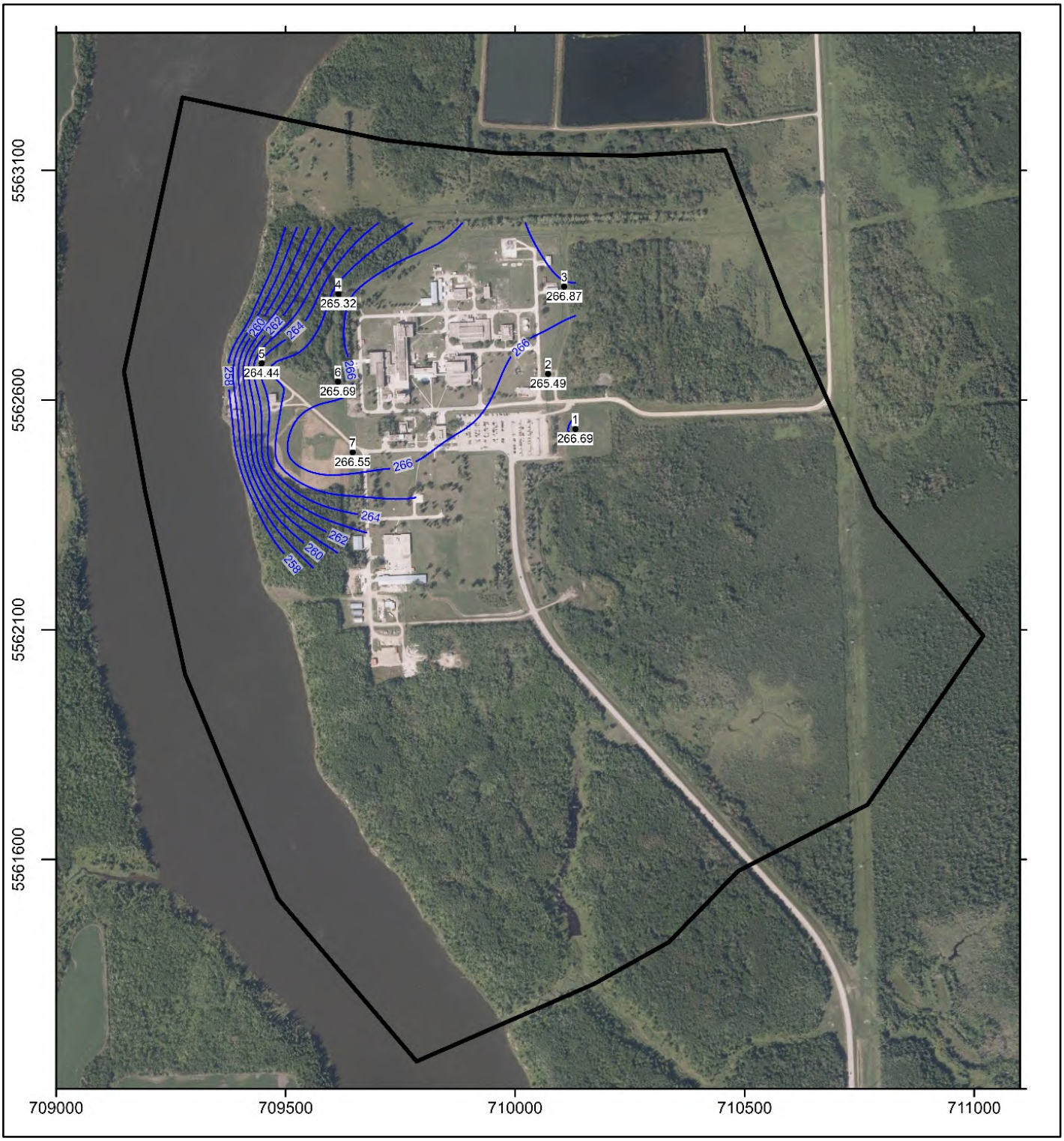
Table 6.3.2-5: Monitoring Well Nest Details

Monitoring Well Nest	Monitoring Well	Hydrostratigraphic Unit	Top of Unit Elevation (masl)	Bottom of Unit Elevation (masl)
1	15-1A	Basal Sand	257.23	—
	15-1B	Clay Till	261.90	257.23
	15-1C	Clay	268.03	261.90
	15-1D	Clay	268.03	261.90
2	15-2A	Basal Sand	257.50	251.52
	15-2B	Clay Till	261.50	257.50
	15-2C	Clay Till	261.50	257.50
	15-2D	Clay	267.30	261.50
	16-2E	Bedrock	251.52	—
3	15-3A	Basal Sand	258.10	—
	15-3B	Clay Till	261.10	258.10
	15-3C	Clay	267.24	261.10
	15-3D	Clay	267.24	261.10
4	15-4A	Basal Sand	253.10	249.48
	15-4B	Clay Till	259.10	253.10
	15-4C	Clay Till	259.10	253.10
	15-4D	Clay	266.40	259.10
	15-4E	Clay	266.40	259.10
	16-4F	Bedrock	249.48	—
5	15-5A	Basal Sand	253	—
	15-5B	Clay Till	258.20	253
	15-5C	Clay	265.37	258.20
	15-5D	Clay	265.37	258.20
6	15-6A	Clay Till	260.29	—
	15-6B	Clay Till	260.29	—
	15-6C	Clay Till	260.29	—
	15-6D	Clay	266.99	260.29
7	15-7A	Clay Till	261.55	254.55
	15-7B	Clay Till	261.55	254.55
	15-7D	Clay	267.05	261.55
	16-7E	Bedrock	246.26	—
8	16-8A	Bedrock	252.83	—

masl = metres above sea level; — = no available measurement.

Groundwater level measurements have been periodically taken from these monitoring wells since December 2015. Groundwater elevation data from December 2015 through November 2016 were initially reviewed to evaluate the groundwater conditions in the vicinity of WR-1 as detailed below. These data were interpreted for the clay, clay till and combined basal sand/upper bedrock units and used to form the basis of the groundwater assessment (the basal sand and upper bedrock units were combined for the purpose of generating potentiometric surface maps due to the similar groundwater elevations and neutral vertical gradients observed between these units). Subsequent groundwater elevation data collected in 2017 and 2018 (that are included in Dillon's 2018 report) have been reviewed and found to be consistent with the 2015-2016 data. As such, the 2015-2016 data were maintained as the basis for interpretation of groundwater conditions. It should be noted that the influence of the other WL main campus buildings on the groundwater flow system (e.g., due to removal of water from building sumps and preferential drainage pathways) was not considered in the interpretation of the groundwater elevations presented herein. While water level measurements collected may have been influenced by these buildings, the monitoring wells are generally located too distant from the known locations of building sumps to confirm this influence. Water levels can be expected to rise to some degree as the existing sumps and storm and sewer drains are removed. This will lead to local variations in groundwater flow direction as the former building basement and crawlspaces gradually become filled in and compacted, and regionally consistent groundwater flow is re-established.

Groundwater samples were collected from each monitoring well in monitoring wells nests 2, 4 and 7 in October 2016 as part of the Dillon (2018) hydrogeological investigation (see Figure 6.3.2-2). These samples were analyzed for select major ions and radiological constituents. Groundwater quality in the LSA is based on the results and interpretation provided by Dillon (2018).



LEGEND

- INTERPRETED GROUNDWATER ELEVATION (mASL)
- PIEZOMETER NEST LOCATION
- LOCAL STUDY AREA

NOTES

GROUNDWATER ELEVATIONS TAKEN BETWEEN SEPTEMBER 14, 2016 AND SEPTEMBER 26, 2016.

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PROJECT

EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE

GROUNDWATER ELEVATIONS IN CLAY UNIT

CONSULTANT

WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	--
PREPARED	RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046		2	**6.3.2-2**

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S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PRO\20145046\40_PROD\0010_EIS_Sec_6.3.2\20145046-0010-G-0002_Figure_6_3_2-2_Groundwater_Elevation_in_Clay.mxd

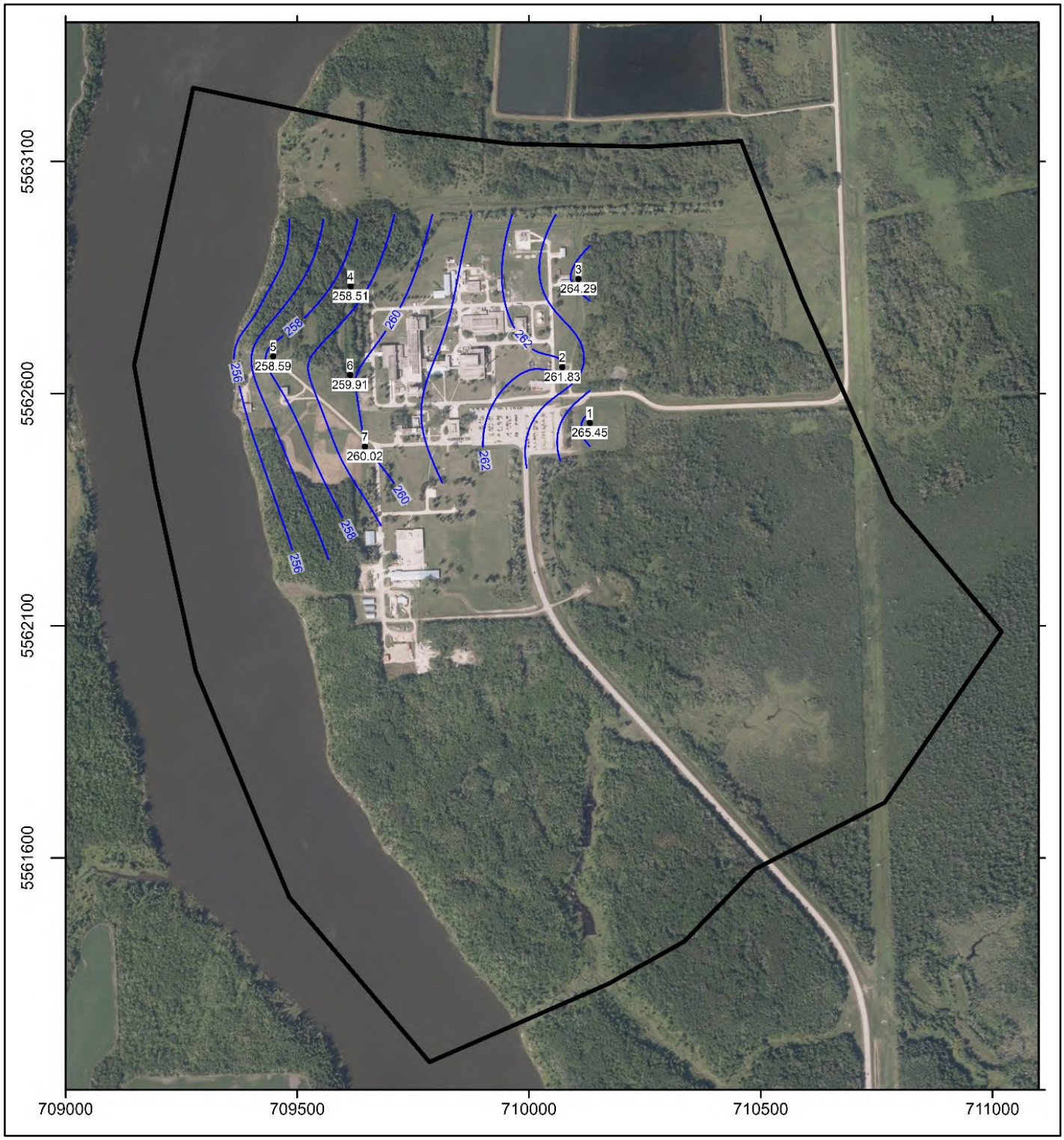
6.3.2.5.2 Results

6.3.2.5.2.1 Groundwater Elevations and Flow Directions

Groundwater flow in the unconsolidated sediments and bedrock within the RSA generally follows topography, with the predominant direction of groundwater flow occurring from east to west. Within the Precambrian bedrock groundwater flow occurs primarily within fractures (AECL 2001). Based on the available information from previous hydrogeological investigations (Robertson and Cherry 1985) groundwater recharge primarily occurs in the local topographic high located approximately 3 km east of the WL main campus (where the geological conditions (a former glacial Lake Agassiz beach structure) at surface allow for greater infiltration) and groundwater discharge ultimately occurs at the Winnipeg River.

The interpreted groundwater elevations for the LSA are illustrated on Figures 6.3.2-2 through 6.3.2-4, based on groundwater elevation measurements from September 2016, which corresponds to the calibration targets used in the groundwater flow modelling assessment (see Section 6.3.2.7). The groundwater elevation data are plotted through time from December 2015 through September 2018 on Figure 6.3.2-5A through Figure 6.3.2-5D, and the measured groundwater elevation data are provided in Table 6.3.2-6. The following observations are made based on a review of these figures and table.

- As shown on Figure 6.3.2-2 through Figure 6.3.2-4, the groundwater flow direction in the LSA was consistent with the existing conceptualization for the RSA in that flow generally occurs from east to west (i.e., towards the Winnipeg River) for all hydrostratigraphic units.
- Groundwater elevations at monitoring well nest 2 were consistently low compared to nearby monitoring wells, potentially indicating an enhanced degree of hydraulic connection between monitoring well nest 2 and the sump in the WR-1 Building (Dillon 2018).
- Groundwater elevations at individual monitoring wells typically varied within 1 m to 3 m over the data record, following a period of recovery data from drilling and instrumentation of the well. At monitoring well 15-4B, 15-5B, 15-5C and 15-6B (situated in the clay and clay till) groundwater elevations varied by approximately 5 m to 6 m, with the highest groundwater elevation occurring on May 27, 2016 and the lowest groundwater elevation occurring in December 2015 and November 2016. Groundwater elevations measured at these wells from August and September 2018 indicate that the groundwater elevation data collected since May 2016 are within the range of seasonal variability at these locations.
- The variability in groundwater levels observed in 2016 at 16-2E, 16-4F and 16-7E (situated in the bedrock) is indicative of recovery following drilling and hydraulic testing. It is inferred that the bedrock in which these wells are screened has a very low hydraulic conductivity, resulting in long periods of recovery from drilling and hydraulic testing. This long recovery time is more apparent for 16-2E. Based on the more recent measurements at these monitoring locations, the groundwater level recovery appeared to be complete by November 9, 2016.
- Groundwater elevation measurements have been periodically taken from the monitoring wells since December 2015. Monthly groundwater level measurements were from March 2016 to September 2016 to evaluate whether stabilization of water levels has been reached in the monitoring wells of the seven nests in the vicinity of WR-1. Water level measurements were subsequently taken at a frequency of twice a year to evaluate the recovery of groundwater in the bedrock wells and to provide a basis for ongoing monitoring of groundwater elevations.



LEGEND

- PIEZOMETER NEST LOCATION
- INTERPRETED GROUNDWATER ELEVATON (mASL)
- LOCAL STUDY AREA

NOTES

1. GROUNDWATER ELEVATIONS TAKEN BETWEEN SEPTEMBER 14, 2016 AND SEPTEMBER 26, 2016.

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TITLE
GROUNDWATER ELEVATIONS IN CLAY-TILL UNIT

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
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REVIEWED	KL
APPROVED	MM

PROJECT NO. 20145046 | CONTROL | REV. 2 | FIGURE **6.3.2-3**

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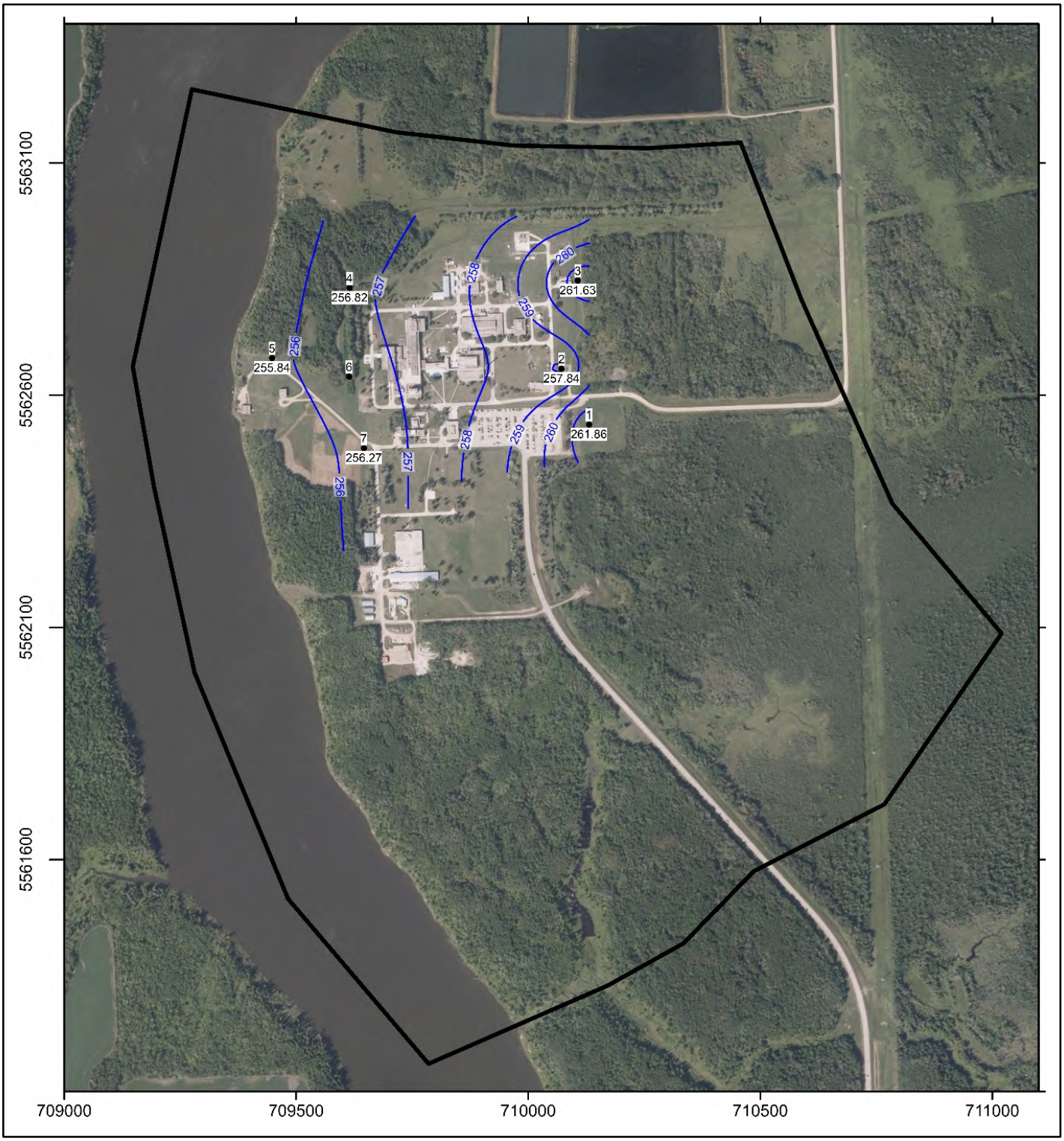

LEGEND

- PIEZOMETER NEST LOCATION
- INTERPRETED GROUNDWATER ELEVATON (mASL)
- LOCAL STUDY AREA

NOTES

GROUNDWATER ELEVATIONS TAKEN BETWEEN SEPTEMBER 14, 2016 AND SEPTEMBER 26, 2016.

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TITLE

GROUNDWATER ELEVATIONS IN COMBINED BASAL-TILL / UPPER BEDROCK UNIT

CONSULTANT

WSP GOLDER

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APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046		2	**6.3.2-4**

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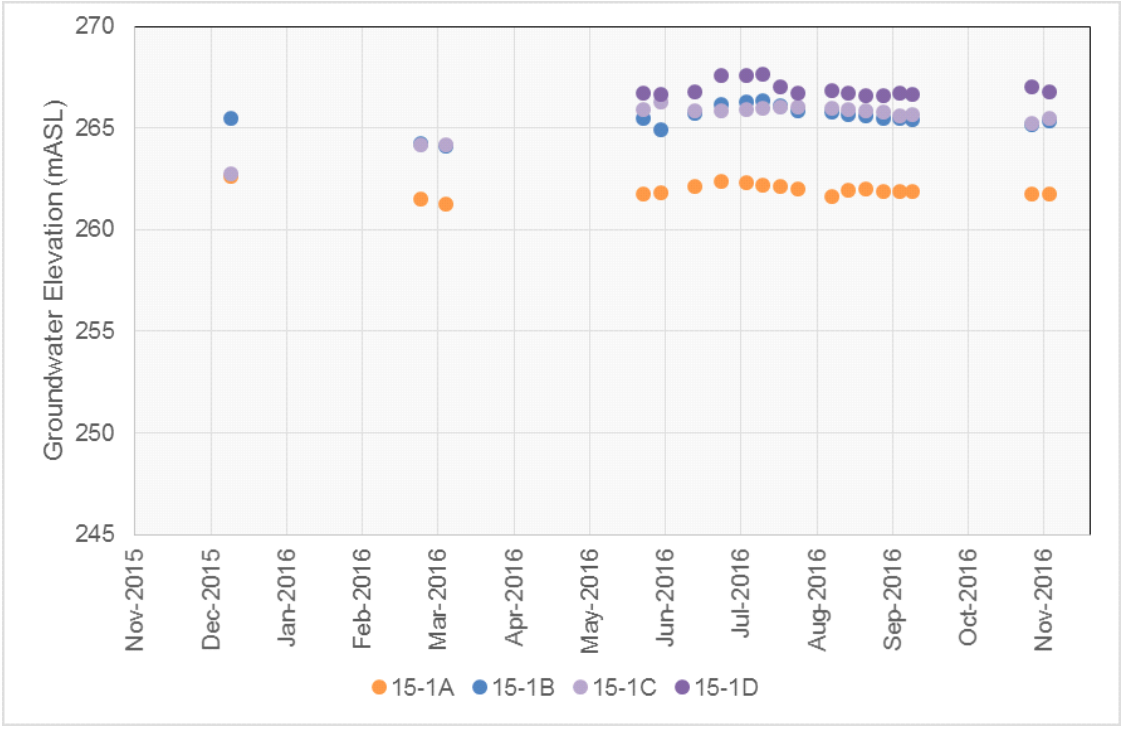

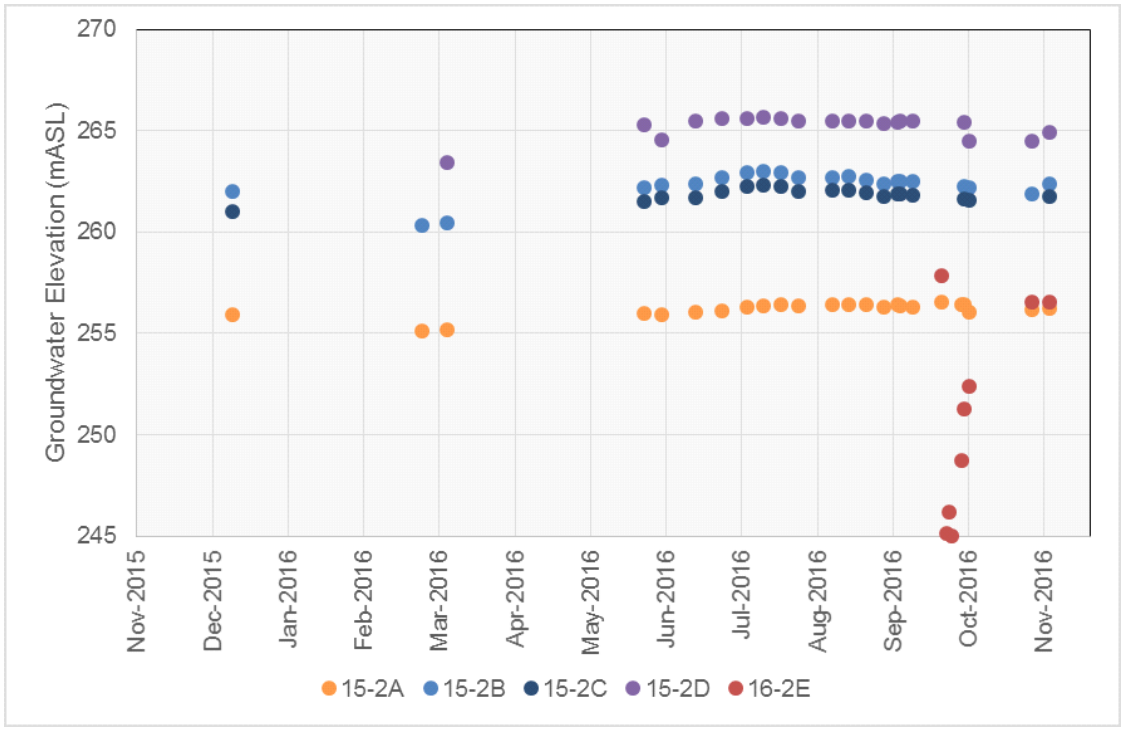

REFERENCE(S)

DILLON (DILLON CONSULTING LTD.). 2018. WR 1 HYDROGEOLOGICAL STUDY REPORT. CANADIAN NUCLEAR LABORATORIES DOCUMENT NO. WLDP-26000-REPT-004. NOVEMBER 2018

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TITLE
GROUNDWATER ELEVATIONS IN MONITORING WELL NESTS 1 AND 2

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
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APPROVED	MM

PROJECT NO. 20145046 | CONTROL | REV. 2 | FIGURE **6.3.2-5A**

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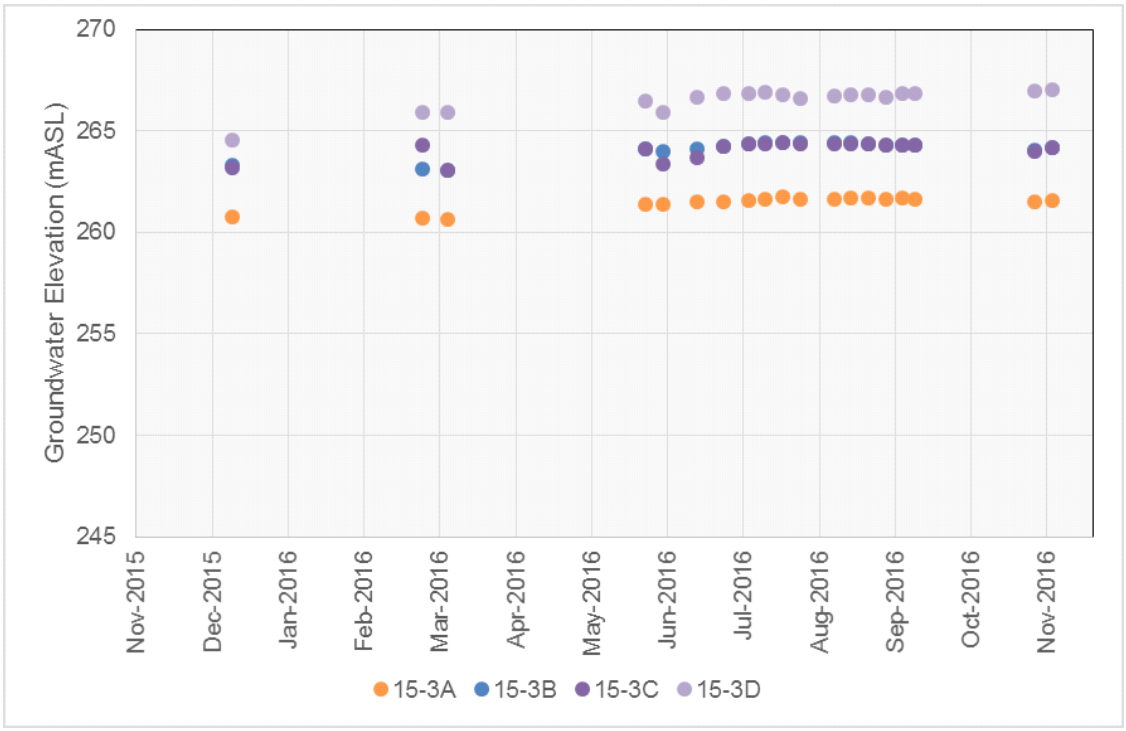
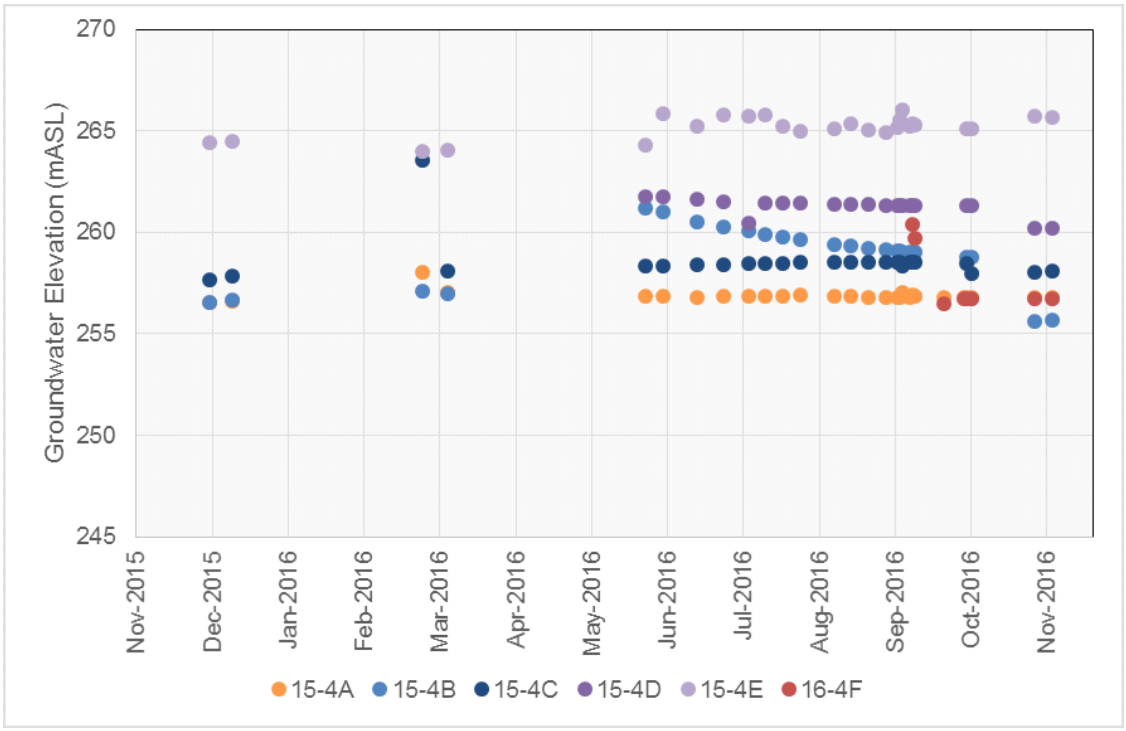
S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PRO\20145046\40_PROD\0010_EIS_Sec_6.3.2\20145046-0010-G-0005_Figure 6_3_2-5A_Groundwater Elevation in Nest1 and Nest2\Figure 6_3_2-5A_Groundwater Elevation in Nest 1 and Nest2.mxd





REFERENCE(S)

DILLON (DILLON CONSULTING LTD.). 2018. WR 1 HYDROGEOLOGICAL STUDY REPORT. CANADIAN NUCLEAR LABORATORIES DOCUMENT NO. WLDP-26000-REPT-004. NOVEMBER 2018

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PROJECT
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TITLE
GROUNDWATER ELEVATIONS IN MONITORING WELL NESTS 3 AND 4

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
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PREPARED	RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO. 20145046 | CONTROL | REV. 2 | FIGURE **6.3.2-5B**

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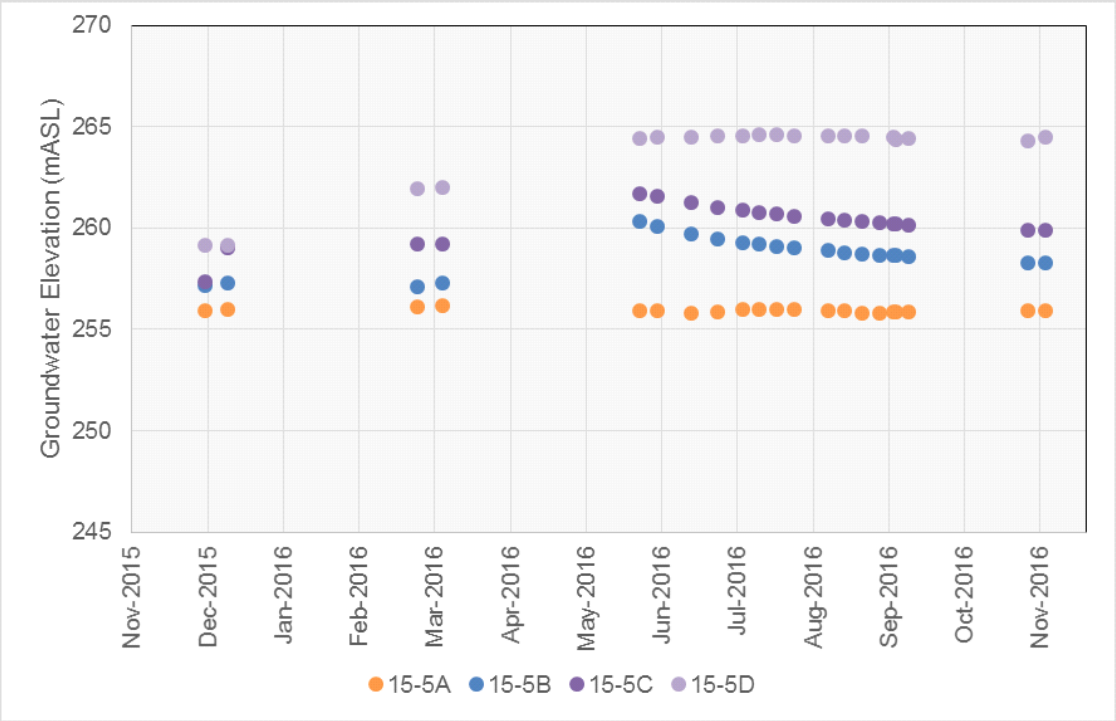
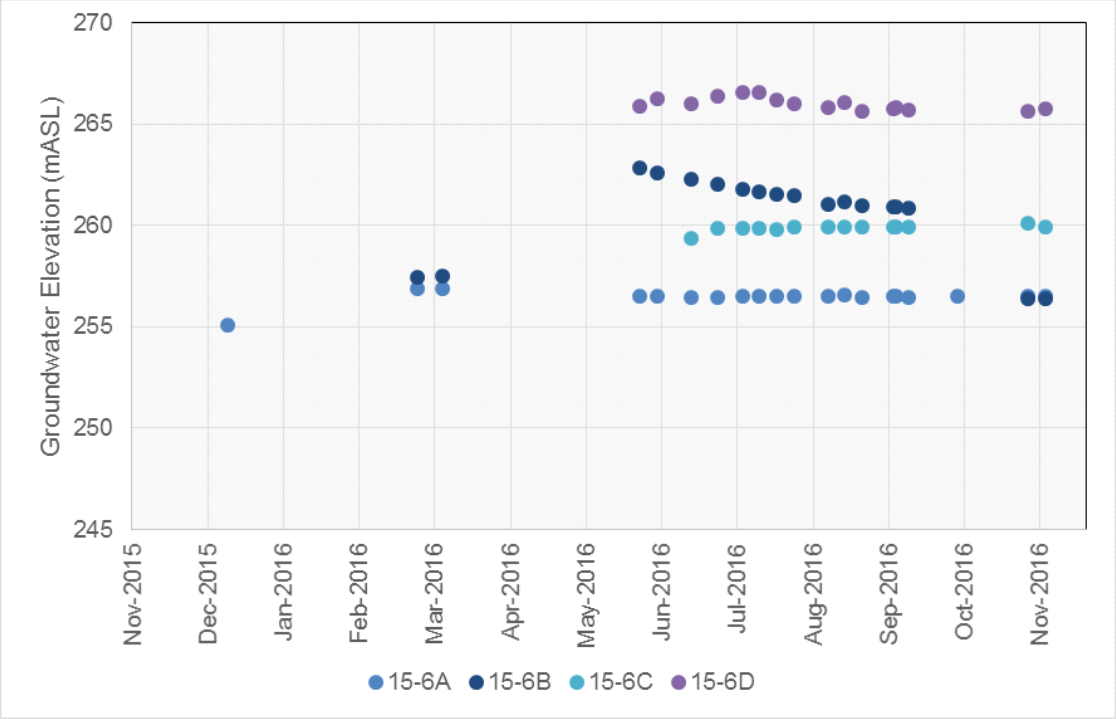
S:\Client\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0010_EIS_Sec_6.3.2\20145046-0010-G-0006_Figure 6_3_2-5B _Groundwater Elevation in Nest 3 and Nest 4.mxd





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DILLON (DILLON CONSULTING LTD.). 2018. WR 1 HYDROGEOLOGICAL STUDY REPORT. CANADIAN NUCLEAR LABORATORIES DOCUMENT NO. WLDP-26000-REPT-004. NOVEMBER 2018

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CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
GROUNDWATER ELEVATIONS IN MONITORING WELL NESTS 5 AND 6

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	--
PREPARED	RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046		2	**6.3.2-5C**

S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PRO\20145046\40_PROD\0010_EIS_Sec_6.3.2\20145046-0010-G-0007_Figure_6_3_2-5C_-_Groundwater_Elevation_in_Nest5_and_Nest6.mxd

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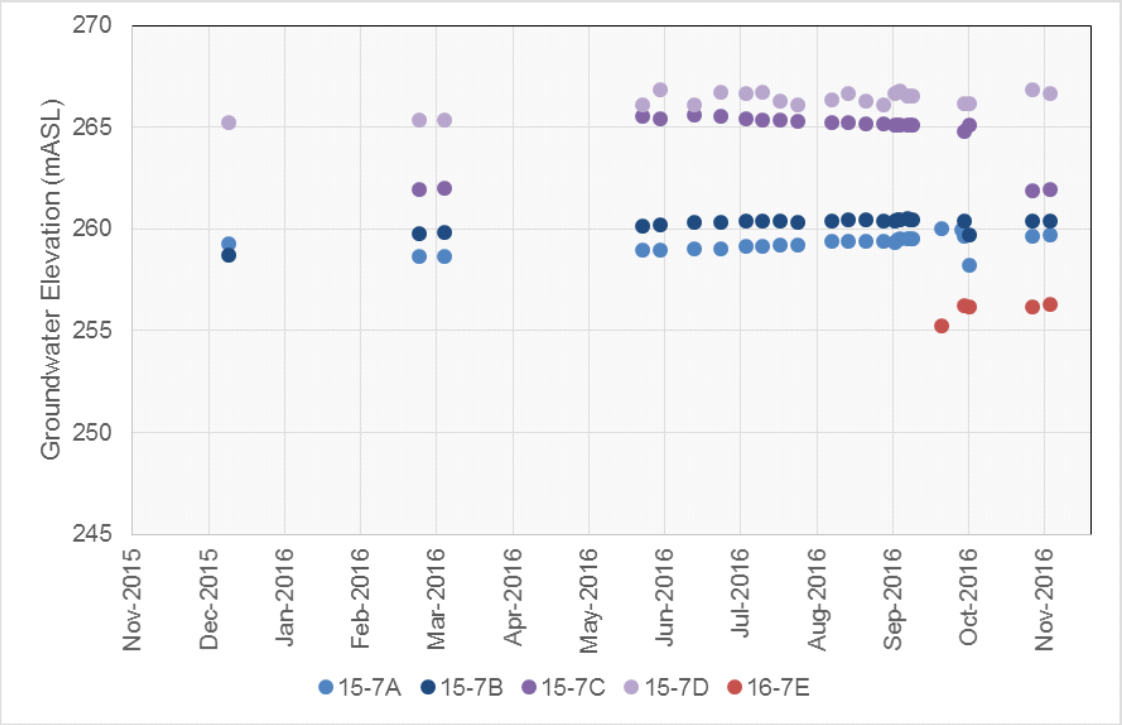

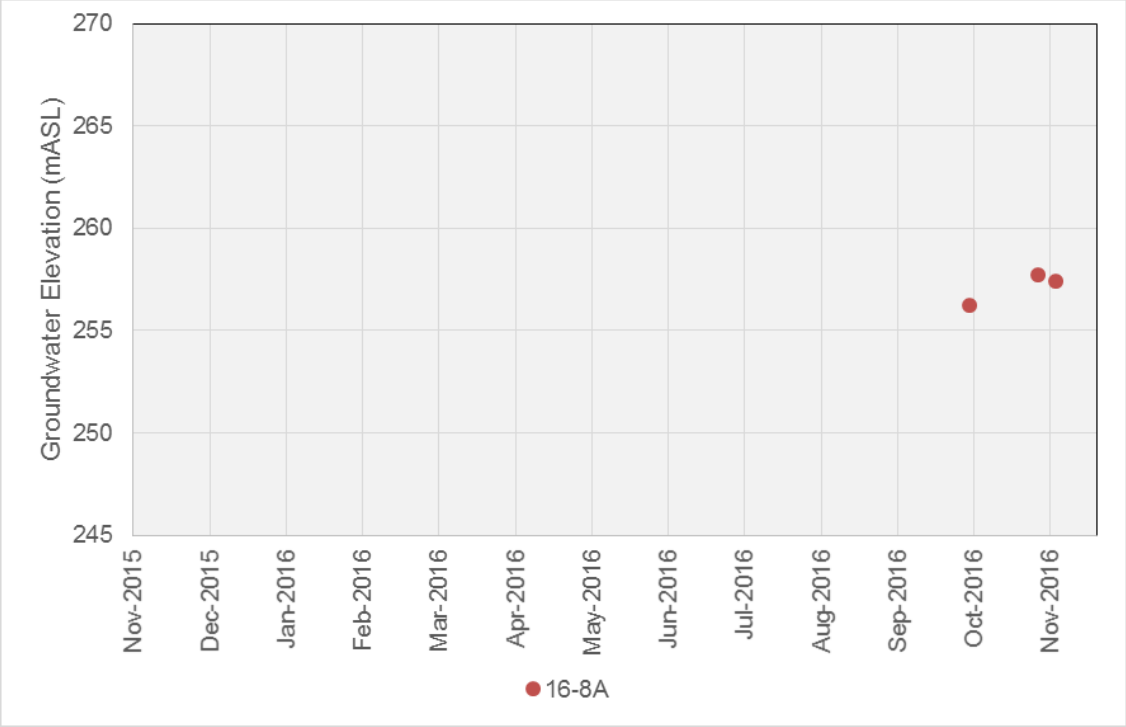

REFERENCE(S)

DILLON (DILLON CONSULTING LTD.). 2018. WR 1 HYDROGEOLOGICAL STUDY REPORT. CANADIAN NUCLEAR LABORATORIES DOCUMENT NO. WLDP-26000-REPT-004. NOVEMBER 2018

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
GROUNDWATER ELEVATIONS IN MONITORING WELL NEST 7 AND MONITORING WELL 16-8A

CONSULTANT

WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	--
PREPARED	RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO. 20145046 | CONTROL | REV. 2 | FIGURE **6.3.2-5D**

S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PRO\20145046\40_PROD\0010_EIS_Sec_6.3.2\20145046-0010-G-0008_Figure_6_3_2-5D_-_Groundwater_Elevation_in_Nest7.mxd

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Table 6.3.2-6: Groundwater Elevations

	Monitoring Well Nest 1				Monitoring Well Nest 2					Monitoring Well Nest 3				Monitoring Well Nest 4						Monitoring Well Nest 5				Monitoring Well Nest 6				Monitoring Well Nest 7					Monitoring Well 8
Date	15-1A	15-1B	15-1C	15-1D	15-2A	15-2B	15-2C	15-2D	16-2E	15-3A	15-3B	15-3C	15-3D	15-4A	15-4B	15-4C	15-4D	15-4E	16-4F	15-5A	15-5B	15-5C	15-5D	15-6A	15-6B	15-6C	15-6D	15-7A	15-7B	15-7C	15-7D	16-7E	16-8A
12/1/2015	–	–	–	–	–	–	–	–	–	–	–	–	–	256.55	256.55	257.68	–	264.43	–	255.92	257.19	257.37	259.16	–	–	–	–	–	–	–	–	–	–
12/10/2015	262.62	265.47	262.78	–	255.91	262.00	261.01	–	–	260.75	263.32	263.20	264.57	256.60	256.65	257.87	–	264.50	–	255.97	257.27	259.04	259.18	255.07	–	–	–	259.29	258.70	–	265.23	–	–
2/26/2016	261.53	264.25	264.18	–	255.12	260.36	–	–	–	260.68	263.13	264.28	265.94	258.05	257.12	263.58	–	264.01	–	256.11	257.13	259.19	261.95	256.90	257.43	–	–	258.65	259.76	261.93	265.39	–	–
3/7/2016	261.26	264.12	264.17	–	255.17	260.47	–	263.46	–	260.67	263.07	263.08	265.91	257.03	256.99	258.09	–	264.07	–	256.20	257.30	259.24	262.03	256.85	257.51	–	–	258.68	259.85	261.98	265.37	–	–
5/27/2016	261.79	265.48	265.90	266.70	255.99	262.18	261.54	265.30	–	261.41	264.11	264.11	266.45	256.85	261.23	258.34	261.79	264.33	–	255.91	260.33	261.68	264.43	256.53	262.81	–	265.87	258.98	260.13	265.56	266.11	–	–
6/3/2016	261.81	264.91	266.32	266.66	255.95	262.32	261.69	264.58	–	261.42	264.02	263.34	265.95	256.85	261.00	258.37	261.73	265.87	–	255.91	260.08	261.55	264.47	256.53	262.62	–	266.28	258.96	260.23	265.40	266.82	–	–
6/17/2016	262.16	265.76	265.85	266.78	256.08	262.40	261.72	265.49	–	261.49	264.11	263.71	266.65	256.80	260.55	258.39	261.61	265.23	–	255.79	259.74	261.26	264.49	256.45	262.25	259.37	266.02	259.02	260.33	265.59	266.08	–	–
6/28/2016	262.39	266.18	265.87	267.62	256.09	262.70	262.03	265.60	–	261.51	264.22	264.21	266.83	256.83	260.27	258.41	261.52	265.77	–	255.89	259.47	261.04	264.56	256.46	262.02	259.85	266.40	259.04	260.33	265.53	266.70	–	–
7/8/2016	262.31	266.31	265.94	267.62	256.29	262.93	262.28	265.64	–	261.55	264.36	264.34	266.86	256.87	260.07	258.47	260.49	265.71	–	255.97	259.29	260.87	264.58	256.49	261.81	259.83	266.56	259.13	260.38	265.44	266.67	–	–
7/15/2016	262.20	266.36	266.01	267.65	256.35	262.99	262.33	265.67	–	261.61	264.41	264.39	266.92	256.86	259.91	258.49	261.47	265.79	–	255.98	259.20	260.78	264.62	256.52	261.68	259.85	266.59	259.17	260.41	265.39	266.75	–	–
7/22/2016	262.16	266.13	266.06	267.02	256.41	262.93	262.28	265.62	–	261.74	264.46	264.44	266.80	256.87	259.78	258.50	261.44	265.24	–	255.98	259.12	260.68	264.61	256.53	261.56	259.83	266.22	259.21	260.38	265.36	266.30	–	–
7/29/2016	262.03	265.89	266.06	266.71	256.34	262.67	262.03	265.47	–	261.62	264.41	264.39	266.61	256.89	259.64	258.53	261.42	264.99	–	256.01	259.03	260.60	264.58	256.53	261.45	259.95	266.00	259.24	260.35	265.32	266.08	–	–
8/12/2016	261.62	265.81	265.97	266.86	256.43	262.71	262.06	265.48	–	261.65	264.40	264.40	266.73	256.86	259.41	258.53	261.38	265.12	–	255.94	258.88	260.45	264.57	256.52	261.06	259.91	265.83	259.38	260.43	265.24	266.34	–	–
8/19/2016	261.94	265.70	265.92	266.71	256.41	262.74	262.10	265.49	–	261.67	264.40	264.39	266.81	256.87	259.32	258.55	261.37	265.37	–	255.92	258.81	260.38	264.55	256.54	261.15	259.90	266.04	259.41	260.44	265.21	266.66	–	–
8/26/2016	262.02	265.61	265.88	266.59	256.40	262.60	261.96	265.49	–	261.68	264.38	264.37	266.81	256.82	259.23	258.55	261.36	265.05	–	255.83	258.75	260.31	264.53	256.44	260.98	259.91	265.66	259.42	260.44	265.18	266.30	–	–
9/2/2016	261.88	265.47	265.80	266.62	256.33	262.40	261.76	265.35	–	261.65	264.33	264.32	266.66	256.79	259.14	258.54	261.34	264.91	–	255.82	258.69	260.26	–	–	–	–	–	259.40	260.38	265.15	266.13	–	–
9/7/2016	–	–	–	–	–	–	–	–	–	–	–	–	–	256.78	259.07	258.51	261.32	265.17	–	–	–	–	–	–	–	–	–	259.36	260.42	265.12	266.65	–	–
9/8/2016	–	–	–	–	256.40	262.53	261.89	265.44	–	–	–	–	–	256.82	259.07	258.53	261.35	265.54	–	255.84	258.64	260.21	264.47	256.49	260.92	259.92	265.79	259.48	260.46	265.12	266.72	–	–
9/9/2016	261.87	265.46	265.59	266.75	256.39	262.53	261.89	265.48	–	261.67	264.33	264.33	266.86	257.07	259.06	258.35	261.34	266.04	–	255.85	258.63	260.20	264.39	256.49	260.90	259.92	265.82	259.50	260.48	265.11	266.77	–	–
9/12/2016	–	–	–	–	–	–	–	–	–	–	–	–	–	256.82	259.02	258.52	261.34	265.24	–	–	–	–	–	–	–	–	–	259.52	260.49	265.10	266.55	–	–
9/13/2016	–	–	–	–	–	–	–	–	–	–	–	–	–	256.95	259.01	258.52	261.32	265.36	260.37	–	–	–	–	–	–	–	–	259.50	260.47	265.10	266.55	–	–
9/14/2016	261.86	265.45	265.67	266.69	256.33	262.48	261.83	265.49	–	261.63	264.29	264.27	266.87	256.84	259.00	258.51	261.32	265.32	259.70	255.84	258.59	260.16	264.44	256.44	260.84	259.91	265.69	259.50	260.47	265.10	266.55	–	–
9/26/2016	–	–	–	–	256.54	–	–	–	257.84	–	–	–	–	256.82	–	–	–	–	256.46	–	–	–	–	–	–	–	–	260.02	–	–	–	255.22	–
9/28/2016	–	–	–	–	–	–	–	–	245.15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
9/29/2016	–	–	–	–	–	–	–	–	246.18	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
9/30/2016	–	–	–	–	–	–	–	–	245.02	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
10/4/2016	–	–	–	–	256.40	–	–	–	248.73	–	–	–	–	256.82	–	–	–	–	256.75	–	–	–	–	256.49	–	–	–	259.98	–	–	–	–	–
10/5/2016	–	–	–	–	256.42	262.27	261.63	265.40	251.27	–	–	–	–	256.82	258.79	258.47	261.32	265.12	256.76	–	–	–	–	–	–	–	–	259.67	260.42	264.78	266.14	256.23	256.22
10/7/2016	–	–	–	–	256.06	262.19	261.55	264.51	252.38	–	–	–	–	256.80	258.75	257.99	261.35	265.13	256.74	–	–	–	–	–	–	–	–	258.26	259.69	265.12	266.17	256.19	–
11/2/2016	261.76	265.19	265.26	267.02	256.15	261.88	–	264.48	256.55	261.53	264.03	264.02	266.98	256.79	255.61	258.04	260.19	265.72	256.75	255.90	258.27	259.91	264.33	256.48	256.41	260.08	265.66	259.64	260.40	261.92	266.82	256.19	257.74
11/9/2016	261.77	265.37	265.47	266.79	256.21	262.38	261.77	264.93	256.57	261.55	264.18	264.16	267.03	256.79	255.67	258.11	260.23	265.67	256.73	255.94	258.27	259.90	264.47	256.49	256.37	259.91	265.74	259.71	260.39	261.97	266.69	256.30	257.41
8/7/2018	260.32	263.18	263.14	264.95	–	–	–	–	–	259.91	262.22	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	261.86	260.94	264.15	265.52	255.98	–
8/9/2018	–	–	–	–	–	–	–	–	–	–	–	262.14	265.81	–	–	–	–	–	–	257.30	–	–	–	–	–	–	–	–	–	–	–	–	–
8/13/2018	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	259.26	261.30	265.37	256.34	259.42	–	264.20	–	–	–	–	–	–
8/15/2018	–	–	–	–	–	–	–	–	–	–	–	–	–	257.15	258.37	261.52	260.43	264.52	257.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–
8/16/2018	–	–	–	–	254.93	260.13	–	264.84	255.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
9/5/2018	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
9/12/2018	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table 6.3.2-6: Groundwater Elevations

	Monitoring Well Nest 1				Monitoring Well Nest 2					Monitoring Well Nest 3				Monitoring Well Nest 4						Monitoring Well Nest 5				Monitoring Well Nest 6				Monitoring Well Nest 7					Monitoring Well 8
9/14/2018	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
9/18/2018	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
9/20/2018	260.21	263.08	263.00	265.85	255.45	260.08	–	265.99	255.30	259.90	262.25	262.15	266.03	257.12	256.96	260.12	261.17	264.30	257.08	257.40	258.84	261.02	264.61	256.31	258.38	–	263.20	261.37	260.75	262.97	265.91	256.06	–
10/12/2018	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

a) Water level data provided in Dillon (2018).
b) "–" indicates no available measurement.

6.3.2.5.2.2 Hydraulic Gradients

Horizontal hydraulic gradients were estimated based on the groundwater elevations in monitoring wells located parallel to the direction of groundwater flow. Relatively neutral gradients were noted for the clay unit, with a maximum estimated gradient of approximately 0.007 metres per metre (m/m) between monitoring well nests 5 and 6. For the clay till unit, the horizontal gradient was approximately 0.012 m/m, as measured between monitoring well nests 3 and 4 and monitoring well nests 1 and 7. Similarly, for the combined basal sand/upper bedrock unit, the horizontal gradient was approximately 0.010 m/m, as measured between monitoring well nests 3 and 4 and monitoring well nests 1 and 7.

Vertical hydraulic gradients were calculated between the various units based on mid-point elevations of monitoring well screens, as summarized in Table 6.3.2-7. At all locations, groundwater elevations were highest in the clay unit and lowest in the combined basal sand/upper bedrock unit, indicating a downward direction of groundwater flow through the overburden. Between the clay and clay till units the vertical gradient ranged from 0.22 m/m at monitoring well nest 1 to 1.39 m/m at monitoring well nest 6, with an average vertical gradient of 0.83 m/m across all locations. Between the clay till and combined basal sand/upper bedrock units the vertical gradient ranged from 0.24 m/m at monitoring well nest 2 to 0.86 m/m at monitoring well nest 5, with an average vertical gradient of 0.52 m/m across all locations.

The principal groundwater gradients in the clay soils above the basal layer and bedrock interface are vertical (i.e., downward flow) and horizontal gradients in the clay are small in comparison. Given the low permeability soils above the basal layer there is no expectation of movement upwards to the surface from the WRDF or downgradient to the river.

Table 6.3.2-7: Vertical Gradients

Monitoring Well Nest	Groundwater Elevation[a] (masl)					Screen Elevation (masl)			Vertical Gradient[c]	
	Clay	Clay-Till	Basal Sand	Bedrock	BS/Br Maximum[b]	Clay	Clay-Till	BS/Br	Clay to Clay-Till	Clay-Till to BS/Br
1	266.69	265.45	261.86	–	261.86	265.81	260.14	254.93	0.22	0.69
2	265.49	261.83	256.33	257.84	257.84	264.92	261.20	244.52	0.98	0.24
3	266.87	264.29	261.63	–	261.63	265.01	260.00	256.00	0.51	0.66
4	265.32	258.51	256.82	256.58	256.82	263.88	257.00	252.21	0.99	0.35
5	264.44	258.59	255.84	–	255.84	261.98	256.40	253.22	1.05	0.86
6	265.69	259.91	–	–	–	264.37	260.21	–	1.39	–
7	266.55	260.02	–	256.27	256.27	264.76	255.44	242.79	0.70	0.30

a) Groundwater elevation measurements taken between September 14, 2016 and September 26, 2016.
b) The maximum groundwater elevation was selected at each monitoring well nest to represent the groundwater elevation for this unit.
c) Vertical gradient calculated based on screen mid-point elevations. Positive values indicate a downward direction of groundwater flow.
"–" indicates no measurement available; masl = metres above sea level; BS/Br = indicates combined basal-sand / bedrock unit.

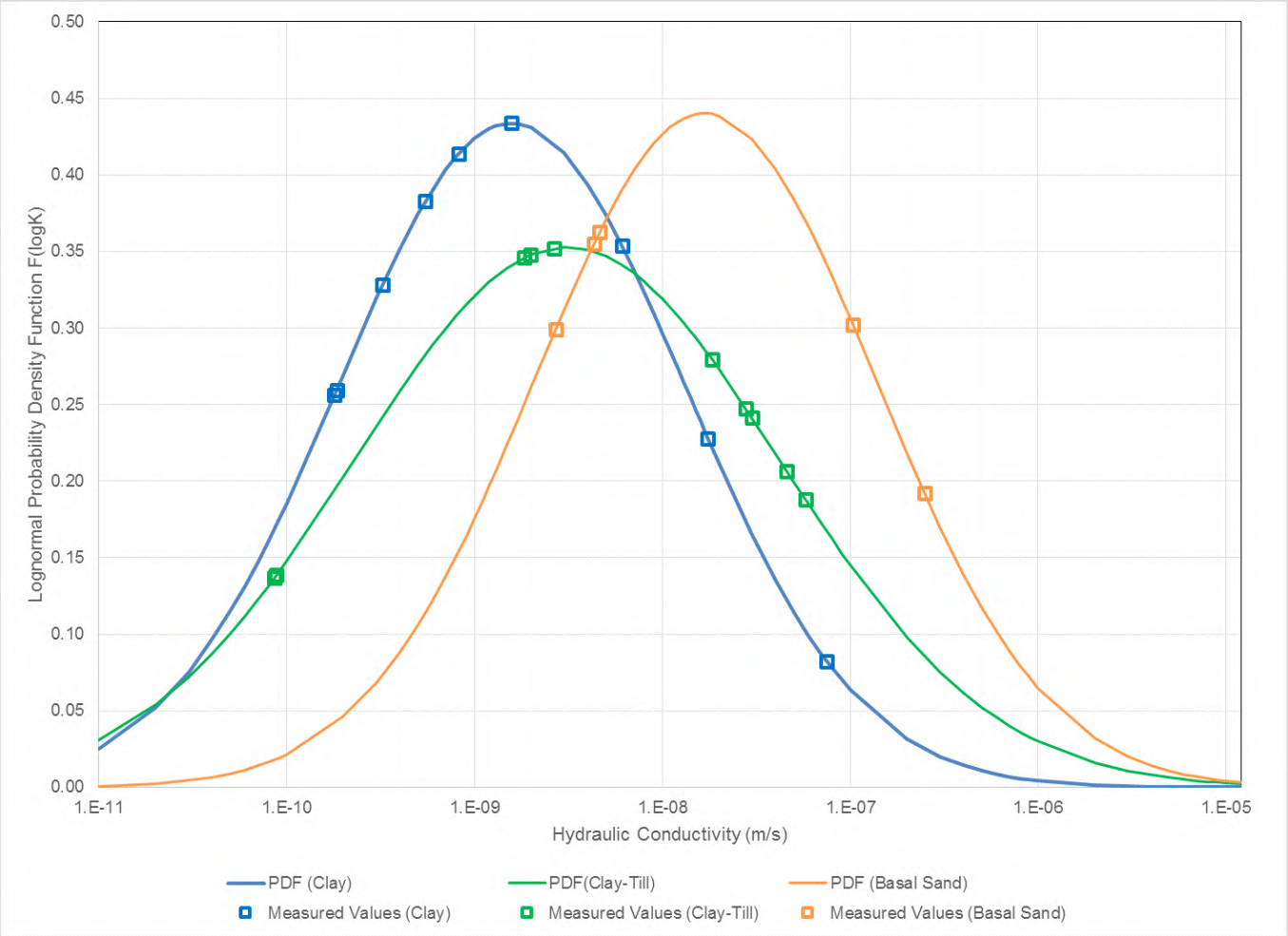
6.3.2.5.2.3 Hydraulic Conductivity

Measurements of hydraulic conductivity of the principal hydrostratigraphic units found within the RSA were available from previous hydrogeological investigations, which focused on the Waste Management Area (WMA). These are summarized below (Dillon 2018).

- Robertson and Cherry (1985) measured the hydraulic conductivity of the overburden in the WMA using both laboratory and field methods (i.e., monitoring well response tests, pumping tests, mass balance methods). The monitoring well response test results suggested that the hydraulic conductivity of the clay (10^{-11} to 10^{-6} m/s), clay till (10^{-10} to 10^{-6} m/s) and basal sand (10^{-11} to 10^{-6} m/s) varied over a wide range of values. Pumping test and mass balance estimates suggested that the average hydraulic conductivity of the clay and clay till units ranged from 10^{-10} to 10^{-9} m/s, and the average hydraulic conductivity of the sand unit ranged from 10^{-6} to 10^{-5} m/s. The wide range of hydraulic conductivity can be attributed to the presence of fine layers of silt/sand and other features such as fractures in the clay, which imparts secondary permeability to the soils.
- Single well response tests (AECL 2008) were completed in most of the BHS 500 series groundwater monitoring wells at the WMA. Most of the hydraulic conductivity values in the clay units from the single well response tests were in the range of 10^{7} to 10^{9} m/s. Groundwater flow through the clay/silt units is probably controlled, for the most part, by these lower permeability soils. In the clay till, most of the single well response tests (21 of 26) provided hydraulic conductivity values in the range of 10^{7} to 10^{9} m/s. Seventeen hydraulic conductivity tests were completed in the basal sand unit (AECL 2008). These tests generally showed a high range of hydraulic conductivity (10^{5} to 10^{7} m/s) compared to the clay and clay till units. Fourteen of the 17 single well response tests completed in the basal sand unit had hydraulic conductivity values in the order of 10^{6} m/s.

Although the primary focus of the above-mentioned studies was the WMA, Robertson and Cherry (1985) indicate that the basal sand demonstrated a fining trend from east to west, resulting in reduction of hydraulic conductivity of this unit in a westerly direction.

Single well response testing was completed at 29 monitoring wells in the unconsolidated (overburden) deposits within the LSA (KGS Group 2016). Data from 25 of the tests were used to define normally-distributed probability density functions of the log hydraulic conductivity estimate for the primary hydrostratigraphic units in the LSA. Data from the remaining wells (15-2C, 15-5D, 15-6D and 15-7C) were omitted from this analysis due to the anomalous responses (i.e., slow recovery) observed during testing, as noted in KGS Group (2016). For wells situated in the unconsolidated (overburden) deposits the probability density functions are plotted on Figure 6.3.2-6 and the data are provided in Table 6.3.2-8.



Hydrostratigraphic Unit	Hydraulic Conductivity (m/s)			
	Minimum	Maximum	Geometric Mean	Standard Deviation
Clay	1.80E-10	7.49E-08	1.58E-09	2.45E-08
Clay Till	8.61E-11	5.76E-08	3.10E-09	2.07E-08
Basal Sand	2.69E-09	2.48E-07	1.69E-08	1.07E-07

REFERENCE(S)

KGS GROUP. 2016. WHITESHELL LABORATORIES PROJECTS BRANCH COMPREHENSIVE FINAL REPORT ON INSTALLATION OF 7 GROUNDWATER MONITORING WELL NESTS. CANADIAN NUCLEAR LABORATORIES DOCUMENT NO. WLDP-35000-041-000-0014. MARCH 2017

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
PROBABILITY DENSITY FUNCTIONS FOR HYDRAULIC CONDUCTIVITY MEASUREMENTS

CONSULTANT

WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	--
PREPARED	RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO. 20145046 | CONTROL | REV. 2 | FIGURE **6.3.2-6**

S:\Client\Canadian Nuclear Laboratories\Manitoba\09 PROJ\1658897 CNL Whiteshell EA\40 PROD\0016 Groundwater Modelling Report\1658897-0015-G-0002.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
25mm
0

Table 6.3.2-8: Hydraulic Conductivity Estimates

Monitoring Well	Hydrostratigraphic Unit	Hydraulic Conductivity Estimate (m/s)
15-1A	Basal Sand	4.61×10^{-9}
15-1B	Clay Till	2.78×10^{-8}
15-1C	Clay	3.24×10^{-10}
15-1D	Clay	1.57×10^{-9}
15-2A	Basal Sand	4.30×10^{-9}
15-2B	Clay Till	4.59×10^{-8}
15-2D	Clay	5.48×10^{-10}
15-3A	Basal Sand	2.69×10^{-9}
15-3B	Clay Till	1.84×10^{-8}
15-3C	Clay	1.74×10^{-8}
15-3D	Clay	8.23×10^{-10}
15-4A	Basal Sand	1.03×10^{-7}
15-4B	Clay Till	8.63×10^{-11}
15-4C	Clay Till	5.76×10^{-8}
15-4D	Clay	1.80×10^{-10}
15-4E	Clay	7.49×10^{-8}
15-5A	Basal Sand	2.48×10^{-7}
15-5B	Clay Till	8.83×10^{-11}
15-5C	Clay	1.85×10^{-10}
15-6A	Clay Till	2.64×10^{-9}
15-6B	Clay Till	8.61×10^{-11}
15-6C	Clay Till	2.99×10^{-8}
15-7A	Clay Till	1.99×10^{-9}
15-7B	Clay Till	1.84×10^{-9}
15-7D	Clay	6.11×10^{-9}

Key observations from Figure 6.3.2-6 and Table 6.3.2-8 are summarized below.

- Consistent with the observations made by others within the RSA, the hydrostratigraphic units exhibited a wide range in estimated hydraulic conductivity values, spanning two to three orders of magnitude.
- Hydraulic conductivity estimates within the LSA were generally within the ranges defined by testing completed at the WMA as noted above, except for the basal sand unit, which was somewhat less permeable. Estimates of basal sand hydraulic conductivity from the LSA were typically an order of magnitude lower than the available estimates from the WMA. This indicates that although the basal sand unit is present in the stratigraphic sequence in both the WMA and LSA, its properties vary spatially. As indicated previously in Section 6.3.1, this unit is referred as a “basal sand” for consistency with previous work completed across the SSA, though within the LSA it does not display the characteristics of a typical sand (e.g., silt content in samples of this unit ranged from 26% to 56%, and clay content was up to 24%).

- Hydraulic conductivity increases with depth on a unit-average basis (i.e., the clay is the least permeable and the basal sand is the most permeable), though this was not always the case at individual monitoring well nests (e.g., the hydraulic conductivity estimate in the basal sand at 15-2A was lower than the estimate in the clay till at 15-2B).
- Single well response (packer) testing was completed in the upper portion of the bedrock at locations within the LSA (Dillon 2018). Interpreted hydraulic conductivity values ranged from less than 1.3E-07 m/s at two of the test locations to 2.0E-06 m/s at the third location. This is generally consistent with previous assessments completed within the RSA that have interpreted the upper bedrock to be within the range of 5.0E-12 m/s to 6.5E-07 m/s (Stevenson et al. 1996). Based on these data, the upper portion of the bedrock (in contact with the overburden) is considered the primary aquifer within the LSA.

6.3.2.5.2.4 Groundwater Quality

Ongoing groundwater sampling within the RSA for both radiological and non-radiological contaminants occur at specific facilities as part of the routine environmental monitoring for the WL site. These facilities include the sewage lagoon, the landfill and the WMA, which includes unlined trenches used to dispose of low level radioactive and conventional waste. The monitoring programs differ slightly by facility and are documented in CNL's 2015 progress report on the Environmental Assessment Follow-up Program for WL (CNL 2021).

Concentrations of metals in groundwater within the RSA are generally low. Slightly elevated concentrations of arsenic (0.017 to 0.025 mg/L) at the landfill and iron (0.2 to 3.0 mg/L) at the WMA were reported in 2015 (CNL 2016a). These metals are known to be naturally elevated in groundwater elsewhere in Manitoba, and concentrations observed in 2015 were attributed to these natural conditions as opposed to anthropogenic sources (CNL 2016a). In 2019, the groundwater quality monitoring indicated iron concentrations at or below the aesthetic objective (0.3 mg/L) at the WMA. Elevated concentrations of chromium were detected in 2019 sampling (0.124 mg/L) and are suspected to be related to issues with sample filtration (CNL 2020a). Volatile organic compounds (VOCs) including benzene, ethylbenzene, toluene and xylene were detected at low concentrations within the WMA and are possibly related to gas powered equipment used during sampling (CNL 2016a), as these compounds were not detected in 2019 (CNL 2020a). HB-40, the primary coolant feedstock for WR-1, was detected at trace concentrations (less than 0.026 mg/L) at four monitoring wells within the WMA in 2015 (CNL 2016a).

The radiological component of the routine environmental monitoring program includes the analysis of gross beta, gross alpha, tritium and uranium in groundwater. In the landfill area, gross beta, gross alpha and uranium activities/concentrations are low (less than 1 Becquerel per litre [Bq/L], 0.5 Bq/L and 0.020 mg/L respectively). Tritium was detected in the in two of the dugouts near the landfill that fill from precipitation and receive shallow groundwater. Tritium at low levels ranging from 41 to 212 Bq/L over the 2015 to 2020 period were measured in the dugout closest to the landfall (CNL 2020b).

At the lagoon, gross beta activity in groundwater is elevated and greater than 1 Bq/L at all monitoring locations within the basal sand unit. Gross alpha activity was also greater than 0.5 Bq/L at half of the lagoon monitoring locations. Uranium concentrations at the lagoon ranged from 0.006 to 0.128 mg/L in 2015 and 0.012 to 0.149 mg/L in 2019. Gamma analysis indicated the presence of naturally occurring potassium-40 and uranium progeny, and the elevated gross beta and gross alpha at the lagoon were attributed to natural conditions as opposed to anthropogenic sources (CNL 2016a, 2020).

Within the WMA, the five-year average gross beta activities in groundwater within the clay and basal sand units are below 1 Bq/L and are slightly above 1 Bq/L within the clay and clay till units (in three samples). The five-year

average gross alpha activities within the clay and basal sand units are below 0.5 Bq/L and are slightly above 0.5 Bq/L within the clay and clay till units. In 2019, uranium concentrations in groundwater within the WMA ranged from 0.0001 to 0.136 mg/L, with concentrations being highest in the clay unit, lowest in the basal sand. As with the lagoon area, gamma analysis of groundwater within the WMA indicated the presence of naturally occurring potassium-40 and uranium progeny, and the elevated gross beta and gross alpha are likely related to natural sources (CNL 2020a). Tritium was detected at several wells within the clay and clay till units, with activities ranging from 7.2 to 66.4 Bq/L in 2015 (CNL 2016a) and 29.9 to 83.3 Bq/L in 2019 (CNL 2020a). Tritium was detected at one location within the basal sand in 2015 (at 17.3 Bq/L) and 2019 (at 72.9 Bq/L) in an area of the WMA where transient reversals of recharge/discharge conditions have been noted (CNL 2016a, 2020). These tritium concentrations in groundwater are attributed to the low-level radioactive waste stored in unlined trenches within the WMA (CNL 2020a). Based on the results of the monitoring it was concluded that no significant contaminant migration from the WMA with groundwater flow has occurred (CNL 2021).

Previous studies within the RSA have indicated that the groundwater quality in the overburden and bedrock aquifers is generally considered potable (AECL 2001). Within the LSA, a piper tri-linear plot presented in Dillon (2018) indicates that groundwater within the bedrock and basal sand units was predominately of a calcium-magnesium-sulphate type, while groundwater within the clay unit was predominately of a calcium-magnesium-bicarbonate type.

Samples analysed by Dillon (2018) showed sulphate levels ranging from 180 to 2500 mg/L. The values of sulphate reach levels that are known to promote sulphate attack on concrete. The sulphate, calcium (63 to 461 mg/L), magnesium (88 to 323 mg/L) and pH (7.11 to 8.67) are similar to the chemistry seen in groundwater wells at the WMA (CNL 2015, 2016b, 2017).

Dillon (2018) noted that the measured uranium concentration in the initial sample collected from the bedrock at monitoring well nest 2 was approximately 2 mg/L. Following subsequent sampling and further analysis completed in October 2016, Dillon (2018) concluded that the results indicated the presence of naturally occurring uranium. Similar elevated uranium concentrations have been previously noted in the Precambrian bedrock within the RSA. These concentrations were previously attributed to leakage of natural groundwater from the overlying uraniferous clay (AECL 2001).

Analysis of groundwater samples for radiological constituents completed by Dillon (2018) resulted in the presence of the following parameters at activities above their respective detection limits:

- Actinum-228 (at monitoring well 15-4A);
- Bismuth-214 (at monitoring well 16-2E);
- Lead-210 (at monitoring wells 15-2A, 15-2D, 16-2E, 16-4F and 16-7E);
- Lead-212 (at monitoring wells 15-2A, 15-4A and 15-7A);
- Lead-214 (at monitoring well 16-2E);
- Radium-226 (at monitoring wells 16-2E, 16-4F, 15-7B, 16-7E); and
- Thorium-234 (at monitoring well 16-2E).

There is no notable radiological component in the initial water samples taken on the WL main campus (Dillon 2018). Only one well, 16-6F located to the northwest of WR-1 as part of monitoring well nest 4, showed a

slightly elevated alpha reading of 41 parts per billion [ppb]. Slightly elevated alpha readings are to be expected as local well waters within the Canadian Shield contain naturally occurring uranium (less than 100 ppb) and therefore elevated alpha readings are not unexpected (Betcher et al. 1988; Betcher et al. 1995), however, in general as at the WMA (CNL 2017) most uranium values are low.

6.3.2.6 Project Interactions and Mitigation

6.3.2.6.1 Methods

This section describes the process by which interactions between Project components and activities and groundwater quantity and quality were identified and evaluated. Potential effect pathways are identified, and mitigation developed to eliminate and/or reduce effects is presented. A pathways analysis is then used to focus the assessment on key interactions between the Project and the environment by evaluating the different effect pathways to determine if, after incorporation of mitigation, there is still potential to cause residual effects. Where effects will be adequately mitigated and are not forwarded for further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are articulated. Primary pathways that may lead to residual effects after incorporation of mitigation are further characterized in Section 6.3.2.7 Residual Effects Analysis. As such, this section helps to focus the remainder of the assessment on those interactions (effects pathways) likely to result in residual adverse effects.

The first part of the analysis was to identify the potential effects pathways for all phases of the Project. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. The next step in the analysis was the development of environmental design features and mitigation practices that could be incorporated into the Project to eliminate and/or reduce adverse effects to hydrogeology. Environmental design features included Project design elements, environmental best practices and management policies and procedures. Environmental design features and mitigation were developed through an iterative process between the Project's engineering and environmental teams, combined with input from Project-specific or regional engagement with other interested parties. The design features and/or mitigation activities were selected considering their effectiveness for implementation and maintenance and their appropriateness within the context of the identified effect pathways.

After incorporation of mitigation, potential pathways were evaluated into the following categories using scientific knowledge, logic, experience with similar developments and the effectiveness of environmental design features and mitigation.

- **No linkage pathway –** pathway is removed by environmental design features or mitigation such that the Project would not be expected to result in a measurable environmental change relative to Base Case values and therefore would have no residual effects to groundwater quantity and quality.
- **Secondary pathway –** the pathway could result in a measurable minor environmental change but would have a negligible residual effect on groundwater quantity and quality relative to Base Case and/or guideline values and is not expected to contribute cumulatively to other Project effects or to the effects of other past, present or reasonably foreseeable developments to cause a significant effect.
- **Primary pathway –** the pathway is likely to result in an environmental change relative to the Base Case and/or guideline values that could contribute to residual effects to groundwater quantity and quality.

Environmental design features and mitigation that have been or could be incorporated into the Project to eliminate and/or reduce adverse effects were considered. Potential pathways that were completely removed due to implementation of environmental design or mitigation were not assessed further. Pathways that were assessed to be secondary and demonstrated to have a negligible residual effect to hydrogeology through simple qualitative or semi-quantitative evaluation of the pathway were also not advanced for further assessment. Primary pathways were carried forward for more detailed quantitative and/or qualitative effects analysis to characterize the residual effects of the Project.

6.3.2.6.2 Results

Pathways through which all phases of the Project may interact with and result in changes to measurement indicators for hydrogeology is provided in Table 6.3.2-9.

Table 6.3.2-9: Pathways Analysis for Hydrogeology Valued Components

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
Closure of the entire WL site	Decommissioning and reclamation of the entire WL site, including the Project.	■ The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-states. ■ The drainage system for the reclaimed WL site will have physical characteristics similar to natural drainage systems in the general geographic region in terms of dynamic stability, robustness and longevity. ■ The WL site will be graded to promote drainage from the site to the Winnipeg River.	Secondary
Long-term performance during the post-closure phase	Release of solutes into the groundwater as the grout and reactor components gradually deteriorate.	■ Installation of a concrete cap and engineered cover system to mitigate moisture infiltration into the Whiteshell Reactor Disposal Facility (WRDF) and hence limit release of solutes into the groundwater. ■ The planned decommissioning of the WR-1 Building presently involves: ▪ removal the service area and infilling in these areas with compacted clay-based soil; ▪ sealing of open conduits in the building foundation; and ▪ grouting the interior portion of the building (containing the remaining components of WR-1) to ground surface elevation. ■ Monitoring will also be completed throughout the post-closure phase for the Project to confirm that the cover and grout is functioning as intended, and to confirm modelling predictions.	Primary
	Release of chemical and radiological contaminants in the long-term during the post-closure phase from the previous activities completed at the WL site.	■ As part of CNL's licence with the Canadian Nuclear Safety Commission, environmental monitoring around the WL site will continue for the Project. ■ Follow-up monitoring during the post-closure phase will continue to verify effect predictions and to provide information for use in adaptive management to address potential unforeseen effects.	No Linkage

6.3.2.6.2.1 No Linkage Pathway

The following pathway was assessed as having no measurable environmental change and hence, no linkage to residual effects on groundwater quality.

- **Release of chemical and radiological contaminants in the long-term during the post-closure phase from the previous activities completed at the WL site.**

The Comprehensive Study Report (AECL 2001) indicated that for effects to groundwater quality, the main area of concern was the low-level waste that may be managed in situ in the WMA. The evaluation of contaminant migration from the WMA trenches concluded that the nature of groundwater flow in the area around the WMA limits contaminant migration away from the WMA. There is no downward movement of groundwater flow from the WMA to the underlying permeable sandy zone, which has the potential to act as a transmission zone to the Winnipeg River (see Section 6.3.4 and Appendix C of AECL 2001). Generally, the natural hydraulic head at 10 m depth is higher, meaning that the hydraulic head gradient is upward leading to potential water discharge towards the surface (i.e., artesian conditions).

Contaminant migration, if it were to occur, would be less than 10 cm over 20 years. Testing also provided no evidence of a “bathtub effect” (i.e., flooding of the trenches so that they have a higher conductivity than the trench wall) and associated near-surface lateral movement of contaminants, although further testing was recommended to support a future detailed safety analysis (AECL 2001).

The final safety assessments for these wastes have not been completed. However, both the Project and the WMA are subject to the same regulatory requirements, which require that no member of the public receive a dose greater than 1 mSv/a. A value of 0.3 mSv/a dose limit to public has been established for the WL site. The Project specified a 0.25 mSv/a target dose rate limit for the public, and results of the assessment for the normal evolution indicate that the Project is well below this target. The expectation is that the final assessment of the WMA will demonstrate negligible dose rates compared to these targets. Consequently, there are negligible cumulative effects of the Project.

Consequently, there is no overlap of effects between WR-1 ISD and previous activities at the WL site (i.e., effects from the WMA) and changes to groundwater quality from the Project. Potential for cumulative effects with surface water quality and human health are considered in Section 6.4.2 Surface Water Quality and Section 6.7.1 Human Health and Section 6.7.2 Ecological Health, respectively.

6.3.2.6.2.2 Secondary Pathways

The following pathways were assessed as potentially having a measurable minor change to hydrogeology relative to Base Case.

- **Decommissioning and reclamation of the entire WL site, including the Project.**

The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-states. Following decommissioning of the building sumps, groundwater levels will approach static conditions similar to the local environment. On the main campus of the WL site, groundwater heads indicate downward flow conditions exist. For the closure and post-closure phases, groundwater will flow downwards through the overburden and westward, ultimately discharging at the Winnipeg River. Overall, cumulative effects from the

Project in combination with the decommissioning of the remaining infrastructure and support facilities and reclamation of the affected areas at the WL site are anticipated to have a negligible effect on groundwater quantity.

6.3.2.6.2.3 Primary Pathways

The Project is expected to have the following primary pathway effects on groundwater quality that are carried forward to the residual effects analysis:

- **Release of solutes into the groundwater as the grout and reactor components gradually deteriorate.**

6.3.2.7 Residual Effects Analysis

The objectives of the groundwater flow and solute transport modelling include estimation of the potential long-term changes to the groundwater flow regime and groundwater quality resulting from the proposed decommissioning of the WR-1 Building. The modelling was completed to provide an estimate of solute mass loadings during the post-closure phase to identify potential solutes of concern within the Environmental Risk Assessment framework.

6.3.2.7.1 Methods

6.3.2.7.1.1 Groundwater Flow and Solute Transport Modelling

Groundwater flow and solute transport modelling was completed in support of an assessment of the Project and is described in detail in the Groundwater Flow and Solute Transport Modelling Report (Golder 2021a). The conceptual model, upon which the numerical model was founded, was developed based on the available information. Primarily, these data included borehole logs, estimates of hydraulic conductivity and groundwater elevations collected during field investigations of the SSA (Dillon 2018). Groundwater elevations and estimates of inflows to the WR-1 Building sump were used as metrics for calibration of the groundwater flow model. A comparison of the simulated to measured data showed that an acceptable model calibration was achieved.

MODFLOW-2005 (Harbaugh 2005) was used to complete the groundwater flow simulations and Visual MODFLOW® (Version 4.6.0.156) was used as the numeric flow engine for the simulations. MODPATH (Pollock 1989), a companion code to MODFLOW, was used to complete the particle tracking analyses necessary to illustrate the flow paths from the WR-1 Building.

An analytical approach was adopted to complete the solute transport modelling. GoldSim® (Version 12.1), a commercially available, flexible, object-oriented computer program, was selected as the software package to complete the analytical calculations. The GoldSim software is fully documented in the Main Users Guide (GTG 2014a) and the Contaminant Transport Module Users Guide (GTG 2014b). Details of the conceptual model development, modelling approach and model assumptions are described in the Groundwater Flow and Solute Transport Modelling Report (Golder 2021a).

6.3.2.7.1.2 Contaminant Release

The planned decommissioning of the WR-1 Building presently involves:

- removal of the service area and infilling in these areas with compacted clay-based soil;
- sealing of open conduits in the building foundation; and
- grouting the interior portion of the building (containing the remaining components of WR-1) to ground surface elevation.

Following the encapsulation of WR-1 and the cessation of pumping from the sumps, the groundwater elevation will gradually become restored to an equilibrium elevation and the majority of the grout (including the remaining components of the reactor) will be situated below the groundwater table. The calibrated groundwater flow model was reconfigured for representation of these conditions at various states of degradation of the encapsulation with respect to the condition of the cover, grout, and foundation materials. The modelling assumed that these materials will experience an increase in hydraulic conductivity as they degrade over time (Golder 2021a). The hydraulic conductivity applied to the building foundation (i.e., the primary barrier) in the model at the beginning of the simulation was specified to be $5x10^{-10}$ m/s. This value is approximately 5 times higher than the highest measured value obtained as a part of testing of the foundation materials that was completed during a recent building condition assessment (Golder 2022). Simulations were completed to estimate the groundwater flow through the components of the decommissioned structure and results of these simulations were used as input to the analytical solute transport model (Golder 2021a).

The solute transport model was defined as a source area (representing the remaining solute mass contained within the decommissioned structure), a barrier for containment (the building foundation), a transport pathway (the upper portion of the bedrock, which receives solute mass loadings from the decommissioned building via advection and diffusion through the barrier and into the surrounding fill material) and a receptor (the Winnipeg River). Solute mass originating from the reactor and lead-containing materials is released gradually over time to represent corrosion of the reactor components that remain following decommissioning; whereas mass originating from other sources was assumed to be present in a dissolved phase throughout the grout at the start of decommissioning. The release of solute mass is therefore a function of the assumed estimated inventory, groundwater flow rates, groundwater chemistry, corrosion rates and degradation rates of the grout and structural concrete. Uncertainty associated with these parameters, as well as other model inputs, was addressed through a sensitivity analysis (see Section 6.3.2.8). Retardation from adsorption of the solutes was considered for the bedrock pathway only, as determined through a review of the available information on sorption-partitioning coefficients. The effect of changes to the surficial geology, for example erosion of the river bank, was also considered through sensitivity analysis. Details are provided in the Groundwater Flow and Solute Transport Modelling Report (Golder 2021a).

6.3.2.7.2 Application Case

The following provides a summary of the key findings from the groundwater flow and solute transport modelling assessment.

- The post-decommissioning groundwater elevation is expected to recover to the top of (or above) the reactor materials. Groundwater seepage (and mass flux) pathways were estimated to occur downwards to the underlying bedrock and then laterally to the west towards the Winnipeg River. The Winnipeg River was identified as the eventual discharge location of seepage from the WRDF.
- Mean advective groundwater travel times to the Winnipeg River were estimated to be on the order 100 years.
- The peak total activity level estimated from the simulations (~2×10^{10} Bq/yr.) occurs after approximately 70 years. The peak activity is principally related to the migration of tritium from the WR-1. Due to dispersion, the finite amount of tritium in the source (grout) and the half-life associated with tritium (approximately 12 years) its peak arrival occurs earlier than the mean advective groundwater travel time.
- Mass flux rates from 56 radiological parameters and 29 non-radiological elements were simulated in the groundwater flow and transport model as shown in Golder (2021a). These parameters and elements were selected based on the expected mass inventory for the WR-1 Building as discussed in Section 4.1.1 of Golder

(2021a). Mass flux estimates for a simulation period of 500,000 years were then provided for incorporation in the Environmental Risk Assessment for an assessment of effects to human and ecological health. Key controls on the magnitude of the peaks and the timing of the peak mass fluxes include adsorption properties for each solute, rates of decay and in-growth for the radiological contaminants, and source release mechanism (i.e., distributed initially within the grout matrix versus released slowly through corrosion of WR-1 components).

6.3.2.8 Prediction Confidence and Uncertainty

The groundwater flow and solute transport results presented in Golder (2021b) are based on currently available best-estimates and assumptions of the input parameters and processes affecting solute transport. Uncertainty in both the groundwater flow and solute transport modelling is recognized and was evaluated through the completion of a sensitivity analysis. The sensitivity analysis included the evaluation of the effect of 18 various model assumptions on model results as discussed in detail in Golder (2021b).

Results of the sensitivity analysis indicated the following:

- Peak mass loading rates and/or earlier arrival of peaks, were found to be most sensitive to: assumptions on where the solute mass initially resides within the grout; the alternative model boundary applied to the cover; the rate of flow through the bedrock pathway (as explored through the preferential pathway simulation, adjustments to the bedrock hydraulic conductivity and lowering of the river stage); the rate of corrosion; the initial mass inventory (for non-radionuclide solutes); the radionuclide source inventory, and adjustments to the solute-partitioning coefficients (for solutes where the upper or lower bound value was significantly different from the base case value).
- Peak mass loading rates and earlier arrival to peaks was found to be less sensitive to: the degradation rate of the engineering components (within the ranges assessed); a local failure of the foundation; increase in the hydraulic conductivity of the backfill; an increase in the rate of degradation of the grout and foundation; and a compromised foundation.
- Negligible Xylene mass was present at the outflow boundary when degradation was applied, indicating the xylene mass loading rate is sensitive to its degradation.

6.3.2.9 Monitoring and Follow-up

As part of CNL's licence (NRTEDL-W5-8.00/2024), CNL will implement an Environmental Assessment Follow-up Program for the Project to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. This monitoring will be integrated with that for the existing Environmental Assessment Follow-up Program for the WL site, where practical. For monitoring requirements arising from the Project appropriate procedures will be developed that will meet or exceed federal and provincial regulatory requirements (Table 6.3.2-10). A post-closure monitoring program will also be developed that will provide the sampling and analysis objectives and procedures for sampling and testing the groundwater quality in the vicinity of the WR-1 Building during the institutional control period. The program will include details concerning sampling locations and sampling frequencies, analysis, quality assurance/quality control requirements, and will be compliant with *CSA N288.7-15: Groundwater Protection Programs at Class I Nuclear Facilities and Uranium Mines and Mills* (CSA Group 2015). As a result of engagement on the Project's follow-up monitoring program thus far, CNL has committed to adding additional ground monitoring well(s) between the WR-1 reactor and the Winnipeg River as requested by the Red River Métis.

It is noted that data generated by the monitoring program will be evaluated on an ongoing basis within an adaptive management framework. Within this framework, modifications to the program may be appropriate to confirm data continue to fulfill program objectives. For example, should a contaminant of potential concern reach concentrations outside the range predicted in the EIS or Decommissioning Safety Assessment Report, including the findings from the Groundwater Flow and Solute Transport Monitoring Report, the frequency of sampling may be increased, and additional locations may be sampled to investigate the source of the increased concentrations. Conversely, cessation of a monitoring activity might be appropriate once it has been shown that an effect has stabilized or has been reduced to a level where it is no longer considered significant with respect to regulatory requirements or community concerns. Any proposals for modifications to the monitoring program and the rationale for the modifications will be communicated to the CNSC prior to implementation. Additional information on the Environmental Assessment Follow-up Program for the Project can be found in Section 11.0 Summary of Monitoring and Follow-up Programs.

Table 6.3.2-10: Monitoring and Follow-up Programs for Hydrogeology

Valued Component	Project Phase, Potential Effect and Conceptual Monitoring Program	Monitoring Program Objective	Suggested Duration	Implementing Program
Hydrogeology	**Potential Source(s) of Effects:** ■ Changes to groundwater quality from the release of solutes into the groundwater as the grout and reactor components gradually deteriorate during post-closure phases. **Proposed Monitoring:** ■ Water elevation measurements to determine groundwater flow direction and gradients. ■ Sampling to confirm groundwater quality to detect potential releases of constituents from the WRDF. ■ Initial sampling frequency will likely be twice per year (spring and fall). **Trigger for further action:** ■ If concentrations of dissolved constituents in groundwater are above applicable guidelines or above typical background concentration, conduct groundwater and/or soil sampling and analysis to delineate the extent and identify the source of contaminants of concern. ■ If significant unexpected changes to groundwater flow are interpreted through analysis of groundwater elevation measurements, complete a survey of the integrity of WRDF (e.g., using geophysical methods).	■ Verify effects predictions on groundwater from the Project. ■ Verify the effectiveness of mitigation. ■ Demonstrate compliance with regulatory requirements.	■ Groundwater monitoring will continue through closure and institutional control period. Semi-annual water level measurement and water quality measurements will be included in the Environmental Assessment Follow-Up Program. The frequency of recurrence of water sampling will be reviewed based on performance data. The number and location of wells and parameters measured, may change based on an annual review of the data.	■ Project groundwater monitoring will be integrated into the overall CNL Groundwater Monitoring Program and will be compliant with CSA N288.7 15: Groundwater Protection Programs at Class 1 Nuclear Facilities and Uranium Mines and Mills (CSA Group 2015).

6.3.2.10 Conclusions

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). Hydrogeology is recognized as an important component of the environment that may be affected by the Project and changes to hydrogeology could, in turn, lead to effects on other VCs selected for assessment. Acknowledging that changes to hydrogeology are considered to be important aspects of the natural and human environment, hydrogeology is referred to as an intermediate VC. Results of the analysis of changes in measurement indicators for hydrogeology are provided to other disciplines for inclusion in their assessment.

Table 6.3.2-10 provides a summary of the residual adverse effects identified for hydrogeology. Based on the Comprehensive Study Report (AECL 2001), it was determined that the likelihood of contaminant transport beyond the WMA was very low and no effects on groundwater were anticipated from ISD of the trenches; therefore, no overlap with the Project is expected. Changes to groundwater quality from the Project due to the release of solutes into the groundwater as the grout and reactor components gradually deteriorate was identified as having a residual effect on the hydrogeological environment. Environmental design features and mitigation implemented to reduce residual effects on groundwater quality include:

- installation of a concrete cap and engineered cover to mitigate moisture infiltration into the WRDF;
- removal of the service area and infilling in these areas with compacted clay-based soil;
- sealing of open conduits in the building foundation;
- grouting the interior portion of the building (containing the remaining components of WR-1) to ground surface elevation; and
- monitoring will be completed throughout the institutional control period for the Project to confirm that the cover and grout is functioning as intended and to confirm modelling predictions.

Groundwater flow and solute transport modelling was completed to provide estimates of solute mass loadings during the post-closure phase. The Winnipeg River was identified by the post-decommissioning groundwater flow model as the principal receptor of groundwater discharge. The Winnipeg River is also of high importance to Indigenous peoples.

Mass flux rates from 56 radiological parameters, along with 29 non-radiological elements, were simulated in the groundwater flow and transport modelling. The groundwater flow modelling indicated that the mean advective groundwater travel times to the Winnipeg River were an estimated 100 years. The peak total activity level from the simulations occurs after approximately 70 years and is principally related to the migration of tritium from WR-1. Due to dispersion, the finite amount of tritium in the source (grout) and the half-life associated with tritium (approximately 12 years), its peak arrival to the Winnipeg River occurs earlier than the mean advective groundwater travel time. Results of the groundwater assessment are used in the surface water quality assessment and the Environmental Risk Assessment to determine potential long-term adverse effects from the Project, which is a key concern expressed by Indigenous peoples.

Indigenous peoples have interest in the current and future monitoring proposed for the Project. As part of CNL's licence (NRTEDL-W5-8.00/2024) with the CNSC, CNL will continue to implement the Environmental Assessment Follow-up Program for the WL site to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. CNL will provide First Nations and the Manitoba Métis Federation with the opportunity to participate in the implementation and review of mitigation measures. For monitoring requirements arising from the Project, but not covered in the Environmental Assessment Follow-up Program, appropriate procedures will be developed that will meet or exceed federal and provincial regulatory requirements. A post-closure monitoring program will also be developed that will provide the sampling and analysis objectives and procedures for sampling and testing the groundwater quality in the vicinity of the WR-1 Building.

Table 6.3.2-11: Summary of Predicted Residual Adverse Effects for Hydrogeology

Valued Component	Assessment Endpoint	Residual Effect	Phase Project Effect Occurs in	Contributing Project Activity	Proposed Mitigation	Significance
Groundwater Quality	Intermediate VC (i.e., it does not have an assessment endpoint)	Release of solutes into the groundwater as the grout and reactor components gradually deteriorate may cause changes in groundwater quality	Post-Closure Phase	Grout and reactor components gradually deteriorate	■ Installation of a concrete cap and engineered cover to mitigate moisture infiltration into the WRDF and hence limit release of solutes into the groundwater. ■ The planned decommissioning of the WR-1 Building presently involves: ▪ removal the service area and infilling in these areas with compacted clay-based soil; ▪ sealing of open conduits in the building foundation; and ▪ grouting the interior portion of the building (containing the remaining components of WR-1) to ground surface elevation. ■ Monitoring will also be completed throughout the post-closure phase for the Project to confirm that the cover and grout is functioning as intended and to confirm modelling predictions.	Significance is not determined as valued component does not have an assessment endpoint; rather the results provided to other disciplines for inclusion in their assessment.

WRDF = Whiteshell Reactor Disposal Facility

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6.4 Surface Water Environment

This section examines the potential residual effects of the Project on surface water hydrology (Section 6.4.1 Hydrology) and surface water quality (Section 6.4.2 Surface Water Quality).

6.4.1 Hydrology

6.4.1.1 Scope of the Assessment

The hydrology assessment follows the overall environmental assessment approach and methods described in Section 6.1 Environmental Assessment Approach. The assessment was completed in the following steps:

- **Step 1 – Identify Valued Components (VCs) and define the spatial boundaries, temporal boundaries and assessment cases** (refer to Sections 6.4.1.3 Valued Components and Section 6.4.1.4 Assessment Boundaries) for the hydrology assessment. The VCs and measurement indicators used to assess Project-related changes to hydrology, the spatial and temporal boundaries at which the assessment occurred, and the assessment cases considered are described.
- **Step 2 – Describe the existing conditions** (refer to Section 6.4.1.5 Description of the Environment). Existing conditions in the local and regional areas are described, including the combined effects of previous and existing developments (Base Case). The existing environment represents the historical and current environmental pressures that have shaped the observed patterns in the environment (i.e., natural variation).
- **Step 3 – Evaluate Project interactions and mitigation** (refer to Section 6.4.1.6 Project Interactions and Mitigation). Project components and/or activities with the potential to affect hydrology are identified and mitigation options are presented to limit or avoid these effects. A pathways analysis is then used to focus on key interactions between the Project and the environment and determine if mitigation can limit or eliminate the predicted residual effects. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. Where effects are adequately mitigated and are not forwarded for further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are described.
- **Step 4 – Present the methods and results of the residual effects analysis**. This step was not required as no primary pathways were identified in the hydrology assessment.
- **Step 5 – Describe the level of certainty and management of uncertainty.** This step was not required as no primary pathways were identified in the hydrology assessment.
- **Step 6 – Classify and determine the significance of the predicted residual effects.** This step was not required as the hydrology VC is an intermediate component which does not include an assessment endpoint to determine significance.
- **Step 7 – Identifying monitoring and follow-up** (refer to Section 6.4.1.7 Monitoring and Follow-up) required to confirm effects predictions and address uncertainty.
- **Step 8 – Present a consolidated summary of conclusions and outcomes of the assessment** (refer to Section 6.4.1.8 Conclusions) for hydrology.

6.4.1.2 Indigenous Engagement Feedback – Key Interests and Concerns

Interests and concerns raised by Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations during engagement that are related to the terrestrial environment assessment are summarized in Table 6.4.1-1. Other general concerns and questions raised during Indigenous engagement activities are documented in Section 4 Indigenous Engagement.

Table 6.4.1-1: Summary of Key Interests and Concerns Raised During Indigenous Engagement Activities Related to the Hydrology Assessment

Interest and Concern	Inclusion Status	Additional information and Rationale
Effects on the Winnipeg River ■ Importance of the river for drinking water, recreation and food.	Already included in the environmental assessment	Effects to the Winnipeg River are addressed in Section 6.4.1.6.2 Results.
Effects on Manitoba Hydro Operations ■ Whether the site's discharge has any effects on Manitoba Hydro operations.	Already included in the environmental assessment	Effects to the Winnipeg River are addressed in Section 6.4.1.6.2 Results. Although not explicitly called out in Section 6.4.1.6.2 Results, effects on the Manitoba Hydro operations are predicted to be negligible as changes to the discharge volume to the Winnipeg River is predicted to be within the natural range of variation of the Winnipeg River.

6.4.1.3 Valued Components

Valued components refer to environmental features identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). Hydrology, which includes surface water flow and drainage direction, is recognized as an important component of the environment that may be affected by the Project and changes to hydrology could, in turn, lead to effects on other VCs selected for assessment. Acknowledging that changes to hydrology could lead to effects on other VCs, hydrology is referred to as an intermediate VC. For example, changes to the characteristics of hydrology flow rates, direction and riverbed location potentially have an influence on the local and regional biodiversity, contributing to the spatial and temporal distribution of aquatic and terrestrial ecosystems. Subsequently, changes to these characteristics by Project activities could affect fish and wildlife and land and resource use (Table 6.4.1-2). Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations did not identify any additional valued components as it relates to the hydrology assessment (Section 4.0).

Table 6.4.1-2: Valued Components for Hydrology Assessment

Valued Component	Rationale for Selection
Hydrology	■ The Project may affect the spatial and temporal distribution of water quantity for aquatic and terrestrial biodiversity, which can subsequently affect land and resource use. ■ Public, Indigenous concerns regarding changes in water quantity in the Winnipeg River are an important consideration in understanding potential effects of the Project.

Changes to intermediate VCs must be understood to facilitate assessment of project interactions. The hydrology assessment, therefore, is analyzed for incremental and cumulative (if applicable) changes in the relevant measurement indicators associated with hydrology (Table 6.4.1-3). The results of the analysis of changes in measurement indicators for hydrology are provided to other disciplines for inclusion in their assessment (Table 6.4.1-3).

Table 6.4.1-3: Measurement Indicators for the Hydrology Assessment

Valued Component	Measurement Indicators	Discipline Assessments where Effects on Hydrology are Considered
Hydrology	■ Runoff rates and volumes ■ Drainage patterns	■ Section 6.4.2 Surface Water Quality ■ Section 6.5 Aquatic Biodiversity ■ Section 6.6 Terrestrial Biodiversity ■ Section 6.8 Land and Resource Use

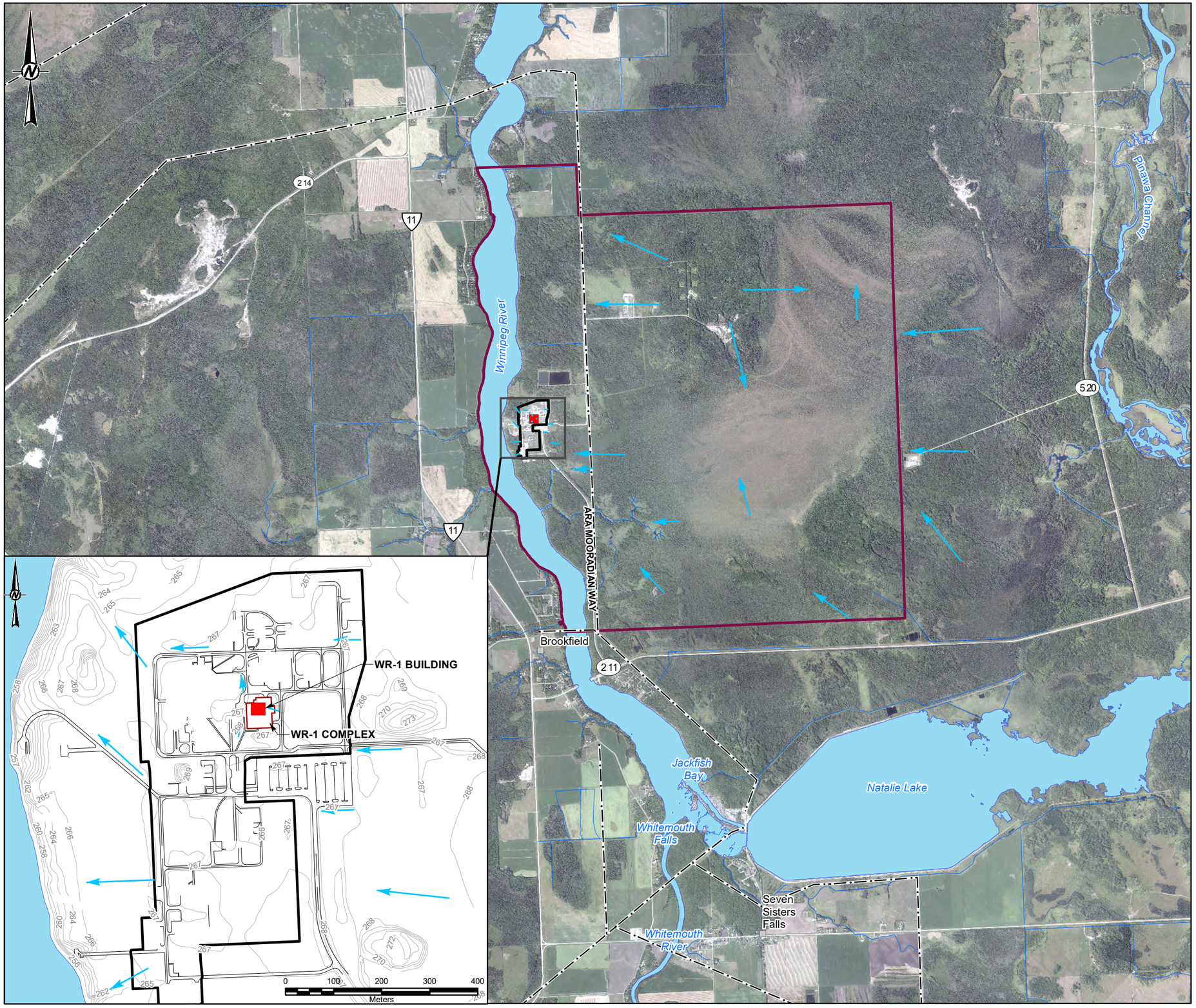
6.4.1.4 Assessment Boundaries

6.4.1.4.1 Spatial Boundaries

The spatial boundaries selected for the hydrology assessment are consistent with the surface water quality and aquatic biodiversity, and are presented on Figure 6.4.1-1 and described below:

- **Site Study Area (SSA)** is the Whiteshell Reactor 1 (WR-1) Building and represents the Project footprint (i.e., where project activities will be undertaken; 0.07 ha).
- **Local Study Area (LSA)** was selected in consideration of the SSA and the spatial extent of potential direct effects of the Project on hydrology, surface water quality and the aquatic environment. The LSA was selected to represent an area that is likely to be directly affected by the Project, helping to identify Project-specific (rather than cumulative effects of the Project in combination with other projects in the region). The LSA is represented by the fenced area of the Whiteshell Laboratories (WL) main campus and includes the SSA. The LSA was based on the area of the WL main campus that is currently drained by roadside ditches and storm sewers. ALL discharges (e.g., sumps, storm, process) flow to the single outfall station discharge. The approximate size of the LSA is 29 ha. The LSA does not include the Winnipeg River as direct effects on hydrology from the Project on the Winnipeg River are not anticipated. For example, direct effects to Winnipeg River as a result of changes in hydrology are anticipated to be negligible as the drainage area of the LSA is several orders of magnitude smaller than that of the Winnipeg River (15,000,000 ha).

- **Regional Study Area (RSA)** is defined as the area within which the maximum geographical extent of potential indirect effects of the Project may interact with the effects of other existing or reasonably foreseeable projects. To the north, east and south the RSA is delineated by the boundaries of the WL site. To the west, the RSA is delineated by the Winnipeg River reach adjacent to WL site. For example, indirect effects on surface water quality from the Project include potential seepage of groundwater into the Winnipeg River. The plume from the discharged effluent during operation was previously assessed to hug the east bank of the river (AECL 1973) and it is assumed that a groundwater seep in relatively the same area will behave similarly. Therefore, the south boundary of the RSA extends from the west shore of the Winnipeg River to the east fence on the property line about 400 m north of Provincial Highway 211. The eastern boundary of the RSA follows the fence on the property line to the north property line. The north boundary follows the north fence on the property line about 1.6 km and then turns north for about 400 m before turning west and extending to the west side of the Winnipeg River. This is to include the first farm downstream on the east bank because this is the most conservative potential water user. The west boundary follows the west bank of the Winnipeg River. The RSA has an approximate size of 4,121 ha.



LEGEND

- WR-1 BUILDING (SITE STUDY AREA)
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

BASE FEATURES

- CITY/TOWN
- TRANSMISSION LINE
- ROAD
- CONTOUR - 1 M INTERVAL
- DRAINAGE FLOW PATTERN
- WATERCOURSE
- WATERBODY

0 1,000 2,000 3,000 4,000

1:60,000 METRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY PROVIDED BY CNL (2016-11-22)
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

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TITLE

SPATIAL BOUNDARIES AND DRAINAGE PATTERNS FOR THE SURFACE WATER ASSESSMENT

CONSULTANT

WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/RRD
REVIEWED	KL
APPROVED	GV

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0011	2	**6.4.1-1**

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Path: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0011_EIS_Sec_6.4.1\20145046-0011-CA-0001_Figure 6_4_1-1_Spatial Boundaries and Drainage Patterns for the Surface Water Assessment.mxd

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6.4.1.4.2 Temporal Boundaries

The temporal boundary of the assessment is the timeframe during which Project activities are occurring and the duration of predicted residual effects. The duration of an effect is defined as the amount of time between the start and end of a Project activity or stressor (which is related to the Project phases) plus the time required for the residual effect to be reversed. In some cases, a residual effect may be irreversible within the temporal boundaries of the Project if the effects were predicted to last so far into the future that they could not be predicted with any level of certainty (e.g., residual effect lasts for thousands of years). The following phases were identified for the Project:

- **Closure Phase:** Preparation and implementation of in situ disposal, which includes preparation for in situ disposal, grouting of below-grade structures and systems, removal of above-grade WR-1 structures and systems, installation of the concrete cap and engineered cover, and environmental controls and final site restoration. These activities last from 2022 to 2027.
- **Post-closure Phase:** The post closure phase has two discrete periods: institutional control and post institutional control. Institutional control is estimated to last 100 years during which long-term monitoring and maintenance activities will continue to demonstrate Whiteshell Reactor Disposal Facility (WRDF) performance is in compliance with the safety case assumptions and performance modelling. The 100 year timeframe is not related to the design life of the WRDF barriers. The 100-year active monitoring period was selected to ensure that sufficient opportunity is provided to verify the WRDF is performing as expected. Additionally, beyond 100 years, there is less confidence that institutional controls, like access restrictions, can be relied upon. Although the duration of institutional control is estimated at 100 years, it is recognized that it will continue until the CNSC, or the appropriate authority at the time, agrees it is no longer needed.

  Post-institutional control occurs after year 2127 and continues indefinitely. The post-closure phase will continue indefinitely; however, the timeframe defined for assessment of potential effects as part of the normal evolution of the Project is 10,000 years. This time period encompasses the phase in which peak effects are anticipated.

6.4.1.4.3 Assessment Cases

The assessment cases considered in the hydrology assessment include the Base Case, Application Case and the Reasonably Foreseeable Development (RFD) Case.

- **Base Case:** represents existing conditions and characterizes combined effects from previous and existing developments and activities. The Base Case reflects the effects of existing disturbances, such as forestry, transportation, agricultural and residential and recreational development. Current effects from the existing facilities and operations at the WL site, for example, are considered part of the Base Case. Seven Sisters Generating Station is approximately 7.5 km upstream of the WL site and McArthur Generating Station is approximately 26 km downstream. In addition, effects from the decommissioning and reclamation activities already completed at the WL site are also considered as part of the Base Case.
- **Application Case:** represents the effects of the Base Case combined with the predicted effects from the Project. The Application Case includes closure and post-closure activities, and therefore, the associated effects during these phases of the Project represents the bounding case.

- **RFD Case**: represents the predictions of the cumulative effects of the Application Case, plus projects that are currently under application review or that have officially entered a regulatory application process and which overlap with the surface water environment RSA. Foreseeable developments in the surface water environment RSA that are expected to overlap with residual effects on hydrology from the Project includes the decommissioning of the remaining infrastructure and support facilities and remediation of affected lands at the WL site as per the existing decommissioning licence. A Comprehensive Study Report (AECL 2001) under the *Canadian Environmental Assessment Act, 1992* was completed for the decommissioning of the WL site. The Environmental Assessment decision to approve the Project was announced by the Minister of the Environment in March 2002 and a decommissioning licence was issued to Atomic Energy of Canada Limited and subsequently to Canadian Nuclear Laboratories (CNL). There are no other foreseeable developments in the surface water environment RSA that are expected to overlap with residual effects on hydrology from the Project (Table 6.4.1-4).

Table 6.4.1-4: Reasonably Foreseeable Developments considered in the Hydrology Assessment

Type of Project	Location	Description	Timeframe	Overlap with Valued Components
Infrastructure Decommissioning	WL	Decommissioning of remaining infrastructure on the WL site (includes in situ disposal of the low-level waste trenches).	2016 to 2027	Yes – there is both spatial and temporal overlap of effects with the Project
Environmental Remediation	WL	Remediation of affected lands, with the exception of the low-level waste trenches.	2016 to 2027	Yes – there is both spatial and temporal overlap of effects with the Project

6.4.1.5 Description of the Environment

6.4.1.5.1 Methods

Existing hydrological conditions (e.g., flow rates, volumes, velocities and direction) within and surrounding the RSA, including the Winnipeg River, were obtained through a literature review of available baseline information and public information. Regional and local hydrology described in the Comprehensive Study Report (AECL 2001) and hydrology assessment at the WL site (AECL 2000) are summarized in this section. Daily discharge rates were provided by Manitoba Hydro (2016) at the Seven Sisters Generating Station (approximately 7.5 km upstream) and also taken from the Water Survey of Canada (WSC 2016) at McArthur Generating Station (approximately 26 km downstream). Water levels in the Winnipeg River for the intake water were provided by CNL (CNL 2016a).

Rainfall data were sourced from Environment and Climate Change Canada (ECCC) Weather Website (Government of Canada 2016). Runoff volumes generated by rainfall events within the SSA were estimated using the rainfall depths and intensities (i.e., Intensity-Duration-Frequency [IDF] data) recorded at Climate Station 5023233. This is the closest climate station with available rainfall IDF data from ECCC and is approximately 75 km west of the WL site (i.e., Winnipeg St Boniface CS 5023233). The Rational Method was applied to determine the peak runoff rates generated from the SSA (MOE 2003).

The analysis method provides estimates of the total runoff volumes from the SSA for storm events that range in frequency from once in every two years to once in every 100 year (return periods). A 1:100-year was selected as the evaluation event for this study since it is the largest IDF event that is provided by Environment Canada and is the industry standard for evaluating and designing structures for large storm events.

6.4.1.5.2 Results

The following sections present the results of the literature review relating to characterization of the Winnipeg River, local and regional drainage patterns, and estimates of the SSA surface water flows.

6.4.1.5.2.1 General Overview

The dominant hydrological feature of the RSA is the Winnipeg River, which flows on the west side of the RSA (Figure 6.4.1-1). The Winnipeg River flows from the Lake of the Woods and the English River system in Northwestern Ontario and drains to Lake Winnipeg located northwest of the WL site.

The Winnipeg River is classified as a medium-sized low land river. The total drainage basin of the Winnipeg River is approximately 15,000,000 ha. The river flow is determined by hydrologic conditions over the entire upstream drainage area and is not likely affected by localized precipitation events.

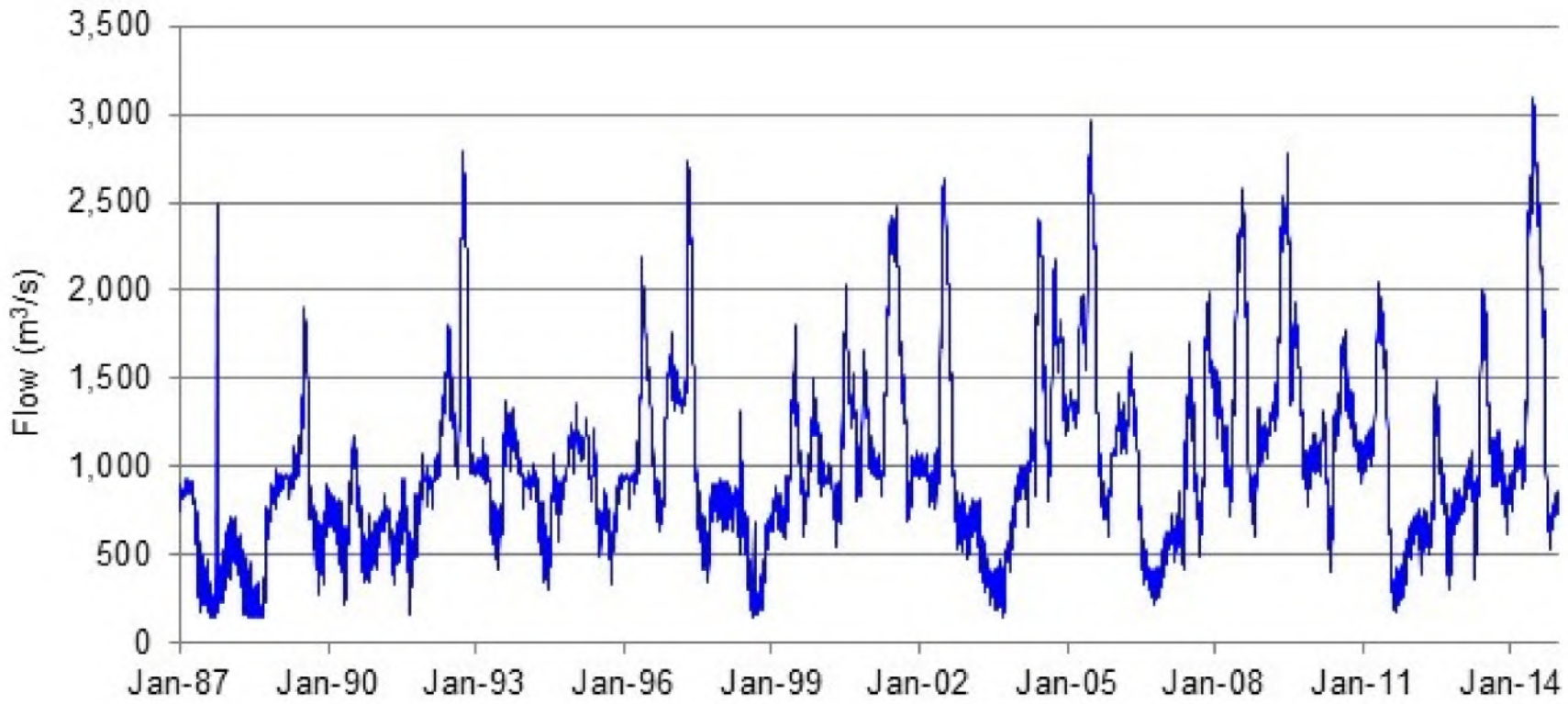
A decrease in ground elevation of 83 m from the Manitoba/Ontario border to Lake Winnipeg through a series of falls and rapids has resulted in extensive hydroelectric exploitation of this river. Six electric generating stations are present on the Winnipeg River, whose discharge rate is now largely controlled by these hydroelectric dams, which precludes any short-term correlation between precipitation and river flow. The two most relevant stations are the Seven Sisters Generating Station, which is approximately 7.5 km upstream of the WL site and McArthur Generating Station, which is approximately 26 km downstream.

Near the LSA, the river is approximately 300 m wide, 7 m deep and flows in a northerly direction at a velocity of approximately 0.3 m/s. Flow rates measured at the nearby Seven Sisters Falls Hydroelectric Generating Station (approximately 7.5 km upstream of the WL site) typically vary between 600 and 1,800 m^3/s with a record low at 125 m^3/s and a high at 2,800 m^3/s (CNL 2016b).

The flow of the river is usually lowest in late summer/early fall and highest in late spring/early summer (Figure 6.4.1-2). This follows typical temporal river patterns with water levels affected by spring snow melt and large precipitation events in spring and fall. The dams on the Winnipeg River provide some storage capacity, preventing extreme flooding and extreme low water levels.

A stage-discharge graph compares the river level to river flow. For the Winnipeg River, the water levels were taken at the WL pump house (AECL 2016) and the flows were taken approximately 7.5 km upstream at Seven Sisters Generating Station (Manitoba Hydro 2016). The stage-discharge for the Winnipeg River adjacent to the WL site demonstrates that there is a relationship between flow and water level at higher flow and water levels, but this changes when flow is below 1,200 m^3/s and elevation is below 255 m (Figure 6.4.1-3). As there are no extreme low water levels at low flows, it is inferred that the downstream dam, McArthur, is likely influencing water elevation in low flow conditions. Water levels on Winnipeg River at the WL pump house in 2013 and 2014 were recorded weekly (approximately 4 or 5 times per month).

S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0011_EIS_Sec_6.4.1\20145046-0011-CS-0002_Figure 6_4_1-2_Flow of the Winnipeg River at McArthur Generating Station.mxd



NOTE(S)

REFERENCE(S)

WSC (WATER SURVEY OF CANADA). 2016. WINNIPEG RIVER AT MCARTHUR GENERATING STATION. STATION 05PF068. ACCESSED NOVEMBER 14, 2016. AVAILABLE AT AVAILABLE AT HTTPS://WATEROFFICE.EC.GC.CA/STATION_METADATA/REFERENCE_INDEX_E.HTML?STNNUM=05PF068

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PROJECT
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CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	-
PREPARED	PR/RRD
REVIEWED	KL
APPROVED	GV

TITLE
FLOW OF THE WINNIPEG RIVER AT MCARTHUR GENERATING STATION

PROJECT NO.	CONTROL	REV.	FIGURE
20145046		2	**6.4.1-2**

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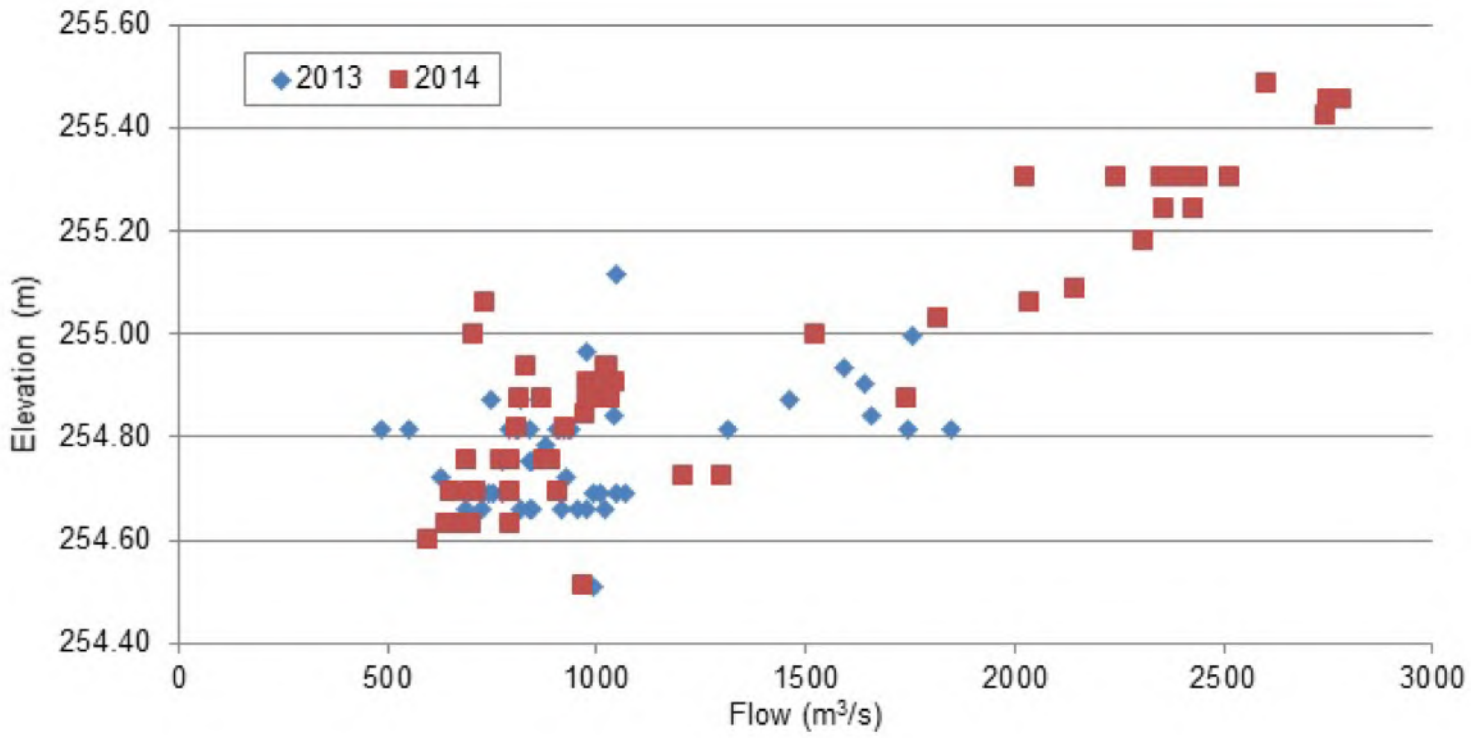

NOTE(S)

REFERENCE(S)
DOCUMENT NUMBER: WLDP-26000-ENA-001, PAGE 9; FIGURE 6.4.1-3

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PROJECT
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CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	-
PREPARED	PR/RRD
REVIEWED	KL
APPROVED	GV

TITLE
WATER ELEVATION OF THE WINNIPEG RIVER AT WHITESHELL LABORATORIES AND THE FLOW AT SEVEN SISTERS GENERATING STATION ON THE SAME DAY IN 2013 AND 2014

PROJECT NO.	CONTROL	REV.	FIGURE
20145046		2	**6.4.1-3**

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6.4.1.5.2.2 Drainage Patterns

Surface water runoff generated within the SSA and LSA drains into the Winnipeg River. The SSA area is 0.07 ha and the LSA area is approximately 29 ha. Drainage around the LSA perimeter is accommodated by the use of shallow swales and drainage ditches. The roads, parking pads and roof discharges within the LSA are drained by underground storm drains that flow into the main drainage ditches within the LSA and directed to the Winnipeg River (AECL 2000).

The LSA is a very low-lying area with local elevations of only a few tens of centimetres to a few metres; the elevation difference from the WL main campus to top of the riverbank is approximately 0.5 m. However, there is a 10 m difference between the normal water elevations in the river and top of bank elevation.

Most of the surficial geology in the RSA consists of glacial lacustrine and glacial till deposits (about 20 m thick). Overlying are deposits of organic matter (i.e., wetland, swamp areas) most often about 0.5 to a few metres thick. There are also some localized areas that are well-drained, and these drier soils support mixed hardwood stands (AECL 2000). Most of the runoff from the RSA drains directly into Winnipeg River. A small amount of land from the low-lying eastern area within the WL site drains by ditches and small streams that flow into the Pinawa Channel. The Pinawa Channel, a diversion of some of the Winnipeg River discharge, flows in a roughly south to north direction on the eastern side of the RSA. Drainage within the RSA are directed by roadside ditches. The drainage area and quantity of discharge within the various drainage ditches vary, with some ditches and culverts having only measurable flow following spring melt and after sustained wet periods. Two of the drainage ditches (along Provincial Highway 211) are considered to be important for reducing surface storage and channel surface runoff directly to the Winnipeg River. One major drainage ditch, potentially diverting surface runoff from eastern boundary of the WL site, crosses Provincial Road 520 and drains into Pinawa Channel.

6.4.1.5.2.3 Surface Water Flow Estimation

The runoff rates and volumes generated by the SSA following activities of the Project are expected to decline from the existing conditions. To estimate the runoff rates and volumes generated by the SSA after the decommissioning activities, a runoff coefficient of 0.23 was assumed for the conditions designed for the SSA (average sloped soil and grassed area) based on speciality literature recommendations (i.e., parks; RTAC 1982). The runoff coefficient assumed for the current drainage conditions within the SSA, is approximately 0.83 (i.e., roofs, RTAC 1982), provided by the high percentage of hard surface area and buildings. The lower runoff coefficient for a grass covered area leads to a decrease of approximately 72% in runoff rates and volumes generated by the SSA.

Runoff volumes generated by rainfall events within the SSA were estimated using the rainfall depths and intensities (i.e., IDF data) recorded at the Climate Station 5023233. The Rational Method was applied to determine the peak runoff rates generated from the SSA that has an area of 0.07 ha (MOE 2003).

The Rational Method equation is: $Q = 0.00278\ C\ i\ A$

Where: Q = peak flow (m^3/s)

- C = runoff coefficient (dimensionless)
- i = rainfall intensity (mm/h)
- A = drainage area (ha)

The rainfall intensity used in the Rational Method equation was determined based on the return period at the time of concentration calculated for the SSA drainage area and applying the IDF curves. Rainfall intensities for a range of return periods at the SSA are given in Table 6.4.1-5. Drainage peak flow generated by the SSA for a specific return period and duration of a rainfall event were determined by applying the rainfall intensity values presented in Table 6.4.1-5 to the Rational Method. The resulting runoff volumes generated by the SSA for various return periods and durations are presented in Table 6.4.1-6.

Table 6.4.1-5: Estimated Rainfall Intensities (mm/hr) at the Site Study Area for Various Return Periods

Duration	Return Period					
	2 Years	5 Years	10 Years	25 Years	50 Years	100 Years
5 minutes	99.2	136.9	162.0	193.6	217.0	240.3
10 minutes	75.9	98.6	113.6	132.5	146.5	160.5
15 minutes	63.6	80.7	92.1	106.5	117.1	127.7
30 minutes	45.5	59.9	69.5	81.5	90.5	99.4
1 hr	27.2	36.9	43.4	51.6	57.6	63.6
2 hr	15.8	21.9	26.0	31.1	34.9	38.7
6 hr	6.6	9.2	10.9	13.1	14.7	16.3
12 hr	3.8	5.3	6.4	7.6	8.6	9.5
24 hr	2.1	2.9	3.4	4.1	4.6	5.0

Table 6.4.1-6: Estimated Runoff Volumes (m^3) Generated by the Site Study Area for Various Return Periods

Duration	Return Period					
	2 Years	5 Years	10 Years	25 Years	50 Years	100 Years
5 minutes	2	2	3	3	4	4
10 minutes	2	3	3	4	4	5
15 minutes	3	3	4	5	5	6
30 minutes	3	4	5	6	6	7
1 hr	4	5	6	7	8	9
2 hr	5	6	8	9	10	11
6 hr	7	9	11	13	14	16
12 hr	8	11	13	16	18	20
24 hr	10	14	16	20	22	25

The peak runoff rate from the SSA for a 1:25-year rainfall event is 0.012 m^3/s and, for a 1:100-year event, it is 0.014 m^3/s. The runoff volume generated by the SSA for a 1:25-year; 24-hour event is approximately 20 m^3 and for a 1:100-year event it is 25 m^3. Flow contribution to the Winnipeg River from the SSA is four or five orders of magnitude smaller than the river average flow.

6.4.1.6 Project Interactions and Mitigation

6.4.1.6.1 Methods

This section describes the process by which interactions between Project components and activities and hydrology were identified and evaluated. Potential effect pathways are identified, and mitigation developed to eliminate and/or reduce effects is presented. A pathways analysis is then used to focus the assessment on key interactions between the Project and the environment by evaluating the different effect pathways to determine if, after incorporation of mitigation, there is still potential to cause residual effects. Where effects will be adequately mitigated and are not forwarded for further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are articulated. Primary pathways that may lead to residual effects after incorporation of mitigation are further characterized in subsequent subsections of the assessment. As such, this section helps to focus the remainder of the assessment on those interactions (effects pathways) likely to result in residual adverse effects.

The first part of the analysis was to identify the potential effects pathways for all phases of the Project. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. The next step in the analysis was the development of environmental design features and mitigation that could be incorporated into the Project to eliminate and/or reduce adverse effects to hydrology. Environmental design features included project design elements, environmental best practices and management policies and procedures. Environmental design features and mitigation were developed through an iterative process between the Project's engineering and environmental teams, combined with input from Project-specific or regional engagement with other interested parties. The design features and/or mitigation were selected considering their effectiveness for implementation and maintenance and their appropriateness within the context of the identified effect pathways.

After incorporation of mitigation, potential pathways were evaluated into the following categories using scientific knowledge, logic, experience with similar developments and the effectiveness of environmental design features and mitigation:

- **No linkage pathway –** pathway is removed by environmental design features or mitigation such that the Project would not be expected to result in a measurable environmental change relative to Base Case values and therefore would have no residual effects to hydrology.
- **Secondary pathway –** the pathway could result in a measurable minor environmental change but would have a negligible residual effect on hydrology relative to Base Case and/or guideline values and is not expected to contribute cumulatively to other Project effects or to the effects of other past, present or reasonably foreseeable developments to cause a significant effect.
- **Primary pathway –** the pathway is likely to result in an environmental change relative to the Base Case and/or guideline values that could contribute to residual effects to hydrology.

Environmental design features and mitigation that have been or could be incorporated into the Project to eliminate and/or reduce adverse effects were considered. Potential pathways that were completely removed due to implementation of environmental design or mitigation were not assessed further. Pathways that were assessed to be secondary and demonstrated to have a negligible residual effect to hydrology through simple qualitative or semi-quantitative evaluation of the pathway were also not advanced for further assessment. Primary pathways were carried forward for more detailed quantitative and/or qualitative effects analysis to characterize the residual effects of the Project.

6.4.1.6.2 Results

Pathways through which all phases of the Project may interact with and result in changes to measurement indicators for hydrology are provided in Table 6.4.1-7.

Table 6.4.1-7: Pathways Analysis for Hydrology Valued Components

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
Installation of the concrete cap and engineered cover during closure	Installation of concrete cap and engineered cover at the WR-1 Building may alter drainage rates and flow patterns	■ The Project site and the engineered cover will be graded to promote drainage to the Winnipeg River.	Secondary
Closure of the entire WL site	Decommissioning and reclamation of the entire WL site, including the Project, may alter drainage rates and flow patterns	■ The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-states. ■ The drainage system for the reclaimed WL site will have the physical characteristics similar to the natural drainage systems in the general geographic region in terms of dynamic stability, robustness and longevity. ■ The WL site will be graded to promote drainage to the Winnipeg River. ■ A stormwater management plan will be developed for the closure of the WL site using best management practices.	Secondary

6.4.1.6.2.1 No Linkage Pathway

There are no pathways identified as having no linkage to effects on hydrology.

6.4.1.6.2.2 Secondary Pathways

- **Installation of concrete cap and engineered cover at the WR-1 Building.**

Drainage from the LSA is to the Winnipeg River. Following the completion of closure activities, the Project site will be graded to promote drainage to the Winnipeg River. Run-off control for the engineered cover is designed to limit erosion and infiltration of water into the grouted structure. This is achieved by sloping the cover surface to maintain a slope toward the edges and the collection of water by the surface water management systems at the WL site. Although the installation of the concrete cap and engineered cover at the WR-1 Building is expected to slightly alter the drainage rates and flow patterns; the changes are expected to be within the natural range of variation. Conclusions on the effect of the concrete cap and engineered cover on the drainage and flow patterns of the Winnipeg River are supported given the footprint of the concrete cap and engineered cover is relatively small (approximately 30 m by 30 m) when considering the drainage area it resides within. Further, the natural variation flow patterns in the Winnipeg River are a cumulative effect of its drainage basin, which outweigh the plausible flow from the concrete cap and engineered cover.

As such, effects to hydrology from the installation of the cover at closure is predicted to have a negligible residual effect on hydrology.

- **Decommissioning and reclamation of the entire WL site, including the Project.**

The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-states. The drainage system for the reclaimed WL site will have physical characteristics similar to natural drainage systems in the general geographic region in terms of dynamic stability, robustness, and longevity. The contribution to site runoff from the Project is expected to be minor relative to the entire decommissioned WL site. The WL site will be graded to promote drainage to the Winnipeg River. Although closure of the WL site may slightly alter the drainage rates and flow patterns and discharge volume to the Winnipeg River; the changes are expected to be within the natural range of variation.

As part of the closure of the WL site, a stormwater management plan will be developed using best management practices and taking into consideration the impact of the WL site's drainage following the demolition of the infrastructure (e.g., buildings, roads, catch basins, storm drainage system). The objectives of this management plan will include alternate drainage works (e.g., swales, ditches, culverts) along with aligning the landscaping to existing grades so that proper drainage is achieved. Typically, the stormwater will be directed to the Winnipeg River utilizing existing topography's drainage paths (creeks) to the greatest extent possible. The storm water management plan will evaluate:

- the post-closure topography applying the appropriate runoff coefficients;
- the impacts due to the reduction/elimination of existing drainage works;
- the rainfall event impacts on peak flow rates to the new drainage works; and
- the integration of remedial drainage works with the existing drains and creeks.

As such, effects to hydrology from the closure of the WL site, including the Project, are predicted to have a negligible residual effect on hydrology.

6.4.1.6.2.3 Primary Pathways

There are no primary pathways identified as having a residual effect on hydrology. As such, there is no residual effects analysis and determination of significance completed for the hydrology assessment.

6.4.1.7 Monitoring and Follow-up

Monitoring and follow-up programs are not identified as there are no predicted residual effects to hydrology. However, CNL will implement an Environmental Assessment Follow-up Program for the Project as identified for other environmental components to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. This monitoring will be integrated with that for the existing Environmental Assessment Follow-up Program for the WL site, where practical.

It is noted that data generated by the monitoring program will be evaluated on an ongoing basis within an adaptive management framework. Within this framework, modifications to the program may be appropriate to confirm data continue to fulfill program objectives. For example, should the precipitation or runoff rates and volumes be outside the range predicted in the EIS during the closure period, investigations and mitigation would be implemented. Conversely, cessation of a monitoring activity might be appropriate once the interaction has ceased (i.e., during

post-closure) or it has been shown that an effect has stabilized or has been reduced to a level where it is no longer considered significant with respect to regulatory requirements or community concerns. Any proposals for modifications to the monitoring program and the rationale for the modifications will be communicated to the CNSC prior to implementation. Additional information on the Environmental Assessment Follow-up Program for the Project can be found in Section 11.0 Summary of Monitoring and Follow-up Programs.

CNL will continue to proactively seek, engage, and support meaningful discussion on issues and opportunities related to the Project, including the monitoring and follow-up program, with First Nations and the Manitoba Métis Federation and communities of interest. CNL will continually evaluate both the process and the outcome of the ongoing engagement and communication activities, to address and manage issues as they arise.

6.4.1.8 Conclusions

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). Acknowledging that changes to hydrology could lead to effects on other VCs, hydrology is referred to as an intermediate VC. Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations indicated the importance of the Winnipeg River for drinking water, recreation, food, and traditional access to land, including transportation. Indigenous peoples did not identify any additional valued components as it relates to the hydrology assessment.

The hydrology assessment considers the potential effects of the Project to the flows and water levels of the Winnipeg River. The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-states. Following the completion of closure activities, the WL site and engineered cover will be graded to promote drainage from the site to the Winnipeg River. Run-off control for the cover is designed to limit erosion and infiltration of water into the grouted structure. This is achieved by sloping the cover surface to maintain a slope toward the edges and the collection of water by the existing surface water management systems at the WL site. A stormwater management plan will be developed for the closure of the WL site using best management practices. The overall contribution of WL site drainage to the Winnipeg River flow is negligible, thus no effects are anticipated.

Natural runoff from the decommissioned WL site will continue to discharge to the Winnipeg River during the post-closure phase. Although the installation of the concrete cap and engineered cover at the WR-1 Building is expected to slightly alter the drainage rates and flow patterns and decrease the volume to the Winnipeg River; the changes are expected to be within the natural range of variation of flow in the Winnipeg River. As such, effects to hydrology from the installation of the concrete cap and engineered cover at closure is predicted to have a negligible residual effect on hydrology. Overall, the assessment of potential effects determined there are no residual adverse effects on hydrology of the Winnipeg River. This conclusion applies to the interests and concerns about the Winnipeg River hydrology raised by the engaged Indigenous Nations that were encompassed by the assessment (Table 6.2.1-1).

Monitoring and follow-up programs are not identified as there are no predicted residual effects to hydrology. However, CNL will implement an Environmental Assessment Follow-up Program for the Project as identified for other environmental components to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. This monitoring will be integrated with that for the existing Environmental Assessment Follow-up Program for the WL site, where practical.

CNL will continue to proactively seek, engage, and support meaningful discussion on issues and opportunities related to the Project, including the monitoring and follow-up program, with First Nations and the Manitoba Métis Federation and communities of interest. CNL will continually evaluate both the process and the outcome of the ongoing engagement and communication activities, to address and manage issues as they arise.

6.4.2 Surface Water Quality

6.4.2.1 Scope of the Assessment

Section 6.4.2 focuses on surface water quality within the Winnipeg River. It assesses the potential change in water quality attributed to the Project, including parameters relevant to the health of humans, aquatic biota and terrestrial wildlife.

The surface water quality assessment follows the overall environmental assessment approach and methods described in Section 6.1 Environmental Assessment Approach. The assessment is completed in the following steps.

- **Step 1 – Identifies Valued Components (VCs) and defines the spatial boundaries, temporal boundaries and assessment cases** (refer to Section 6.4.2.3 Valued Components and Section 6.4.2.4 Assessment Boundaries) for the surface water quality assessment. The VCs, assessment endpoints and measurement indicators used to assess Project related changes to surface water quality, the spatial and temporal boundaries at which the assessment occurred, and the assessment cases considered are described.
- **Step 2 – Describes the existing conditions** (refer to Section 6.4.2.5 Description of the Environment). Existing conditions in the local and regional areas are described, including the combined effects of previous and existing developments (Base Case). The existing environment represents the historical and current environmental pressures that have shaped the observed patterns in the environment (i.e., natural variation).
- **Step 3 – Evaluates Project interactions and mitigation** (refer to Section 6.4.2.6 Project Interactions and Mitigation). Project components and/or activities with the potential to affect surface water quality are identified and mitigation options are presented to limit or avoid these effects. A pathways analysis is then used to focus on key interactions between the Project and the environment and determine if mitigation can limit or eliminate the predicted residual effects. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. Where effects are adequately mitigated and are not forwarded to further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are described. Primary pathways that may lead to residual effects to surface water quality after incorporating mitigation are carried forward to Step 4 for further analysis and residual effects characterization.
- **Step 4 – Presents the methods and results of the residual effects analysis** (refer to Section 6.4.2.7 Residual Effects Analysis). This section outlines the methods used to predict and characterize residual effects to surface water quality from primary effect pathways. The analysis results are also presented including the characterization of incremental effects from the Project, as well as cumulative effects of the Project in combination with other reasonably foreseeable developments (if applicable). A key outcome of this section is the predicted changes to surface water parameters in the Winnipeg River that are passed to other disciplines for their assessment.

- **Step 5 – Describes the level of certainty and management of uncertainty** (refer to Section 6.4.2.8 Prediction Confidence and Uncertainty). The purpose of the section is to evaluate the available literature, data and models used for the assessment, and describe the level of certainty that can be placed on predicted residual effects. This section will also identify how the uncertainty has been managed so that the effects are not underestimated.
- **Step 6 – Classify and determine the significance of the predicted residual effects.** This step was not required as the surface water quality VC is an intermediate component, which does not include an assessment endpoint to determine significance.
- **Step 7 – Identifies monitoring and follow-up** (refer to Section 6.4.2.9 Monitoring and Follow-up) required to confirm effect predictions and address uncertainty.
- **Step 8 – Presents a consolidated summary of conclusions and outcomes of the assessment** (refer to Section 6.4.2.10 Conclusions) of residual effects on surface water quality.

6.4.2.2 Indigenous Engagement Feedback – Key Interests and Concerns

Information and concerns raised specifically by Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations during engagement related to the surface water quality assessment are summarized in Table 6.4.2-1. Other general concerns and questions raised during Indigenous engagement activities are documented in Section 4 Indigenous Engagement.

Table 6.4.2-1: Summary of Key Interests and Concerns Raised During Indigenous Engagement Activities Related to the Surface Water Quality Assessment

Interest and Concern	Inclusion Status	Additional information and Rationale
Effects on the Winnipeg River ■ The containment of waste in the disposal facility and long-term effects of the site and the Project on water quality. ■ Past releases and potential future discharges of hazardous and radioactive material	Already included in the environmental assessment	The Winnipeg River was included in the Regional Study Area for the assessment of water quality. See Section 6.4.2.4.1 Spatial Boundaries. Effects on water quality are described in Section 6.4.2.7 Residual Effects Analysis.
Spills of Hazardous Materials ■ How CNL detects spills	Already included in the environmental assessment	CNL's Emergency Preparedness Program is summarized in Section 7.3.2 Spills and Leaks.
Water Quality Monitoring	Already included in the environmental assessment	Information on the monitoring program is available in Section 6.4.2.9 Monitoring and Follow-up.

6.4.2.3 Valued Components

Valued components refer to environmental features that may be influenced by the Project and that have been identified to be of importance by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). Surface water quality is recognized as an important component of the environment that may be affected by the Project. Subsequently, changes to surface water quality by Project activities could affect human health, fish and wildlife and land and resource use (Table 6.4.2-2). Indigenous engagement confirmed the importance of surface water quality. Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations were concerned as the Project may indirectly discharge water into the Winnipeg River.

Table 6.4.2-2: Valued Components for Surface Water Quality Assessment

Valued Component	Rationale for Selection
Surface Water Quality	There is potential for interaction with the Project; species of concern live in the river; river has ecological and socio-economic value to communities, government agencies and the public; and downstream areas have traditional, cultural and heritage importance to Indigenous peoples.

Acknowledging that change to water quality is considered to be an important aspect of the natural and human environment, surface water quality is referred to as an intermediate VC (i.e., it does not have an assessment endpoint). Changes to intermediate VCs must be understood to facilitate assessment of project interactions. The surface water assessment, therefore, is analyzed for incremental and cumulative (if applicable) changes in the relevant measurement indicators associated with surface water quality (Table 6.4.2-3).

Measurement indicators represent properties of the environment and VCs that, when changed, could result in or contribute to an effect on a VC. Measurement indicators also provide the primary factors for discussing the uncertainty of effects on VCs and, subsequently, are the key variables for study in follow-up and monitoring programs. The changes are characterized in terms of magnitude, duration, and geographic extent, but are not classified using rankings for effects criteria. The surface water quality assessment also does not include the assessment of the significance of these changes; rather, results of the analysis of changes in measurement indicators for surface water quality are provided to other disciplines for inclusion in their assessment (Table 6.4.2-3).

Surface waters interact with other environment features, including humans, aquatic biota, and terrestrial wildlife. The results of the surface water quality assessment therefore extend to other disciplines as listed in Table 6.4.2-3.

Table 6.4.2-3: Measurement Indicators for the Surface Water Quality Assessment

Valued Component	Measurement Indicators	Discipline Assessments where Effects on Surface Water Quality are Considered
Surface Water Quality	Changes to ambient levels of surface water contaminants (turbidity, radionuclides, metals)	■ Aquatic Environment (Section 6.5) ■ Terrestrial Environment (Section 6.6) ■ Human and Ecological Health (Section 6.7) ■ Land and Resource Use (Section 6.8)

6.4.2.4 Assessment Boundaries

6.4.2.4.1 Spatial Boundaries

The spatial boundaries selected for the surface water quality assessment are consistent with hydrology and aquatic environment, and are presented on Figure 6.4.2-1.

- **Site Study Area (SSA):** is the Whiteshell Reactor 1 (WR-1) Building and represents the Project footprint (i.e., where project activities will be undertaken; 0.07 ha).
- **Local Study Area (LSA):** was selected in consideration of the SSA and the spatial extent of potential direct effects of the Project on hydrology, surface water quality and the aquatic environment. The LSA was selected to represent an area that is likely to be directly affected by the Project, helping to identify Project-specific (rather than cumulative effects of the Project in combination with other projects in the region). The LSA is represented by the fenced area of the WL main campus and includes the SSA. The LSA was based on the area of the WL main campus that is currently drained by roadside ditches and storm sewers. The approximate size of the LSA is 29 ha. The LSA does not include the Winnipeg River as direct effects to surface water quality from the Project on the Winnipeg River are anticipated to be negligible. Conversely, indirect effects to the surface water quality of the Winnipeg River may occur as a result of changes to groundwater quality resulting from the Project. As such, the Winnipeg River is considered as part of the RSA (see description below).
- **The Regional Study Area (RSA)** is defined as the area within which maximum geographical extent of potential indirect effects of the Project may interact with the effects of other existing or reasonably foreseeable projects. For example, indirect effects on surface water quality from the Project include potential seepage of groundwater into the Winnipeg River. The plume from the discharged effluent during operation was previously assessed to hug the east bank of the river (AECL 1973) and it is assumed that a groundwater seep in relatively the same area will behave similarly. Therefore, the south boundary of the RSA extends from the west shore of the Winnipeg River to the east fence on the property line about 400 m north of Provincial Highway 211. The eastern boundary of the RSA follows the fence on the property line to the north property line. The north boundary follows the north fence on the property line about 1.6 km and then turns north for about 400 m before turning west and extending to the west side of the Winnipeg River. This is to include the first farm (Farm A) downstream on the east bank because this is the most conservative potential water user. The west boundary follows the west bank of the Winnipeg River. The RSA has an approximate size of 4,121 ha.

6.4.2.4.2 Temporal Boundaries

The temporal boundary of the assessment includes effects observed under existing conditions, the timeframe during which Project activities are actively occurring and the duration of predicted residual effects. The duration of an effect is defined as the amount of time between the start and end of a Project activity plus the time required for the residual effect to be reversed. In some cases, a residual effect may be irreversible within the temporal boundaries of the Project if the effects were predicted to last so far into the future that they could not be predicted with any level of certainty (e.g., residual effect lasts for thousands of years). The following phases were identified for the Project:

- **Closure Phase:** Preparation and implementation of in situ disposal, which includes preparation for in situ disposal, grouting of below-grade structures and systems, removal of above-grade WR-1 structures and systems, installation of the concrete cap and engineered cover, and environmental controls and final site restoration. These activities last from 2022 to 2027.
- **Post-closure Phase:** The post closure phase has two discrete periods: institutional control and post institutional control. Institutional control is estimated to last 100 years during which long-term monitoring and maintenance activities will continue to demonstrate Whiteshell Reactor Disposal Facility (WRDF) performance is in compliance with the safety case assumptions and performance modelling. The 100 year timeframe is not related to the design life of the WRDF barriers. The 100-year active monitoring period was selected to ensure that sufficient opportunity is provided to verify the WRDF is performing as expected. Additionally, beyond 100 years, there is less confidence that institutional controls, like access restrictions, can be relied upon. Although the duration of institutional control is estimated at 100 years, it is recognized that it will continue until the CNSC, or the appropriate authority at the time, agrees it is no longer needed.

  Post-institutional control occurs after year 2127 and continues indefinitely. The post-closure phase will continue indefinitely; however, the timeframe defined for assessment of potential effects as part of the normal evolution of the Project is 10,000 years. This time period encompasses the phase in which peak effects are anticipated.

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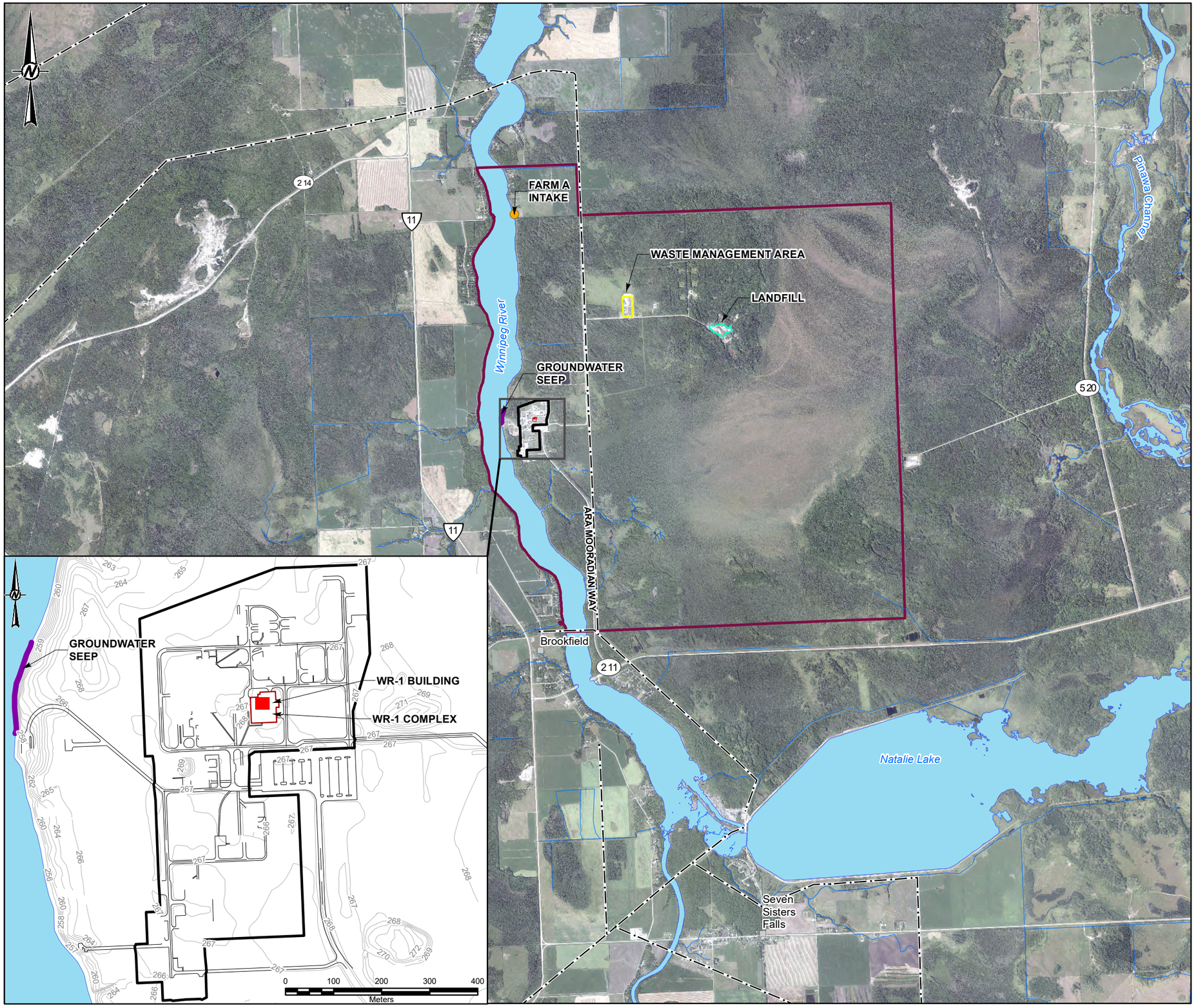

LEGEND

- FARM A INTAKE
- GROUNDWATER SEEP
- WR-1 BUILDING (SITE STUDY AREA)
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

WHITESHELL LABORATORIES

- WR-1 COMPLEX
- WASTE MANAGEMENT AREA
- LANDFILL

BASE FEATURES

- CITY/TOWN
- TRANSMISSION LINE
- ROAD
- CONTOUR - 1 M INTERVAL
- WATERCOURSE
- WATERBODY

0 1,000 2,000 3,000 4,000

1:60,000 METRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY PROVIDED BY CNL (2016-11-22)
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT

CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT

EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE

SPATIAL BOUNDARIES FOR THE SURFACE WATER QUALITY ASSESSMENT

CONSULTANT

WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/PR/RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0012	2	**6.4.2-1**

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Path: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0012_EIS_Sec_6.4.2\20145046-0012-CS-0001_Figure 6_4_2-1_Spatial Boundaries for the Surface Water Quality Assessment.mxd

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6.4.2.4.3 Assessment Cases

There are three assessment cases considered in this EIS: the base case; application case; and reasonably foreseeable developments (RFD) case.

- **Base Case:** represents existing conditions and characterized combined effects from previous and existing developments and activities. The Base Case reflects the effects of existing disturbances, such as forestry, transportation, agricultural, mining, and residential and recreational activities. Current effects from the existing facilities at the WL site such as effluent discharged to the Winnipeg River are considered. These include the ditch drainage system of the Waste Management Area (WMA) and sewage lagoon. Sediment near the effluent outfall has elevated levels of radionuclides due to historical discharge and fallout (AECL 2001a) and is also considered as part of the Base Case. Levels of caesium-137 in soil and sediment are elevated in the WL area (latitude 40 to 60 degrees) due to above average deposition from world-wide nuclear weapon testing during the cold war (AECL 2001a; NRCC 1983). In addition, existing conditions of areas not affected by the WL site are also considered as part of the Base Case. For example, Seven Sisters Generating Station is approximately 7.5 km upstream of the WL site and McArthur Generating Station is approximately 26 km downstream. Effects from the decommissioning and reclamation activities already completed at the WL site are also considered as part of the Base Case.
- **Application Case:** represents the effects of the Base Case combined with the predicted effects from the Project. The Application Case includes closure and post-closure activities. Surface water runoff during closure and the groundwater seep during post-closure represent the bounding cases.
- **RFD Case:** represents the predictions of the cumulative effects of the Application Case, plus projects that are currently under application review or that have officially entered a regulatory application process and which overlap with the surface water quality in the RSA. Foreseeable developments in the surface water environment RSA that are expected to overlap with residual effects on surface water quality from the Project includes the decommissioning of the remaining infrastructure and support facilities and remediation of affected lands at the WL site as per the existing decommissioning licence. A Comprehensive Study Report (AECL 2001b) under the *Canadian Environmental Assessment Act, 1992* was completed for the decommissioning of the WL site. The Environmental Assessment decision to approve the Project was announced by the Minister of the Environment in March 2002 and a decommissioning licence was issued to Atomic Energy of Canada Limited (AECL) and subsequently to Canadian Nuclear Laboratories (CNL). There are no other foreseeable developments in the RSA that are expected to overlap with changes to surface water quality (Table 6.4.2-4).

Table 6.4.2-4: Reasonably Foreseeable Developments considered in the Surface Water Quality Assessment

Type of Project	Location	Description	Timeframe	Overlap with Valued Components
Infrastructure Decommissioning	WL	Decommissioning of remaining infrastructure on the WL site (includes in situ disposal of the low-level waste trenches).	2016 to 2027	Yes – there is both spatial and temporal overlap of effects with the Project
Environmental Remediation	WL	Remediation of affected lands, with the exception of the low-level waste trenches.	2016 to 2027	Yes – there is both spatial and temporal overlap of effects with the Project

6.4.2.5 Description of the Environment

6.4.2.5.1 Methods

This section documents the methods, data and results that were used to describe the background surface water quality in the SSA, LSA and RSA for surface water parameters. The assessment was carried out by reviewing documents and collecting data from government agencies.

Background, or ambient water quality for the Winnipeg River exclusive of any potential WL site related influence is represented herein by two sampling locations – the WL Intake and the Powerview Dam. The WL Intake is located in the river at the WL site, upstream of any potential site-associated influence. Sampling at WL is completed by CNL. The Powerview Dam site is located on the river at the community of Powerview-Pine Falls approximately 26 km downstream of WL, well beyond the influence of the WL site. Sampling at the Powerview Dam is completed through a provincial government initiative by the Department of Sustainable Development. Water quality data collected over the period 2011 through 2019 (where available) at these two locations are summarized in Table 6.4.2-5 and Table 6.4.2-6. The data are associated with monthly sampling events and are summarized on a yearly basis. In the tables, data for the WL Intake station are prioritized over the Powerview Dam site - that is, where available, the data for the WL Intake are shown. The Powerview Dam data are provided to supplement the WL Intake data for specific constituents that are not captured in the WL Intake sampling program, in order to present a broader characterization of background conditions in the river. Notes provided with the tables identify the origin of the data shown for each constituent.

Where possible, surface water parameters were compared to federal or provincial standards, objectives, or guidelines. Where guidelines from the federal or provincial jurisdictions were missing, guidelines from other provinces or toxicity tests were used. Acute toxicity tests were divided by 100 and chronic toxicity tests were divided by 10 to adjust the values to a no observable adverse effects level guideline.

Some sediment samples downstream of the outfall had elevated levels of radionuclides so a more detailed investigation was conducted in 2000 (AECL 2001a). The sediment surface was surveyed with a gamma survey probe and gamma spectroscopy probe. Sediment samples were also collected for laboratory analysis of radionuclides. In 2006, sediment cores were taken as part of the Environmental Assessment Follow-Up Program (AECL 2008). This program involves sampling in Lake Sylvia and upstream and downstream of the waterbody Lac du Bonnet every 20 years. The objective is to characterize sediment adjacent to the WL site by age dating with lead-210 methods. As part of the routine monitoring at the WL site, water, sediment, and biota are sampled regularly (CNL 2012, 2013, 2014, 2015 2016a, 2017a, 2018a, 2019a, 2020a). Radionuclides measured in liquids

are reported as Becquerel per litre (Bq/L) and radionuclides measured in solids are reported as Becquerels per kilogram (Bq/kg).

Daily discharge rates were provided by Manitoba Hydro (2016) at the Seven Sisters Generating Station 7.5 km upstream and were also taken from the Water Survey of Canada (WSC 2016) at McArthur Generating Station. Water levels in the Winnipeg River and water chemistry for the intake water was provided by CNL (CNL 2016b, 2020b). Water quality was also provided by the Manitoba Water Quality Management Section (WQMS 2016; 2020) from Pine Falls.

6.4.2.5.2 Results

6.4.2.5.2.1 General Overview

The Winnipeg River is considered to be a medium-sized lowland river (AECL 2001b). Its drainage area is approximately 15,000,000 ha, originating in Ontario at Lake of the Woods (Figure 6.4.2-2). The Winnipeg River and its chief tributary, the English River, drain a 150,000 km^2 area contained almost entirely within the Precambrian Shield. Two thirds of the basin lie within northwestern Ontario. From Ontario, it extends south into northern Minnesota, and west from the head of the Great Lakes through the Whiteshell Provincial Park. In eastern Manitoba, Lake of the Woods is the largest single lake in the Winnipeg River drainage basin. Lake of the Woods and its major tributary, the Rainy River, form a system that drains the southern portion of the area. The northern portion is drained by the English River and Lac Seul systems.

There are nine hydroelectric dams within the watershed, the closest approximately 7.5 km upstream of the WL site. These dams have extensively modified flow patterns in the river (AECL 2001b). Dams store water during periods of high precipitation and release water during periods of low precipitation. This regulates the downstream flow (Section 6.4.1.4.2, Figure 6.4.1-3). Adjacent to the WL site, the river is approximately 0.3 km wide and 7 m deep and flows northerly between 436 and 1,842 m^3/s (2010 to 2015 average at Seven Sisters Generating Station; Manitoba Hydro 2016) to Lake Winnipeg.

The flow of the river is usually lowest in late summer/early fall and highest in late spring/early summer (Section 6.4.1.4.2, Figure 6.4.1-2). This follows typical temporal river patterns with water levels affected by spring snow melt and large precipitation events in spring and fall. The dams on the Winnipeg River provide some storage capacity, preventing the extreme flooding and extreme low water levels. For the Winnipeg River, the water levels were taken at the WL pump house (CNL 2016b) and the flows were taken approximately 7.5 km upstream at Seven Sisters Generating Station (Manitoba Hydro 2016). The stage-discharge for the Winnipeg River adjacent to the WL site demonstrates that there is a relationship between flow and water level at higher flow and water levels, but this changes when flow is below 1,200 m^3/s and elevation is below 255 m (Section 6.4.1.4.2, Figure 6.4.1-3).

An extensive wetland area is situated in the middle to eastern portion of the RSA (AECL 2001b). Surface water drainage from the wetland area generally flows from the east towards the Winnipeg River (Section 6.4.1.3).

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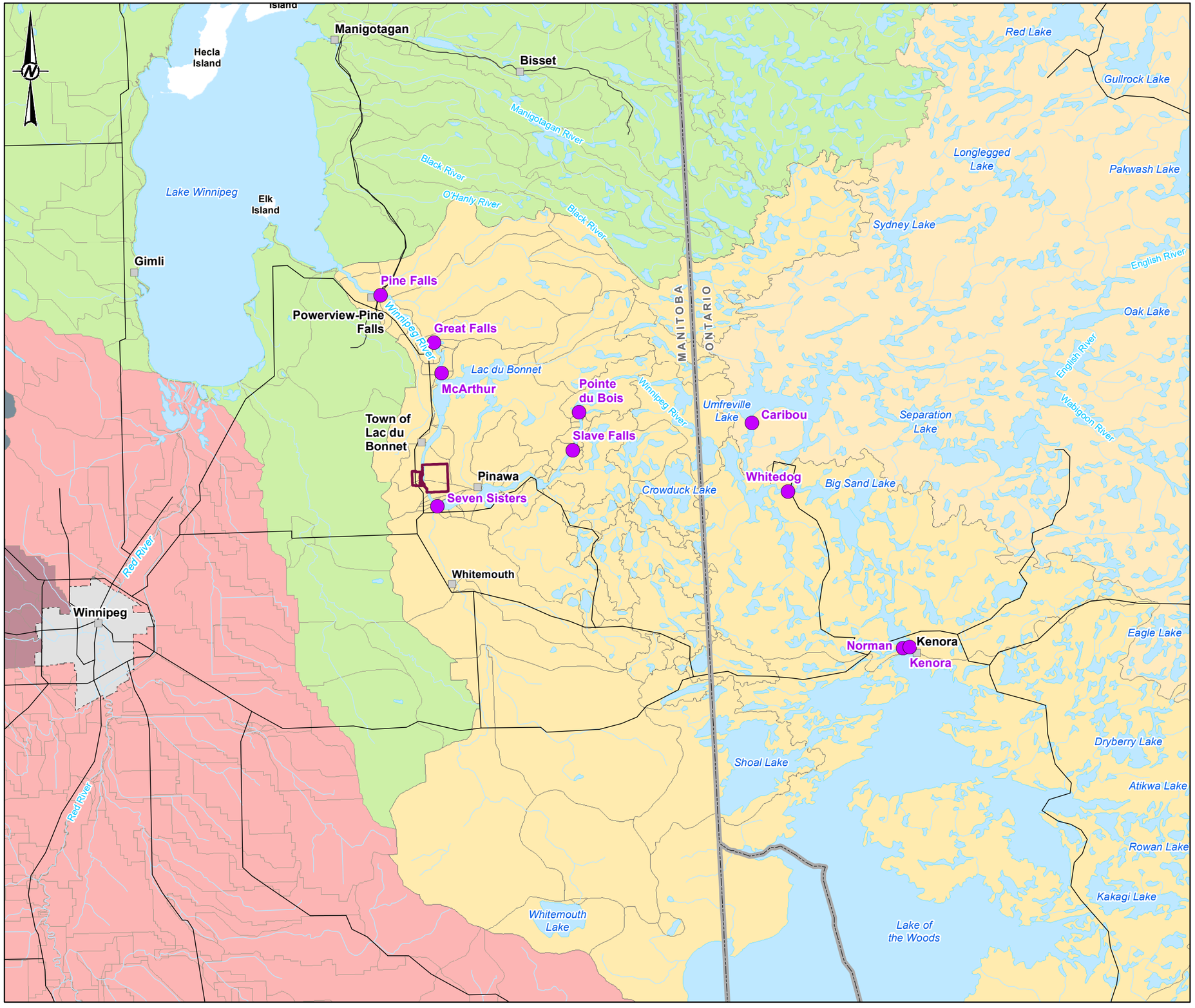

LEGEND

- HYDROELECTRIC DAM LOCATION
- REGIONAL STUDY AREA

BASE FEATURES

- CITY/TOWN
- PROVINCIAL BOUNDARY
- MAJOR ROAD
- WATERCOURSE
- WATERBODY
- FIRST NATION RESERVE

WATERSHEDS

- ASSINIBOINE RIVER
- LAKE MANITOBA
- LAKE WINNIPEG
- RED RIVER
- WINNIPEG RIVER

0 20 40 60

1:900,000 KILOMETRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. ORIGINAL CONTENT PROVIDED BY ECOMETRIX
3. WINNIPEG RIVER WATERSHED EXTENT BASED ON LAKE OF THE WOODS CONTROL BOARD FIGURE TITLED "WINNIPEG RIVER DRAINGE BASIN", 2000 {HTTPS://WWW.LWCB.CA/PERMPDF/DETAIL_MAP.PDF}
4. WL SITE PROPERTY BOUNDARY PROVIDED BY CNL (2016-11-22)
5. HYDROELECTRIC DAM LOCATION - HYDROELECTRIC DAM LOCATIONS PROVIDED BY ECOMETRIX
6. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT

CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT

EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE

HYDROELECTRIC DAMS AND WATERSHEDS

CONSULTANT

wsp GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/PR/RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0012	2	**6.4.2-2**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm 0

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6.4.2.5.2.2 Surface Water and Sediment Quality

Liquid effluent from the active liquid waste treatment systems at the WL site discharged to the Winnipeg River via the Process Sewer at the sewer outfall located about 8 m offshore in approximately 5 m of water (AECL 2001b). The Winnipeg River Task Force (WRTF 1995) looked at potential sources of Winnipeg River water quality degradation near Sagkeeng First Nation. The Winnipeg River Task Force found that the WL site has not had an adverse effect on water quality in the Winnipeg River for downstream communities (AECL 2001b). The Winnipeg River Task Force included members from the Sagkeeng First Nation, Environment Canada, Indian and Northern Affairs Canada and Health Canada. The concentration of the dominant radionuclide associated with the discharge, caesium-137, in downstream river water (K11 on Figure 6.4.2-3) was an average of 0.005 Bq/L in 2015 and 0.014 Bq/L in 2019 compared to the Canadian Drinking Water Quality Guideline of 10 Bq/L.

The monthly average of water chemistry for 2011 to 2019 for the intake water for WL site had concentrations of copper, iron and lead exceeding the Manitoba Water Quality Standards, Objectives and Guidelines (WQSOG). Copper and lead also exceeded the Canadian Council of Ministers of the Environment Water Quality Guidelines (CCME WQG; Table 6.4.2-5; Figure 6.4.2-2, Figure 6.4.2-3), although concentrations have decreased starting in 2016, and lead concentrations have been under the WQSOG and CCME WQG since 2017. Concentrations of mercury exceeded the WQSOG in 2016 but not in any other years. Phosphorous concentrations in the river also exceeded the WQSOG between 2014 and 2017 but have since decreased to below guideline levels. The intake water quality is considered to be uninfluenced by the WL site because it is located upstream of discharges from the WL site. Recently, the Winnipeg River has been classified as meso-eutrophic (at Pointe du Bois; ECCC 2015). This indicates that nutrient levels are moderate, which may lead to plant growth and reduced water clarity.

The provincial water sampling location at Powerview Dam Forebay (shown as Pine Falls on Figure 6.4.2-2) exceeded the aquatic life guideline for barium. Dissolved oxygen levels (Table 6.4.2-6) were usually around 12 mg/L, but were occasionally below 4 mg/L in the morning. Water quality does not comply with the WQSOG if the dissolved oxygen goes below 4 mg/L more than three times per year (MWS 2011). Temperatures varied seasonally, with extremes of 0.8°C and 25°C. The lowest and highest hardness measured was 43.2 and 58.5 mg/L, respectively, since 2011. Samples collected upstream of the WL site (Pinawa) has consistently had caesium-137 and strontium-90 concentrations below the federal drinking water standard (Table 6.4.2-6).

During the 2000 sediment investigation, the sediment downstream of the outfall was determined to be erosional, with a clay bottom covered in parts with sand, gravel, cobble, and boulders (AECL 2001a). Figure 6.4.2-4 presents the results from the 2000 gamma sediment survey. The y- and x-axis are distance on the bottom of the river in relation to the shore and outfall pipe of WL. The colouring indicates the gamma count rate (Becquerel, equivalent to counts per second), where the redder the peak, the higher the count rate, the higher the disintegration of the radionuclides. The z-axis (up axis) indicates the relation of the disintegration to background, where the very top of the axis is 350-fold above background, which is considered a threshold for environmental exposure (AECL 2001a). AECL (2001a) determined that 350-fold above background or lower was acceptable for the protection of aquatic life. The highest count rate was 54 times background and the area averaged approximately 7 times background. The sediment core samples taken in this area had the highest activity in the top 1 cm. A small area adjacent to the outfall had elevated radionuclide levels, but these levels were below the threshold that would cause adverse effects to human or ecological health. Therefore, during the discharge of the 1990s and 2000s, the accumulation of radionuclides in sediment had negligible environmental effects.

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Table 6.4.2-5: Water Quality of the Winnipeg River between Whiteshell Laboratories and Pine Falls, 2011 to 2019, for Parameters that are Stable Inorganics

Year	Summary Statistic	Unit	Parameter																					
			Boron	Barium	Bismuth	Cadmium	Cobalt	Total Chromium	Copper	Gadolinium	Iron	Hardness (mg/L)	Lead	Manganese	Mercury	Molybdenum	Nickel	Nitrogen	Palladium	Phosphorous	Potassium	Potassium Hydroxide	Ruthenium	Sulphur	Zinc
WQSOG		µg/L	—	—	—	**0.14***	—	**37.1***	**4.3 ***	—	**300**	—	**0.99***	—	**1**	—	**25.5 ***	—	—	**25**	—	—	—	—	**57.8***
CCME WQG		µg/L	**1,500**	—	—	**0.08**	—	—	**2**	—	—	—	**1**	—	**0.026**	**73**	**25**	—	—	—	—	—	—	—	—
CDWG		µg/L	**5,000**	**1,000**	—	**5**	—	**50**	—	—	—	—	**10**	—	**1**	—	—	**1,000**	—	—	—	—	—	—	—
Other Aquatic Life Guideline		µg/L	—	**0.4[1]**	**0.25[2]**	—	**0.9[3]**	—	—	**1.5[2]**	—	—	—	**794***	—	—	—	**3,000[5]**	**5.7[2]**	—	**5,300[1]**	**5,300[1]**	**10[2]**	-	—
2011	Minimum	µg/L	<10	11	<0.2	<0.01	<0.2	0.5	6.0	NV	400	46	<	10	<	<0.2	<	NV	NV	12	902	NV	NV	NV	<
	Maximum	µg/L	<10	15	<0.2	<0.01	0.31	1.9	39	NV	2,300	55	10	48	0.017	0.23	4.8	NV	NV	30	1,280	NV	NV	NV	20
	Average	µg/L	<10	13	<0.2	<0.01	0.21	1.2	13	NV	821	51	1.5	21	0.01	0.20	2.3	NV	NV	23	1,009	NV	NV	NV	5.1
	Count	—-	12	12	12	7	12	11	11	NA	11	11	11	12	11	12	11	NA	NA	11	12	NA	NA	NA	11
2012	Minimum	µg/L	<10	11	<0.2	<0.01	<0.2	<	4.0	NV	300	54	<	9.0	<	<0.2	<	NV	NV	18	843	NV	NV	NV	4.0
	Maximum	µg/L	15	15	<0.2	0.02	0.36	2.2	61	NV	2,600	51	7.0	102	0.011	<0.2	4.6	NV	NV	37	1,200	NV	NV	NV	14
	Average	µg/L	11	12	<0.2	0.011	0.21	0.78	14	NV	738	59	1.3	19	0.01	0.20	2.2	NV	NV	27	945	NV	NV	NV	8.9
	Count	-—	12	12	12	12	12	12	12	NA	12	3	12	12	12	12	12	NA	NA	12	12	NA	NA	NA	12
2013	Minimum	µg/L	<10	11	<0.2	<0.01	<0.2	<	3.0	NV	250	47	<	9.3	<	<0.2	<	NV	NV	20	819	NV	NV	NV	<
	Maximum	µg/L	<10	16	<0.2	0.01; <0.01	0.34	1.0	100	NV	4,000	52	6.0	63	0.01	0.22	3.1	NV	NV	105	1,120	NV	NV	NV	12
	Average	µg/L	<10	12	<0.2	0.01	0.21	0.43	19	NV	853	51	1.5	18	0.004	0.20	1.3	NV	NV	53	961	NV	NV	NV	3.5
	Count	—-	12	12	12	12	12	11	11	NA	11	5	11	12	11	12	11	NA	NA	11	12	NA	NA	NA	11
2014	Minimum	µg/L	<10	10	<0.2	<0.01	<0.2	<	4.2	NV	300	45	<	10	<	<0.2	<	NV	NV	99	874	NV	NV	NV	<
	Maximum	µg/L	20	14	<0.2	<0.01	0.26	1.9	45	NV	4,801	53	6.3	20	0.030	0.21	3.6	NV	NV	122	1,020	NV	NV	NV	20
	Average	µg/L	12	11	<0.2	<0.01	0.20	0.79	18	NV	1,767	48	1.0	14	0.01	0.20	1.3	NV	NV	108	945	NV	NV	NV	6.5
	Count	—-	13	13	13	13	13	10	10	NA	10	13	10	13	10	13	10	NA	NA	10	13	NA	NA	NA	10

Table 6.4.2-5: Water Quality of the Winnipeg River between Whiteshell Laboratories and Pine Falls, 2011 to 2019, for Parameters that are Stable Inorganics

Year	Summary Statistic	Unit	Parameter																					
			Boron	Barium	Bismuth	Cadmium	Cobalt	Total Chromium	Copper	Gadolinium	Iron	Hardness (mg/L)	Lead	Manganese	Mercury	Molybdenum	Nickel	Nitrogen	Palladium	Phosphorous	Potassium	Potassium Hydroxide	Ruthenium	Sulphur	Zinc
WQSOG		µg/L	—	—	—	**0.14***	—	**37.1***	**4.3 ***	—	**300**	—	**0.99***	—	**1**	—	**25.5 ***	—	—	**25**	—	—	—	—	**57.8***
CCME WQG		µg/L	**1,500**	—	—	**0.08**	—	—	**2**	—	—	—	**1**	—	**0.026**	**73**	**25**	—	—	—	—	—	—	—	—
CDWG		µg/L	**5,000**	**1,000**	—	**5**	—	**50**	—	—	—	—	**10**	—	**1**	—	—	**1,000**	—	—	—	—	—	—	—
Other Aquatic Life Guideline		µg/L	—	**0.4[1]**	**0.25[2]**	—	**0.9[3]**	—	—	**1.5[2]**	—	—	—	**794***	—	—	—	**3,000[5]**	**5.7[2]**	—	**5,300[1]**	**5,300[1]**	**10[2]**	-	—
2015	Minimum	µg/L	<10	9	<0.2	<0.01	<0.2	0.2	3.7	NV	270	44	<	8.5	<	<0.2	<	NV	NV	81	846	NV	NV	NV	<
	Maximum	µg/L	13	12	<0.2	0.01; <0.01	<0.2	4.6	26	NV	771	54	8.0	14	0.048	0.2; <0.2	3.5	NV	NV	290	991	NV	NV	NV	6.2
	Average	µg/L	10	11	<0.2	0.01	0.2	1.7	14	NV	405	48	2.6	11	0.01	0.20	1.8	NV	NV	111	907	NV	NV	NV	2.5
	Count	—-	12	12	12	12	12	12	12	NA	12	12	12	12	12	12	12	NA	NA	12	12	NA	NA	NA	12
2016	Minimum	µg/L	10	9.45	0.2	0.01	0.2	<	2	NV	210	43.7	<	8.19	<	0.2.	<	NV	NV	<	846	NV	NV	NV	<
	Maximum	µg/L	22	13.2	0.2	0.01	0.22	0.8	26	NV	410	55.5	4	16.5	7	0.28	1.9	NV	NV	94	1020	NV	NV	NV	16
	Average	µg/L	11.3	11.3	0.2.	0.01	0.2	0.2	7	NV	320	48.7	1	13.2	1.6	0.2	0.8	NV	NV	40	924	NV	NV	NV	2.3
	Count	—-	12	12	12	12	12	11	11	NA	11	12	11	12	11	12	11	NA	NA	11	12	NA	NA	NA	11
2017	Minimum	µg/L	10	9.58	0.05	0.005	0.1	<	2	NV	185	44.4	<	8.2	<	0.169	<	NV	NV	19	803	NV	NV	NV	<
	Maximum	µg/L	18	13.2	0.2	0.01	0.2	<	9	NV	639	52.2	0.4	19.2	<	0.2	<	NV	NV	32	969	NV	NV	NV	<
	Average	µg/L	10.9	11	0.13	0.008	0.16	<	4	NV	310	48.9	0.2	12.7	<	0.19	<	NV	NV	26	886	NV	NV	NV	<
	Count	—-	11	11	11	11	11	11	11	NA	11	11	11	11	11	11	11	NA	NA	11	11	NA	NA	NA	11
2018	Minimum	µg/L	10	9.08	0.05	0.005	0.1	<	2	NV	132	46.2	<	7.63	<	0.152	<	NV	NV	12	797	NV	NV	NV	<
	Maximum	µg/L	11	11.3	0.05	0.0175	0.13	1.6	12	NV	399	54.4	0.4	18.1	2.6	0.205	<	NV	NV	28	915	NV	NV	NV	<
	Average	µg/L	10.1	10.4	0.1	0.007	0.1	0.1	5	NV	233	51.4	0.1	10.8	0.2	0.175	<	NV	NV	20	847	NV	NV	NV	<
	Count	—-	12	12	12	12	12	12	12	NA	12	12	12	12	12	12	12	NA	NA	12	12	NA	NA	NA	12
2019	Minimum	µg/L	10	9.92	0.05	0.005	0.11	<	4	NV	154	49.8	<	8.71	<	0.152	<	NV	NV	13	805	NV	NV	NV	<
	Maximum	µg/L	12	12.2	0.05	0.0144	0.21	1.8	12	NV	1380	58.9	0.3	21.9	<	0.29	12	NV	NV	26	1090	NV	NV	NV	<
	Average	µg/L	10.2	11.0	0.05	0.006	0.15	0.5	7	NV	331	53.9	0.1	15.6	<	0.18	0.1	NV	NV	17	886	NV	NV	NV	<
	Count	—-	11	11	11	11	11	12	12	NA	12	11	12	11	12	11	12	NA	NA	12	11	NA	NA	NA	12
Sampling Location			Pine Falls	Pine Falls	Pine Falls	Pine Falls	Pine Falls	WL Intake	WL Intake	NA	WL Intake	Pine Falls	WL Intake	Pine Falls	WL Intake	Pine Falls	WL Intake	NA	NA	WL Intake	Pine Falls	NA	NA	NA	WL Intake

Table 6.4.2-5: Water Quality of the Winnipeg River between Whiteshell Laboratories and Pine Falls, 2011 to 2019, for Parameters that are Stable Inorganics

Year	Summary Statistic	Unit	Parameter																					
			Boron	Barium	Bismuth	Cadmium	Cobalt	Total Chromium	Copper	Gadolinium	Iron	Hardness (mg/L)	Lead	Manganese	Mercury	Molybdenum	Nickel	Nitrogen	Palladium	Phosphorous	Potassium	Potassium Hydroxide	Ruthenium	Sulphur	Zinc
WQSOG		µg/L	—	—	—	**0.14***	—	**37.1***	**4.3 ***	—	**300**	—	**0.99***	—	**1**	—	**25.5 ***	—	—	**25**	—	—	—	—	**57.8***
CCME WQG		µg/L	**1,500**	—	—	**0.08**	—	—	**2**	—	—	—	**1**	—	**0.026**	**73**	**25**	—	—	—	—	—	—	—	—
CDWG		µg/L	**5,000**	**1,000**	—	**5**	—	**50**	—	—	—	—	**10**	—	**1**	—	—	**1,000**	—	—	—	—	—	—	—
Other Aquatic Life Guideline		µg/L	—	**0.4[1]**	**0.25[2]**	—	**0.9[3]**	—	—	**1.5[2]**	—	—	—	**794***	—	—	—	**3,000[5]**	**5.7[2]**	—	**5,300[1]**	**5,300[1]**	**10[2]**	-	—
Water Quality Source			WQMS 2016, 2020	WQMS 2016, 2020	WQMS 2016, 2020	WQMS 2016, 2020	WQMS 2016, 2020	CNL 2016b, 2017b, 2018b, 2019b, 2020b	CNL 2016b, 2017b, 2018b, 2019b, 2020b	NA	CNL 2016b, 2017b, 2018b, 2019b, 2020b	WQMS 2016, 2020	CNL 2016b, 2017b, 2018b, 2019b, 2020b	WQMS 2016, 2020	CNL 2016b, 2017b, 2018b, 2019b, 2020b	WQMS 2016, 2020	CNL 2016b, 2017b, 2018b, 2019b, 2020b	NA	NA	CNL 2016b, 2017b, 2018b, 2019b, 2020b	WQMS 2016, 2020	NA	NA	NA	CNL 2016b, 2017b, 2018b, 2019b, 2020b

Notes:
WQSOG = Manitoba Water Quality Standards, Objective and Guidelines (MWS 2011). 43 mg/L was used for hardness from Pine Falls (WQMS 2016).
CCME WQG = CCME Water Quality Guidelines for the protection of aquatic life (CCME 1999a).
CDWG = Canadian Drinking Water Guidelines (Health Canada 2009).
Other - Other guidance used where ecological or human health values not provided by sources above.
* Guideline is hardness-dependent.
<Value is less than detection.
1 - Secondary Chronic Value from Suter and Tsao (1996) divided by 10.
2 - LC_{50} from Borgmann et al. (2005) divided by 100.
3 - Ontario Provincial Water Quality Objective (MOEE 1994).
4 - British Columbia Water Quality Guidelines (BC MOE 2009).
WQMS 2016; 2020 indicates water quality from the provincial water sampling location at Pine Falls on the Winnipeg River located downstream of the WL site.
CNL 2016b, 2017b, 2018b, 2019b, 2020b indicates water quality from the Whiteshell Laboratories intake on the Winnipeg River located upstream of the process outfall station.
NA – Not applicable; NV – No value; —- = no guidelines or no value

Table 6.4.2-6: Water Quality of the Winnipeg River between Whiteshell Laboratories and Pine Falls, 2011 to 2019, for Parameters that are not Stable Inorganics

Year	Summary Statistic	Parameter											
		pH	Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	Temperature (°C)	Turbidity (NTU)	Total Suspended Solids (mg/L)	Phenol (µg/L)	HB-40	Oil & Grease (mg/L)	Xylene	Caesium-137 (Bq/L)	Stronium-90 (Bq/L)
WQSOG		**6.5-9.0**	—	**‡**	**site-specific**	**10% Change**	—	**4.0**	—	**Free of**	—	—	—
CCME WQG		—	—	—	—	**+8/2 NTU short/long term**	—	**4.0**	—	—	—	—	—
CDWG		**6.5-8.5**	—	—	—	**3.0**	—	—	—	—	**90**	**10**	**5**
Other Aquatic Life Guideline		—	—	—	—	—	—	—	**2[1]**	—	**30[2]**	—	—
2011	Minimum	6.44	101	7.1	1.2	4.0	0.5	<	0	<	NV	0.002	0.004
	Maximum	7.55	114	14	23	48	5.5	2	0	1.9	NV	0.009	0.009
	Average	6.88	107	11	12	11	2.9	1.1	0	1.2	NV	0.004	0.007
	Count	11	23	12	24	12	11	11	NA	11	NA	12	12
2012	Minimum	6.37	98	2.0	4.0	4.2	1.5	<	0	0.7	NV	0.002	0.002
	Maximum	7.55	126	14	24	32	9	2	0	2.2	NV	0.007	0.11
	Average	6.81	109	8.8	14	9.9	4.2	0.79	0	1.4	NV	0.004	0.007
	Count	12	24	12	24	12	12	12	NA	12	NA	12	12
2013	Minimum	6.58	99	3.4	4.0	3.8	0.5	<	0	<	NV	0.003	0.044
	Maximum	7.67	119	14	25	8.1	9	2.4	0	3.1	NV	0.016	0.007
	Average	6.93	111	9.6	15	5.8	3.9	1.1	0	1.4	NV	0.006	0.019
	Count	11	24	12	23	12	11	11	NA	11	NA	12	12
2014	Minimum	6.65	86	1.9	0.8	3.2	0.5	<	0	<	NV	0.002	0.003
	Maximum	7.80	118	14	23	20	6	3.4	0	5.1	NV	0.006	0.031
	Average	7.23	102	9.0	12	5.1	2.9	0.9	0	1.3	NV	0.004	0.009
	Count	10	22	13	22	13	10	10	NA	10	NA	12	12
2015	Minimum	6.86	96	6.7	12	2.6	0.5	<	0	<	NV	0.003	0.005
	Maximum	7.66	113	13	23	7.0	4	7.1	0	3.8	NV	0.009	0.011
	Average	7.30	103	10	6.8	5.2	2.1	1.3	0	1.5	NV	0.005	0.007
	Count	12	20	12	18	12	12	12	NA	12	NA	11	11
2016	Minimum	6.67	92	8.4	-0.5	3.7	0.5	<	0	<	NV	0.003	0.001
	Maximum	7.53	1560	18	23	11	7.0	4.4	0	1.6	NV	0.006	0.024
	Average	7.03	172	12	10	6.4	2.6	1.4	0	0.4	NV	0.004	0.006
	Count	11	20	12	20	12	11	11	NA	11	NA	12	12

Table 6.4.2-6: Water Quality of the Winnipeg River between Whiteshell Laboratories and Pine Falls, 2011 to 2019, for Parameters that are not Stable Inorganics

Year	Summary Statistic	Parameter											
		pH	Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	Temperature (°C)	Turbidity (NTU)	Total Suspended Solids (mg/L)	Phenol (µg/L)	HB-40	Oil & Grease (mg/L)	Xylene	Caesium-137 (Bq/L)	Stronium-90 (Bq/L)
WQSOG		**6.5-9.0**	—	**‡**	**site-specific**	**10% Change**	—	**4.0**	—	**Free of**	—	—	—
CCME WQG		—	—	—	—	**+8/2 NTU short/long term**	—	**4.0**	—	—	—	—	—
CDWG		**6.5-8.5**	—	—	—	**3.0**	—	—	—	—	**90**	**10**	**5**
Other Aquatic Life Guideline		—	—	—	—	—	—	—	**2[1]**	—	**30[2]**	—	—
2017	Minimum	7.12	93	7.8	-0.7	4.1	0	0	0	0	NV	0.002	0.003
	Maximum	7.81	124	14	22	8.8	5.6	6.1	0	1.5	NV	0.009	0.013
	Average	7.42	100	11	9.1	5.5	3.0	1.7	0	0.1	NV	0.004	0.006
	Count	11	22	11	21	11	11	11	NA	11	NA	12	12
2018	Minimum	7.11	100	0.4	-0.5	2.6	0	0	0	0	NV	0.003	0.006
	Maximum	7.73	109	14	23	6.3	5.10	1.5	0	1.2	NV	0.005	0.008
	Average	7.41	105	10	8.8	4.0	2.05	0.2	0	0.1	NV	0.003	0.006
	Count	12	17	12	16	12	12	12	NA	12	NA	12	12
2019	Minimum	6.93	95.8	7.4	-0.5	2.69	0	0	0	0	NV	0.007	0.006
	Maximum	7.84	228	14.6	23.3	10.4	6.1	0.005	0	0	NV	0.015	0.015
	Average	7.43	111.4	10.9	9.9	5.9	3.15	0.0007	0	0	NV	0.011	0.010
	Count	12	19	11	18	11	12	12	NA	12	NA	12	12
Sampling Location		WL Intake	Pine Falls	Pine Falls	Pine Falls	Pine Falls	WL Intake	WL Intake	NA	WL Intake	NA	Pinawa (US on Figure 6.4.2-3)	
Water Quality Source		CNL 2016b, 2019a,b	WQMS 2016 and 2020	WQMS 2016, 2020	WQMS 2016, 2020	WQMS 2016, 2020	CNL 2016b, 2019a,b, 2020b	CNL 2016b, 2019a,b, 2020b	Assumed	CNL 2016b, 2019a,b, 2020b	NA	CNL 2012, 2013, 2014, 2015, 2016a, 2019a,b, 2020a	

Notes:
WQSOG = Manitoba Water Quality Standards, Objective and Guidelines (MWS 2011). 43 mg/L was used for hardness from Pine Falls (WQMS 2016).
CCME WQG = CCME Water Quality Guidelines for the protection of aquatic life (CCME 1999a).
CDWG = Canadian Drinking Water Guidelines (Health Canada 2009).
Other - Other guidance used where ecological or human health values not provided by sources above.
* Standard is hardness-dependent.
<Value is less than detection.
‡ For cool water, not more than once each 3 years below 5.5, 6.0, 4.0, 5.0 and 3.0 mg/L for 30 days, 7 days, 7 day minimum, instantaneous minimum and instantaneous minimum, respectively. For cold water not more than once each 3 years below 6.5, 9.5, 5, 8 and 4 mg/L for 30 days, 7 days, 7 day minimum, instantaneous minimum and instantaneous minimum, respectively.
1 - Lowest IC_{25} from HB-40 Toxicity Testing (EcoMetrix 2017) divided by 10.
2 - British Columbia Water Quality Guidelines (BC MOE 2007).
WQMS 2016 and 2020 indicates water quality from the provincial water sampling location at Pine Falls on the Winnipeg River located downstream of the WL site.
CNL 2016b and 2019a,b, 2020b indicates water quality from the Whiteshell Laboratories intake on the Winnipeg River located upstream of the process outfall station.
µS/cm = microSiemens per centimetre; Bq/L = Becquerel per litre; NTU = Nephelometric Turbidity Units; NA = Not applicable; NV=– No value

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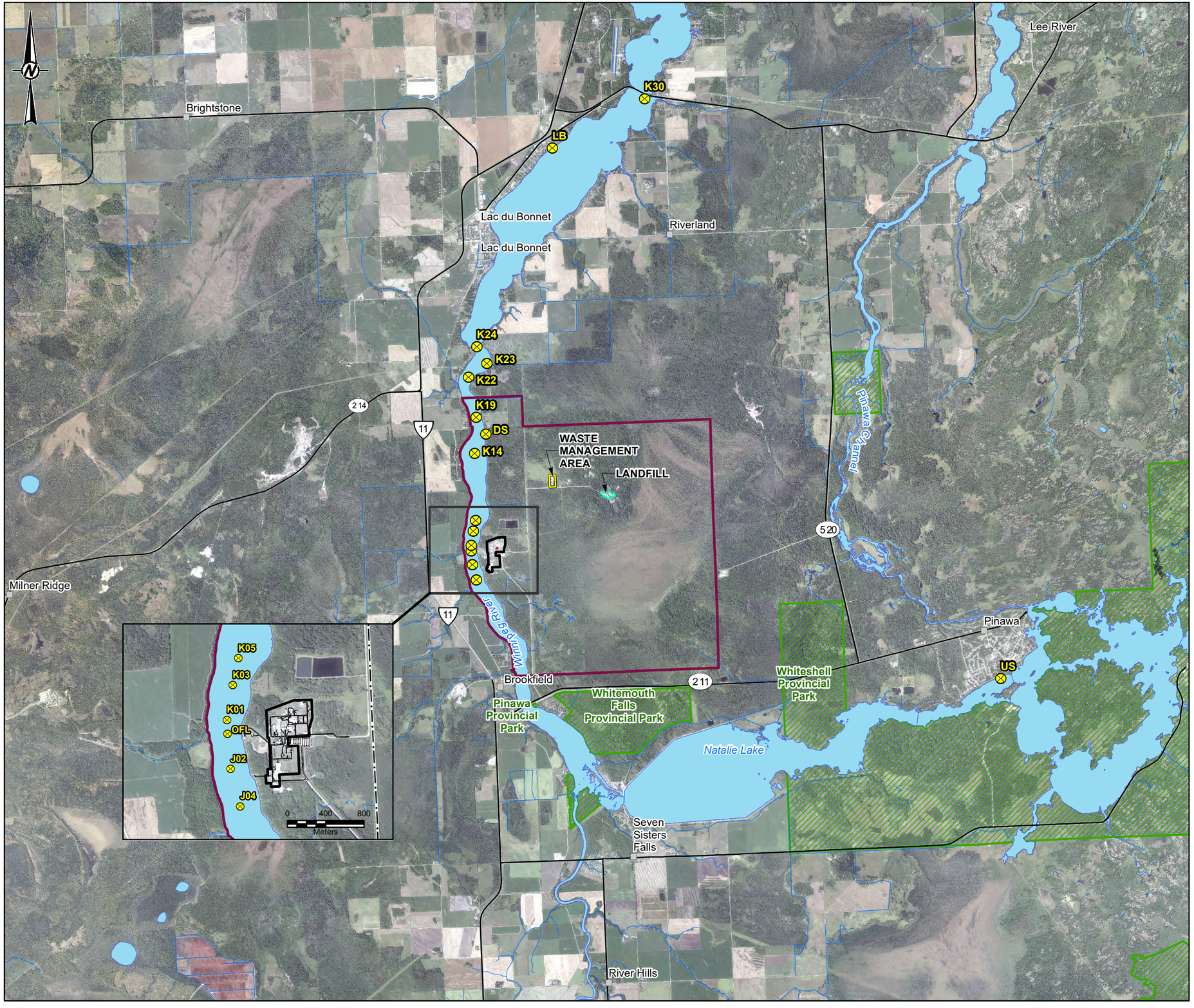

LEGEND

- SAMPLING LOCATION
- WR-1 BUILDING (SITE STUDY AREA)
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

WHITESHELL LABORATORIES

- BUILDING 100
- WASTE MANAGEMENT AREA
- LANDFILL

BASE FEATURES

- CITY/TOWN
- WATERCOURSE
- WATERBODY

0 1 2 3 4 5
1:100,000 Kilometers

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY PROVIDED BY CNL (2016-11-22)
3. SAMPLING LOCATIONS PROVIDED BY ECOMETRIX
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
ANNUAL REPORTING WATER AND SEDIMENT SAMPLING LOCATIONS ON THE WINNIPEG RIVER

CONSULTANT
wsp GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/PR/RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0012	2	**6.4.2-3**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

Path: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0012_EIS_Sec_6.4.2\20145046-0012-CS-0003_Figure 6.4.2-3_Annual Reporting Water and Sediment Sampling Locations on the Winnipeg River.mxd

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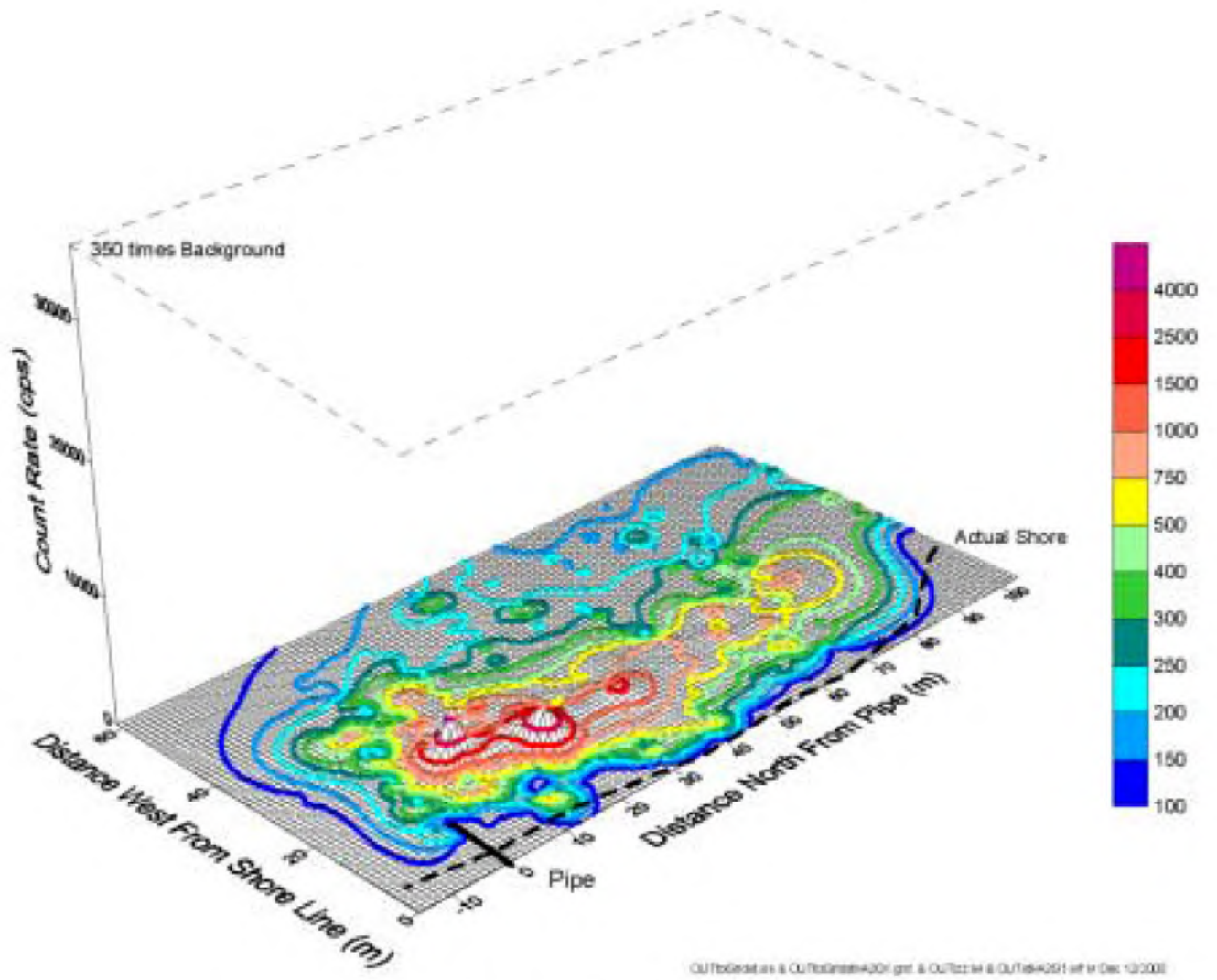

COUNT RATE FROM OUTFALL STUDY AREA

REFERENCE(S)

AECL. 2001A. EVALUATION OF THE POTENTIAL ECOLOGICAL AND HUMAN HEALTH RISKEFFECTS OF SEDIMENT CONTAMINATED BY THE PROCESS WATER DISCHARGE ATWHITESHELL LABORATORIES. APPENDIX B.1 OF WHITESHELL LABORATORIESDECOMMISSIONING PROJECT COMPREHENSIVE STUDY REPORT. WLDP-03702-041-000. MARCH 2001.

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
GAMMA COUNT RATE OF SEDIMENT DOWNSTREAM OF THE WHITESHELL LABORATORIES EFFLUENT OUTFALL

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	-
PREPARED	PR/RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046		2	6.4.2-4

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Sediment core sampling as part of the Environmental Assessment Follow-Up was completed in 2006 and is planned to occur every 20 years following. The top 10 cm in each area was below the caesium-137 *Nuclear Substance and Radiation Devices Regulations (*SOR/2000-207) (NSRDR) Clearance Level of 100 Bq/kg (AECL 2008). Caesium-137 activity increased with depth in all cores (AECL 2008). For the upstream cores this was attributed to the preferential fallout in the area during global weapons testing in the 1960s. The downstream cores increase in activity was attributed to a combination of the weapon's testing and WL discharges in the 1970s and 1980s. Sediments at depths dating to before 1990 had caesium-137 activities that exceeded the NSRDR Clearance Level (AECL 2008).

As part of the routine monitoring at the WL site, river bottom sediments were collected from twelve locations along the Winnipeg River, ranging from 0.8 km upstream to 13.1 km downstream of the Outfall (Figure 6.4.2-3). In 2019, the gross alpha activity detected in the samples ranged from 167 to 633 Bq/kg (CNL 2020a). In five years prior, average minimums and maximums activities ranged from 214±173 to 534±255 Bq/kg. The alpha activity in these samples is due to naturally occurring isotopes such as uranium-238 or thorium-232 and their progeny, as both upstream and downstream samples contain similar levels. All samples are below the NSRDR Clearance Level for naturally occurring uranium-238 or thorium-232 of 1,000 Bq/kg (CNL 2020a).

Gamma spectrometry of the samples identified the presence of caesium-137 and potassium-40. The gross beta activity in sediment ranged from 333 to 1133 Bq/kg in 2019 at the twelve sampling locations (CNL 2020a). The previous five years average minimums and maximums ranged from 283±119 to 1,504±206 Bq/kg. The gross beta activities measured in 2019 for most sediment samples are higher than averages for the previous five years, with no trends observed. Beta activity includes contributions from naturally occurring potassium-40 and from caesium-137. Aliquots of samples collected in 2019 were submitted for strontium-90 analysis, and results indicated that strontium-90 makes an insignificant contribution to radioactivity in sediments. The majority of the beta activity for all locations continues to be from naturally occurring potassium-40 (CNL 2020a). The NSRDR Clearance Level for potassium-40 is 10,000 Bq/kg.

The highest measured Cs-137 level in a sediment sample during the 2000 study was 2,610 Bq/kg (AECL 2001a). This exceeds the NSRDR Clearance Level of 100 Bq/kg for caesium-137. Although the activity level in the sediment at the K03 location is above NSRDR unconditional clearance level, it is well below a human external exposure level of concern of 2.8×10^6 Bq/kg. It is also well below the Tier 2 estimated no-effects value for benthic invertebrates' of 1.5×10^5 Bq/kg. The caesium-137 levels detected in the samples collected during routine monitoring at locations OFL, K03, K05, K14 and K23 from 2010 to 2019 were one to two orders of magnitude lower than the highest 2000 sample (Table 6.4.2-7; CNL 2016a, 2020a). Caesium-137 levels at all locations except OFL, K03 and K05 were below the NSRDR Clearance Level of 100 Bq/kg. With exception of samples from K19, K23 and K30, all caesium-137 activity levels in 2019 were below the lower limit of detection of 20 Bq/kg (CNL 2020a). The activity at OFL has historically varied from less than 5 Bq/kg to 75,500 Bq/kg (CNL 2016a). Variation of activity is not unexpected for all samples due to the highly localized and spotty nature of the contamination in the river sediments. This variability is the likely reason for the unusually high caesium-137 activity noted in the K05 sample in 2015 (Table 6.4.2-7; CNL 2016a).

Table 6.4.2-7: Sediment Quality Upstream, at Outfall and Downstream of Whiteshell Laboratories (CNL 2016a, 2019a, 2020a)

Location	Distance from Outfall (km)	Caesium-137 (Bq/kg dry weight)									
		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
J04	-0.76 (US)	9.7	14	18	13	5.7	13	5	4	9	20 LLD
J02	-0.37 (US)	10	13	12	13	4.7	15	4	7	7	20 LLD
OFL	**0 (outfall)**	**240**	**130**	**125**	**75**	**285**	**473**	**5**	**82**	**12**	**20 LLD**
K01	0.15 (DS)	23	11	19	13	5.3	11	4	53	13	20 LLD
K03	**0.52**	**49**	**16**	**19**	**11**	**6.3**	**59**	**157**	**15**	**13**	**20 LLD**
K05	**0.79**	**21**	**42**	**13**	**68**	**13**	**732**	**12**	**10**	**10**	**20 LLD**
K14	**2.56**	**21**	**33**	**16**	**17**	**12**	**23**	**5**	**8**	**37**	**20 LLD**
K19	3.48	10	72	14	24	18	10	7	10	11	20 ± 8
K22	4.63	15	15	14	29	17	19	8	8	17	20 LLD
K23	**4.78**	**14**	**18**	**14**	**19**	**15**	**31**	**10**	**13**	**10**	**53 ± 10**
K24	4.93	27	24	28	25	33	24	19	21	12	20 LLD
K30	13.06	25	5.3	13	30	26	15	18	26	23	23 ± 5

US – upstream of Whiteshell Laboratories outfall; DS – downstream of Whiteshell Laboratories outfall.
LLD – lower limit of detection
Bq/kg – Becquerels per kilogram

6.4.2.5.2.3 Traditional Knowledge

This section summarizes observations and concerns shared by Indigenous Nations in their Traditional Land Use and Occupancy Studies. The following are quotes relevant to surface water quality.

From the Sagkeeng First Nation:

> *"You know what, drinking water was no problem … You know, just dig a hole, just dig a hole there, there'd be nothing, right, maybe two, three feet and then just leave it, you know, you keep picking your blueberries or whatever you're doing. And then you fill up your container and by the time you go and, by the time you go and fill it up, by the time it's filled up and then you go and check your water, your hole then it's full of water already. So, there was always water filled by, flowing under, you know what I mean."* (Firelight Group Inc and Sagkeeng Anicinabe 2018)

From Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation:

> *"Years ago, the water was clean…My husband said he remembered the river clear or blue and you could dip your dipper in and see it. He used to go out paddling with his grandmother to get medicine. And she would dip her dipper in and drink it."* (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019)

> *"Something is happening in our water reservoir of Lake Winnipeg. Our lake is bad now and getting worse. Fishermen are having a hard time catching our limits. We were out 3 weeks and caught only 200 kilograms of pickerel. Now the dirty water in the lake is contaminated. Need to go further to do more testing on the lake to clean it up like they did in the North Basin. Not only fishing – we drank from there, too. We're*

hearing stories about deformed fish with growths on their scales. Winnipeg River has something to do with it too." (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019)

For further information on how CNL incorporated Traditional knowledge into the EIS refer to Section 4..3 Influence of Traditional Knowledge on the Environmental Assessment and to Section 5.0 Traditional Land and Resources Use of the Indigenous Engagement Report (CNL 2022).

6.4.2.6 Project Interactions and Mitigation

6.4.2.6.1 Methods

This section describes the process by which interactions between Project components and activities and surface water quality were identified and evaluated. Potential effect pathways are identified and mitigation developed to eliminate and/or reduce effect is presented. A pathways analysis is then used to focus the assessment on key interactions between the Project and the environment by evaluating the different effect pathways to assess if, after incorporation of mitigation, there is still potential to cause residual effects. Where effects will be adequately mitigated and are not forwarded for further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are articulated. Primary pathways that may lead to residual effects after incorporation of mitigation are further characterized in Section 6.4.2.6 (Residual Effects Analysis). As such, this section helps to focus the reminder of the assessment on those interactions (effects pathways) likely to result in residual adverse effects.

The first part of the analysis was to identify the potential effects pathways for all stages of the Project. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. The next step in the analysis was the development of environmental design features and mitigation practices that could be incorporated into the Project to eliminate and/or reduce effects to surface water quality. After incorporation of mitigation, potential pathways were evaluated into the following categories using scientific knowledge, logic, experience with similar developments and the effectiveness of environmental design features and mitigation.

- **No linkage pathway –** pathway is removed by environmental design features or mitigation such that the Project would not be expected to result in a measurable environmental change to concentrations of parameters relative to Base Case values, and therefore would have no residual effects to surface water quality.
- **Secondary pathway –** the pathway could result in a measurable minor change to concentrations of parameters but would have a negligible residual effect on surface water quality relative to Base Case and/or guideline values and is not expected to contribute cumulatively to other past, present, or reasonably foreseeable developments to cause a significant effect.
- **Primary pathway –** the pathway is likely to result in an environmental change to concentrations of parameters relative to the Base Case and/or guideline values that could contribute to residual effects to surface water quality.

Environmental design features and mitigation that have been or could be incorporated into the Project to eliminate and/or reduce adverse effects to the aquatic environment were considered. Potential pathways that were completely removed due to implementation of environmental design or mitigation were not assessed further. Pathways that were assessed to be secondary and demonstrated to have a negligible residual effect on the aquatic environment through simple qualitative or semi-quantitative evaluation of the pathway were also not advanced for further assessment. Primary pathways are carried forward for more detailed quantitative and qualitative effects analysis to characterize the residual effects of the Project on the aquatic environment.

6.4.2.6.2 Results

Pathways through which the Project may interact with and result in changes to concentrations of surface water parameters are provided in Table 6.4.2-8.

Table 6.4.2-8: Pathways Analysis for Surface Water Quality Valued Component

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment

General Project activities during the closure phase	Non-radiological air emissions and dust emissions (including sulphur dioxide, nitrogen oxides [NO_X/NO_2] and particulate matter) and subsequent deposition.	■ Implementation of CNL's *Environmental Protection* (CNL 2021) and *Management and Monitoring of Emissions* (CNL 2018c), which includes operational control monitoring, air verification monitoring and environmental monitoring.
		■ Implementation of dust management techniques to control dust generated by the Project, consistent with the current Environmental Assessment Follow-up Program.
		■ Use of contamination immobilization agents, containment, ventilation and HEPA filters to control generation of airborne emissions during decontamination or removal of contaminated systems or structures.
		■ Use of dust suppression methods during building demolition or soil remediation activities to control airborne emissions and nuisance dust during building demolition or soil remediation. Methods may include:
		  ▪ wetting techniques during demolition to limit mobility of dust;
		  ▪ wind restrictions during demolition to stop work or apply wetting techniques; and
		  ▪ hydro seeding during backfilling and landscaping to reduce soil erosion.
		■ Road watering and chemical dust suppressant when necessary. Dust suppressant is already used annually at the site for select unpaved roads.
		■ Removal of accumulations of particulates (e.g., dirt) on road as soon as possible.
		■ On-site vehicles and equipment engines will meet Tier 3 emission standards, where possible, and be maintained in good working order.
		■ Limit idling of vehicles on-site and speed on roads.
		■ Use of tarps or 3-sided enclosures for raw material storage.
			Secondary

Table 6.4.2-8: Pathways Analysis for Surface Water Quality Valued Component

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
General Project activities during the closure phase	During closure activities, there is the potential for the transport of site runoff to the Winnipeg River.	■ Wastewater from decommissioning activities is collected and tested, and based on the results, is directed either to the waste treatment center, domestic drain, processed drain or ditch systems, or is sent for evaporation and/or solidification and disposal. ■ Existing surface water management systems at the WL site will remain in place to manage site runoff. ■ As per CNL's *Management of Land, Habitat and Wildlife* (CNL 2018d), any work within 30 metres of rivers, streams and lakes will have preventative and mitigation measures in place.	No Linkage
Installation of concrete cap and engineered cover over grouted structure and final restoration	Installation of concrete cap and engineered cover may alter drainage rates and flow patterns.	■ The WL site and engineered cover will be graded to promote drainage from the site to the Winnipeg River.	Secondary
Closure of the entire WL site	Decommissioning and reclamation of the entire WL site, including the Project, may alter drainage rates and flow patterns as current precipitation management is removed.	■ The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-states. ■ The drainage system for the reclaimed WL site will have physical characteristics similar to natural drainage systems in the general geographic region in terms of dynamic stability, robustness and longevity. ■ The WL site will be graded to promote drainage from the site to the Winnipeg River.	Secondary
Post-closure Performance (Project-related)	Release of chemical and radiological contaminants in the long-term during the post-closure phase from the Project.	■ The planned decommissioning of the WR-1 Complex presently involves: ▪ removal the service area and infilling in these areas with compact soil; ▪ sealing of open conduits in the building foundation; and ▪ grouting the interior portion of the building (containing the remaining components of WR-1) to ground surface elevation. ■ As part of CNL's licence with the Canadian Nuclear Safety Commission (CNSC), environmental monitoring around the WL site is required and will continue for the Project during institutional control. ■ Follow-up monitoring will be completed during institutional control to verify effect predictions and to provide information for use in adaptive management to address potential unforeseen effects.	Primary

Table 6.4.2-8: Pathways Analysis for Surface Water Quality Valued Component

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
Post-closure Performance (Other activities at the WL site)	Release of chemical and radiological contaminants in the long-term during the post-closure phase from the previous activities completed at the WL site.	■ As part of CNL's licence with the CNSC, environmental monitoring around the WL site will continue for the Project during the institutional control. ■ Follow-up monitoring will continue during institutional control to verify effect predictions and to provide information for use in adaptive management to address potential unforeseen effects.	Secondary

6.4.2.6.2.1 No Linkage Pathway

The following pathway was assessed as having no measurable environmental change and hence, no linkage to residual effects on surface water quality.

- **During closure activities, there is the potential for the transport of site runoff to the Winnipeg River.**

The LSA drains to the Winnipeg River. During closure phase activities, specifically those that are demolition-related, there is the potential for the transport of site runoff to the Winnipeg River in the vicinity of the WL site. Site runoff may be compromised by various activities such as the mobile batch plant (increased pH and suspended solids levels), crushing masonry (increased pH and suspended solids levels) and cutting steel (increased metal levels).

Currently, wastewater from decommissioning activities is collected and tested and based on the results, is directed either to the waste treatment center, domestic drain, processed drain or ditch systems, or is sent for evaporation and/or solidification and disposal. This process follows the requirements in CNL's *Management and Monitoring of Emissions* (CNL 2018c). Wastewater directed to the ground or ditch system only occurs when the wastewater is below levels of concern for all contaminants.

During the closure phase, existing stormwater management systems at the WL site will remain in place to manage site runoff from precipitation. For example, surface water runoff from the site is collected by storm sewers and is discharged to the Winnipeg River. Stormwater is routinely monitored to ensure that stormwater quality is normal.

In addition, containment barriers will be constructed where necessary to provide for the collection, control of and treatment of contaminated water and to reduce surface water runoff during decommissioning and reclamation activities. Surface water quality is also assessed at locations where surface water leaves the WL site's boundary and in water-bodies affected by discharges. Concentrations of radiological and non-radiological contaminants are measured and compared against existing provincial or federal surface water quality guidelines or standards. It is also noted that closure phase activities will occur well away from the river and its riparian zone and therefore no direct changes in surface water quality will result. As per CNL's *Management of Land, Habitat and Wildlife* (CNL 2018d), any work within 30 m of rivers, streams and lakes will have preventative and mitigation measures in place. General provisions adopted for work at CNL sites in or near a watercourse incorporate appropriate sediment retention measures such as silt curtains and straw bales. Consequently, this interaction was determined to have no linkage to effects to surface water quality in the Winnipeg River. Assuming these best management practices

are followed and that the current surface water management facilities remain in place during building demolition, this mitigation is expected to be effective. No residual effects are anticipated.

6.4.2.6.2.2 Secondary Pathways

The following pathways were assessed as potentially having a measurable minor change to surface water quality relative to Base Case.

- **Non-radiological air emissions and dust emissions (including sulphur dioxide, nitrogen oxides [NOx/NO2] and particulate matter) and subsequent deposition.**

Construction and operation of the Project will generate air and dust emissions such as carbon monoxide (CO), oxides of sulphur (SO_x includes sulphur dioxide [SO_2]), oxides of nitrogen (NO_x includes nitrogen dioxide NO_2), particulate matter ($PM_{2.5}$, PM_{10}) and suspended particulate matter (SPM). Air emissions, such as SO_x and NO_x, can result from the use of fossil fuels in generators, vehicles, and machinery. Vehicle exhaust and fugitive dust from roads is the largest contributor to particulate matter (SPM, PM_{10} and $PM_{2.5}$) during both construction and operations phases (Section 6.2.1.7.2).

Examples of mitigation implemented to limit predicted residual effects from Project emissions to air quality (and subsequently surface water quality) include:

- implementation of CNL's *Environmental Protection* (CNL 2021b) and *Management and Monitoring of Emissions* (CNL 2018c), which includes operational control monitoring and air verification monitoring;
- use of dust suppression methods during building demolition or soil remediation activities to control airborne emissions and nuisance dust during building demolition or soil remediation. Methods may include:
  - wetting techniques during demolition to limit mobility of dust;
  - wind restrictions during demolition to stop work or apply wetting techniques; and
  - hydro seeding during backfilling and landscaping to reduce soil erosion.
- apply road watering and chemical dust suppressant when necessary (dust suppressant is already used annually at the site for select unpaved roads);
- removal of accumulations of particulates (e.g., dirt) on road as soon as possible; and
- use of tarps or 3-sided enclosures for raw material storage.

The residual effects to air quality were predicted because of the Project. Fugitive dust from roads is the largest contributor to SPM emissions. Material handling from demolition is the largest contributor to PM_{10} emissions. Non-road equipment exhaust emissions are the largest contributors to $PM_{2.5}$ and NOx (as NO_2) emissions. Finally, the largest contributor to SO_2 and CO emissions is fuel combustion for emergency power generators. Predicted concentrations for the Application Case are below applicable air quality guidelines and/or standards (Section 6.2.1.7.2).

Mitigation of fugitive dust emissions is provided in Table 6.2.1-10 (Pathways Analysis for the Air Quality Valued Component) and includes the use of contamination immobilization agents, containment, ventilation and High-efficiency Particulate Air (HEPA) filters to control generation of airborne emissions during decontamination or

removal of contaminated systems or structures. In addition, use of dust suppression methods during building demolition or soil remediation activities will be implemented to control airborne emissions and nuisance dust during building demolition or soil remediation. Consequently, air emissions are predicted to be below applicable air quality guidelines and/or standards as discussed in Section 6.2.1.7.2 (Application Case Results) and will not impact the surrounding aquatic environment.

CNL recently demolished a number of other buildings at the WL site. The mitigation listed above was applied and successfully reduced SPM emissions which ultimately reduce subsequent deposition. It is expected that this same mitigation will also be effective during the demolition of the WR-1 Building. Therefore, with the implementation of CNL's *Management and Monitoring of Emissions* (CNL 2018c) and through the implementation of dust management techniques for the Project, air and dust emissions and subsequent deposition are expected to result in local, minor changes relative to Base Case conditions. As such, this pathway is determined to result in a negligible effect on surface water quality.

- **Installation of concrete cap and engineered cover may alter drainage rates and flow patterns.**

Installation of concrete cap and engineered cover and alterations of the current precipitation management system may alter drainage rates and flow patterns, and consequently the discharge volume to Winnipeg River. Following the completion of closure activities, the WL site will be graded to promote drainage from the site to the Winnipeg River. Run-off control for the engineered cover is designed to limit erosion and infiltration of water into the grouted structure. This is achieved by sloping the cover surface to maintain a slope toward the edges and the collection of water by the existing surface water management systems at the WL site (Section 3.0). Although the installation of the concrete cap and engineered cover over the grouted structure is expected to slightly alter the drainage rates and flow patterns and discharge volume to the Winnipeg River; the changes are expected to be within the natural range of variation. As such, changes to the discharge volume from the installation of the cover at closure are predicted to have a negligible effect on surface water quality in the Winnipeg River. Assuming the cover is built to the engineered drawing's specifications, this mitigation measure is expected to be effective. Negligible residual effects are anticipated.

- **Decommissioning and reclamation of the entire WL site, including the Project, may alter drainage rates and flow patterns.**

The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-states. The drainage system for the reclaimed WL site will have physical characteristics similar to natural drainage systems in the general geographic region in terms of dynamic stability, robustness, and longevity. The contribution to site runoff from the Project is expected to be minor relative to the entire decommissioned WL site. Although closure of the WL site may slightly alter the drainage rates and flow patterns and discharge volume to the Winnipeg River; the changes are expected to be within the natural range of variation. As such, changes to discharge volume to from the closure of the WL site, including the Project, are predicted to have a negligible effect on the surface water quality in Winnipeg River.

- **Release of chemical and radiological contaminants in the long-term during the post-closure phase from the previous activities completed at the WL site.**

The Comprehensive Study Report indicated residual effects on surface water, particularly the Winnipeg River, are related to discharges from the Active Liquid Waste Treatment Centre and the sewage lagoon. No decrease in water quality is expected and effluent emissions to the Winnipeg River are expected to decline to virtually zero following decommissioning. Re-suspension of contaminated sediments is also not expected to lead to a decrease in water quality (see Section 7.0 of AECL 2001b).

The Comprehensive Study Report (AECL 2001b) also examined the potential for effects via groundwater quality from the low-level waste that may be managed in situ in the WMA and their potential to affect the Winnipeg River (see also Section 6.3.2.5.2.4 Groundwater Quality). The assessment considered three general exposure pathways: upward migration (with potential contamination of soils and vegetation), near-surface lateral migration (with potential contamination to local discharge in perimeter and roadside ditches) and downward migration and contamination of the sand and gravel aquifer and subsequently the river). Only the near-surface lateral migration scenario was considered in further detail. With respect to downward migration and release to the river it was determined that the general hydrology of the site limits or eliminates this pathway.

Water concentrations in the ditch were predicted and compared to established guidelines for several of the contaminants in the WMA. Radionuclide modelling in the Comprehensive Study Report (Appendix C of AECL 2001b) indicated that three radionuclides have the potential to exit the WMA through migration over a 200-year period, namely tritium, technetium-99 and carbon-14. Only technetium-99 is potentially present in nonzero concentrations in the ditch adjacent to the WMA in as early as 20 years. The carbon-14 and tritium will be lost to the atmosphere. When this is modelled, there is no release of these radionuclides to the perimeter ditch. These predictions were considered further for their potential effect on human health (see Section 6.7.1.7 Residual Effects Analysis). With respect to non-radiological contaminants, some exceedances of applicable standards were predicted. Further refinement of the modelling and potential need for selective remediation to remove the hazard was recommended (AECL 2001b).

Both the Project and the WMA are subject to the same regulatory requirements, which require that no member of the public receive a dose greater than 1 mSv/a. *REGDOC 2.11.1, Waste Management, Volume III: Assessing the Long-Term Safety of Radioactive Waste Management* (CNSC 2018), Section 6.2.1, specifies a 1 mSv/a limit, and also specifies that a lower dose rate target should be set to account for emissions from other sources. Therefore, a value of 0.3 mSv/a dose limit to public has been established for the WL site. The Project specified a 0.25 mSv/a target dose rate limit for the public and results of the assessment for the normal evolution indicates that the Project is well below this target. Consequently, there are negligible effects between the Project and previous activities at the WL site (i.e., effects from the WMA) and changes to surface water quality in the Winnipeg River.

As part of CNL's licence with the CNSC, environmental monitoring around the WL site will continue for the Project. Follow-up monitoring during the post-closure phase will continue to verify effect predictions and to provide information for use in adaptive management to address potential unforeseen effects. Consequently, changes to surface water quality from the closure of the WL site, are predicted to be negligible.

6.4.2.6.2.3 Primary Pathways

The Project is expected to have the following primary pathway effects on surface water quality that are carried forward to the residual effects analysis:

- **Release of chemical and radiological contaminants in the long-term during the post-closure phase from the Project.**

6.4.2.7 Residual Effects Analysis

6.4.2.7.1 Methods

Residual effects of the Project are those effects that remain after implementation of all mitigation. During the post-closure phase groundwater will encounter materials from the reactor and migrate to the Winnipeg River. As such, the potential for groundwater seepage to the Winnipeg River is considered a primary pathway and carried forward to the residual effects analysis. It is noted that a relatively large area of the LSA is upgradient of the groundwater seepage flow path. Environmental features or VCs that are upgradient of WR-1 are not considered as there is no complete exposure pathway. As the groundwater flow direction is primarily towards the west, away from the wetlands on the east side of the WL site, there is no reasonably foreseeable groundwater pathway to the wetland; therefore, this pathway was not considered in the assessment, and characterization of the wetland was not required.

The assessment of effects of the Project on surface water quality involves two steps, namely the calculation of groundwater release rates and use of a dispersion model to predict concentrations of surface water parameters. These steps are described below.

6.4.2.7.1.1 Groundwater Release Rates

When groundwater enters the WRDF[1] it will come in contact with radioactive and non-radioactive materials from the reactor. In Section 6.3.2.7.1 Methods (hydrogeology assessment), the groundwater plume from the WRDF was modeled and loadings reaching the Winnipeg River were determined from the start of post-closure, when pumping groundwater away from the WRDF foundation ceases, spanning 500,000 years. The various materials in the reactor building were modeled considering flow of the groundwater through the cover, grout, building foundation and geological pathways. Only radionuclides with half-lives longer than one day were included in the modelling. GoldSim® (Version 12.1) was used to model transportation and is described further in Section 6.3.2.7.1.

The majority of the potentially contaminated groundwater was predicted to reach the Winnipeg River approximately 100 years after groundwater infiltrates the WRDF. Parameters not within the reactor core had an instantaneous mass release. The groundwater plume was estimated to move west-northwest from the WRDF and seep into the river over 95 m of bank.

[1] The Whiteshell Reactor Disposal Facility (WRDF) is the end-state of the Project, after the WR-1 Building is demolished, grouted and covered with a concrete cap and engineered cover.

The groundwater release rates (A_{Bq}) for radionuclides were calculated by using the groundwater loadings in the equation below.

$$A_{Bq} = \frac{m}{m_a} N_A \frac{ln(2)}{t_{1/2}}$$

where,

- m = mass of radionuclide (g)
- m_a = atomic mass (g/mol)
- N_A = Avogadro's number (6.022×10^{23}/mol)
- $t_{1/2}$ = half-life of the radionuclide (s)
- ln(2) = natural log of 2

Atomic masses and the half-lives used in this calculation can be found in Appendix 6.4.2-1.

To calculate the groundwater concentrations, the release rates were divided by the groundwater flow used in the groundwater model (Section 6.3.2.7.1), which ranged from 2.0×10^{-6} to 2.2×10^{-6} m^3/s, depending on the year (Appendix 6.4.2-1). The maximum mass loadings, the year the maximum loading occurs, the release rates to surface water and the concentration of the groundwater are provided in Table 6.4.2-9 for radionuclides and Table 6.4.2-10 for non-radionuclides.

Mass loadings from the groundwater model of argon, helium, radon-222 and xenon were provided but aquatic dispersion of these parameters was excluded as they are expected to volatilize rapidly to air. Samarium-148 also had mass loadings provided from the groundwater model but was determined to have no radiological concern due to its very long half-life and no toxicological concern based on its low groundwater concentration (6.99E-23 µg/L versus an aquatic life benchmark of 0.74 µg/L (Borgmann et al. 2005)). Therefore, samarium-148 was also excluded from aquatic dispersion modelling. Americium-241, americium-243, curium-244, cobalt-60, caesium-137, europium-152, europium-154, europium-155, iron-55, neodymium-144, nickel-63, neptunium-239, plutonium-238, plutonium-241, strontium-90, uranium-237 and yttrium-90 were also included in the groundwater model but did not reach the river (mass loadings equal zero). Therefore, these parameters are not included in the analysis. For those radionuclides and non-radionuclides that did not achieve maximum loadings before 500,000 years, the groundwater flow and solute transport model was run again without the 500,000 years constraint to determine the peak mass loadings.

The solute transport model assumes background water quality to be clean (i.e., no additional source of carbon-14 is considered external to WR-1). Simulation of carbon-14 migration through the groundwater flow path was completed assuming that all carbon-14 from within WR-1 is converted to dissolved phase carbon-14 in the groundwater. Details are provided in the Groundwater Flow and Solute Transport Modelling Report (Golder 2021).

Table 6.4.2-9: Mass Loadings and Radionuclide Release Rates to the Winnipeg River during Post-Closure

Radionuclide	Maximum Groundwater Mass Loading (g/a)	Time of Maximum (yr)	Maximum Groundwater Release Rate (Bq/s)	Maximum Groundwater Concentration (Bq/L)
Actinium-225	1.70×10^{-17}	87,200	1.16×10^{-09}	5.26×10^{-07}
Actinium-227	1.41×10^{-14}	157,200	1.20×10^{-09}	5.44×10^{-07}
Bismuth-210	2.29×10^{-14}	204,000	3.33×10^{-06}	1.52×10^{-03}
Calcium-41	1.55×10^{-06}	19,500	1.56×10^{-04}	7.08×10^{-02}
Carbon-14	5.55×10^{-04}	1,006	$2.90 \times 10^{+00}$	$1.48 \times 10^{+03}$
Chloride-36	1.15×10^{-08}	162	4.47×10^{-07}	2.27×10^{-04}
Gadolinium-152	1.71×10^{-07}	204	4.37×10^{-15}	2.22×10^{-12}
Iodine-129	1.44×10^{-04}	170	2.99×10^{-05}	1.52×10^{-02}
Lead-210	9.29×10^{-13}	206,200	8.33×10^{-08}	3.79×10^{-05}
Neptunium-237	5.15×10^{-06}	40,700	4.26×10^{-06}	1.94×10^{-03}
Nickel-59	5.48×10^{-05}	486,000	3.86×10^{-03}	$1.76 \times 10^{+00}$
Niobium-94	6.43×10^{-21}	646,000	1.42×10^{-18}	6.44×10^{-16}
Plutonium-239	2.39×10^{-07}	106,400	1.74×10^{-05}	7.91×10^{-03}
Plutonium-240	1.58×10^{-10}	66,200	4.21×10^{-08}	1.91×10^{-05}
Polonium-210	1.64×10^{-10}	199,800	8.68×10^{-04}	3.95×10^{-01}
Protactinium-231	2.16×10^{-11}	159,200	1.20×10^{-09}	5.45×10^{-07}
Protactinium-233	2.33×10^{-16}	40,400	5.68×10^{-09}	2.58×10^{-06}
Radium-223	3.36×10^{-16}	157,700	2.02×10^{-08}	9.18×10^{-06}
Radium-224	6.67×10^{-22}	1,903,000	1.26×10^{-13}	5.71×10^{-11}
Radium-225	2.17×10^{-16}	87,300	9.92×10^{-09}	4.51×10^{-06}
Radium-226	1.65×10^{-11}	203,700	1.91×10^{-08}	8.70×10^{-06}
Radium-228	3.90×10^{-19}	936,000	1.26×10^{-13}	5.73×10^{-11}
Silver-108m	7.96×10^{-13}	3,661	7.07×10^{-09}	3.39×10^{-06}
Technetium-99	1.60×10^{-05}	10,600	3.22×10^{-04}	1.46×10^{-01}
Thorium-227	6.12×10^{-17}	160,000	2.21×10^{-09}	1.01×10^{-06}
Thorium-228	2.84×10^{-20}	1,090,000	2.73×10^{-14}	1.24×10^{-11}
Thorium-229	8.69×10^{-12}	89,300	2.18×10^{-09}	9.91×10^{-07}
Thorium-230	1.73×10^{-10}	200,400	4.19×10^{-09}	1.90×10^{-06}
Thorium-231	4.63×10^{-18}	117,000	2.89×10^{-09}	1.31×10^{-06}
Thorium-232	2.12×10^{-10}	632,000	2.72×10^{-14}	1.24×10^{-11}
Thorium-234	7.35×10^{-16}	115,400	2.00×10^{-08}	9.08×10^{-06}
Tritium	6.37×10^{-05}	67	$7.20 \times 10^{+02}$	$3.66 \times 10^{+05}$
Uranium-233	2.79×10^{-08}	74,500	3.16×10^{-07}	1.44×10^{-04}
Uranium-234	1.36×10^{-07}	126,500	9.93×10^{-07}	4.52×10^{-04}
Uranium-235	1.60×10^{-04}	118,000	4.05×10^{-07}	1.84×10^{-04}

Table 6.4.2-9: Mass Loadings and Radionuclide Release Rates to the Winnipeg River during Post-Closure

Radionuclide	Maximum Groundwater Mass Loading (g/a)	Time of Maximum (yr)	Maximum Groundwater Release Rate (Bq/s)	Maximum Groundwater Concentration (Bq/L)
Uranium-236	7.21×10^{-06}	117,900	5.46×10^{-07}	2.48×10^{-04}
Uranium-238	7.10×10^{-03}	116,600	2.80×10^{-06}	1.27×10^{-03}

Radon-222 and samarium-148 in groundwater were excluded from the surface water assessment as they will not emit radiation to potential receptors.

Multiple radionuclides in WR-1 had mass loadings of 0 (i.e., did not reach the Winnipeg River) and are excluded from the assessment (e.g., caesium-137 and strontium-90).

g/a = grams per year; Bq/s = Becquerel per second; Bq/L = Becquerels per litre.

Table 6.4.2-10: Mass Loadings and Non-radionuclide Release Rates to the Winnipeg River during Post-closure

Non-Radionuclide	Maximum Groundwater Mass Loading (g/a)	Time of Maximum (yr)	Maximum Groundwater Release Rate (µg/s)	Maximum Groundwater Concentration (µg/L)
Barium	1.82×10^{-08}	10,740,000	5.77×10^{-10}	2.62×10^{-07}
Bismuth	1.12×10^{-08}	78,800	3.55×10^{-10}	1.61×10^{-07}
Boron	1.87×10^{-04}	4,235	5.92×10^{-06}	2.84×10^{-03}
Cadmium	3.71×10^{-01}	203,000	1.18×10^{-02}	$5.35 \times 10^{+00}$
Chromium	2.42×10^{-03}	19,998,000	7.68×10^{-05}	3.49×10^{-02}
Cobalt	2.12×10^{-02}	93,800	6.71×10^{-04}	3.05×10^{-01}
Copper	5.47×10^{-04}	876,000	1.73×10^{-05}	7.89×10^{-03}
Gadolinium	6.48×10^{-06}	213	2.05×10^{-07}	1.04×10^{-04}
HB-40[a]	$4.05 \times 10^{+01}$	10,200	$1.28 \times 10^{+00}$	$5.84 \times 10^{+02}$
Lead	$5.05 \times 10^{+00}$	5,596,000	1.60×10^{-01}	$7.27 \times 10^{+01}$
Manganese	8.33×10^{-05}	354,500	2.64×10^{-06}	1.20×10^{-03}
Mercury	4.16×10^{-05}	6,546,000	1.32×10^{-06}	6.00×10^{-04}
Molybdenum	1.17×10^{-02}	17,900	3.72×10^{-04}	1.69×10^{-01}
Nickel	4.81×10^{-05}	840,000	1.53×10^{-06}	6.94×10^{-04}
Nitrogen	5.44×10^{-04}	17,900	1.72×10^{-05}	7.84×10^{-03}
Palladium	1.05×10^{-01}	121,000	3.32×10^{-03}	$1.51 \times 10^{+00}$
Potassium	3.27×10^{-07}	13,000	1.04×10^{-08}	4.72×10^{-06}
Potassium Hydroxide	4.76×10^{-02}	142	1.51×10^{-03}	5.37×10^{-01}
Ruthenium	6.15×10^{-09}	374,100	1.95×10^{-10}	8.87×10^{-08}
Samarium	3.65×10^{-12}	20,000,000	1.16×10^{-13}	5.26×10^{-11}
Sulphur	2.37×10^{-12}	193	7.52×10^{-14}	1.14×10^{-10}
Xylene	$4.32 \times 10^{+00}$	202	1.37×10^{-01}	$6.96 \times 10^{+01}$
Zirconium	1.51×10^{-10}	20,000,000	4.79×10^{-12}	2.18×10^{-09}

g/a = grams per year; > = greater than.

a) HB-40 was used in WR-1 as a cooling agent. It consists mainly of hydrogenated terphenyl (74% to 87%), with smaller fractions of partially hydrogenated terphenyls and terphenyl.

6.4.2.7.1.2 Dispersion Modelling

The Winnipeg River flows approximately 1,014 m^3/s near the WL site, in comparison to a predicted groundwater flow rate at the WL site of 2.0E-06 to 2.2E-06 m^3/s. This results in a dilution factor of 460,000,000:1 to 515,000,000:1 once the groundwater seepage fully mixes with the river. Even if the groundwater seepage mixes with a fraction of the river flow, the attenuation renders it indistinguishable from ambient river water.

Surface water concentrations were estimated using the EcoMetrix Incorporated software IMPACT™ DRL Version 5.5.1 (IMPACT™). IMPACT™ is consistent with the equations outlined in *CSA Standard N288.1-14: Guidelines for Calculating Derived Release Limits for Radioactive Material in Airborne and Liquid Effluents for Normal Operation of Nuclear Facilities* (CSA Group 2014). The equations for surface waters represent the advection, dispersion and radioactive decay and ingrowth of radionuclides from the point of release through the receiving water to the receptor. It also represents the advection and dispersion of trace metals and other parameters. It is applicable to the WL site by representing the groundwater release as an area source within the Winnipeg River. The concentrations of contaminants in water is determined by the release rate and the transfer parameter (P_{02} in seconds per litre (s/L) for non-radiological contaminants and seconds per Becquerel (s/Bq) for radiological contaminants) from the source to the Winnipeg River.

$$P_{02}(x,y) = \frac{1}{2\pi d\sqrt{k_x k_y}} e^{\left(\frac{U_x x}{2k_x} - \lambda_s \frac{x}{U_x}\right)} e^{\left(-\lambda_r \frac{x}{U_x}\right)} K_o\left(\frac{U_x}{2k_x}\sqrt{x^2 \frac{k_x}{k_y}(y-y_o)^2}\right)$$

where,

- d = average water depth between the release point and the receptor (m)
- k_x = longitudinal dispersion coefficient (m^2/s)
- k_y = lateral dispersion coefficient (m^2/s)
- U_x = current velocity (m/s)
- x = downstream distance between the source and the point (x,y) (m)
- λ_s = removal constant for sedimentation (s^{-1})
- λ_r = radioactive decay constant (s^{-1})
- K_o = modified Bessel function of the second kind
- y = offshore distance coordinate for the point (x,y) (m)
- y_o = offshore distance to the plume centreline (m)

The transfer parameter (P_{02}) is multiplied by the release rate (x_o (w)) to give the concentration (X_2) at point (x,y). For non-radionuclides, the decay constant was set to zero. This equation above works if there are no riverbanks, as it assumes infinite spread of parameters downstream of the source. To account for the restriction of riverbanks, a mirroring effect was applied as follows:

$$X_2{}' = X_2 + \sum_{n=1}^{\infty} (X_2[x, y_n] + X_2[x, y'_n])$$

where,

- X_2' = concentration modified to account for the effects of the riverbanks (Bq/L)
- X_2 = P_{02} X_0 (w) in accordance with Equation above (Bq/L)
- x = downstream distance between the source and the point (x,y) (m)
- $y = n{\cdot}B - \left(y_0 - \frac{B}{2}\right) + (-1)^n \cdot \left(y - \frac{B}{2}\right)$
- $y'_n = -n{\cdot}B - \left(y_0 - \frac{B}{2}\right) + (-1)^n \cdot \left(y - \frac{B}{2}\right)$

  where,

  - n = number of reflection cycles
  - B = average width of the river between the release point and the receptor (m)
  - y_0 = offshore distance to the plume centreline (m)
  - y = offshore distance coordinator for the point (x,y) (m)

The input parameters for the model are shown in Table 6.4.2-11. The concentration of surface water parameters was determined at 50 m and 3,150 m downstream from the upstream edge of the groundwater seep. These locations correspond to the Nearfield and Farm A receptors (Figure 6.4.2-1), which are used in the Environmental Risk Assessment (EcoMetrix 2021).

Table 6.4.2-11: Input Parameters for Surface Water Modelling

Parameter	Value	Unit	Source
River Depth	0.1 and 7.7	m	Nearfield and Farm in DRL (CNL 2016d)
River Width	470	m	DRL (CNL 2016d)
Longitudinal Dispersion Coefficient	150	m^2/s	DRL (CSA value for Deep River; CNL 2016d)
Lateral Dispersion Coefficient	0.129	m^2/s	Calculated (CSA N288.1-14)
Flow Rate	1,014	m^3/s	WSC (2016)
Current Velocity	0.3	m/s	Calculated
Distance between Upstream Edge of Seep and Nearfield Area	145	m	Calculated
Distance between Downstream Edge of Seep and Nearfield	50	m	Nearfield Assessment
Distance between Upstream Edge of Seep and Farm A Water Intake	3,150	m	Measured on Google Earth
Distance between Downstream Edge of Seep and Farm A Water Intake	3,055	m	Calculated

DRL = derived release limit.

Table 6.4.2-12 presents the predicted dilution at the Nearfield located 50 m downstream and at the Farm A Intake located 3,055 m downstream. The dilution at the Nearfield location exceed 1,000,000:1, which would result in concentrations difficult to detect in situ. Dilution at the Farm A location was 69,000,000:1.

Table 6.4.2-12: Calculated Dilution

Location	Calculated Dilution
Nearfield	1,300,000:1
Farm A Intake	69,000,000:1
Fully mixed condition	460,000,000:1 to 515,000,000:1

Where available, the concentration of the river (Table 6.4.2-5 and Table 6.4.2-6) was added to the concentration derived from the dispersion model to estimate surface water concentrations.

6.4.2.7.2 Application Case Results

The assessment considered maximum surface water concentrations in accordance with *REGDOC-2.9.1, Environmental Principles, Assessments and Protection Measures* (CNSC 2020). Table 6.4.2-9 and Table 6.4.2-10 presented the estimated loadings from the groundwater seep to the Winnipeg River, and Table 6.4.2-13 and Table 6.4.2-14 present the corresponding predicted surface water quality associated with radionuclide and non-radionuclide loadings, respectively. The surface water quality is predicted from the river dispersion model in CSA N288.1-14 (CSA Group 2014) and corresponds to two locations: 1) the Winnipeg River immediately at the point of groundwater release to the river (Nearfield); and 2) the Winnipeg River at the freshwater intake for the nearest downstream farm (Farm A Intake).

Table 6.4.2-13 and Table 6.4.2-14 compares the predicted surface water quality to the available guidelines and to available background concentrations. For radionuclides predicted to reach the Winnipeg River from WR-1 or decay products of those materials, no water guidelines or background concentrations were available (i.e., Table 6.4.2-13 does not include background or natural generation of any radionuclide, only values predicted from the groundwater model). Surface water concentrations in the Nearfield and Farm A intake are six and eight orders of magnitude lower than the groundwater concentration, respectively. Further, exposure was assessed for the time of maximum loadings to the river for each constituent of potential concern during the post-closure phase, irrespective of when that peak occurs. This simplification is conservative as not all peaks occur at the same time but are effectively assumed to do so for purposes of the assessment.

Table 6.4.2-13: Predicted Radionuclide Concentrations in the Winnipeg River at the Nearfield and Farm A Intake

Radionuclide	Time of Maximum (yr)	Maximum Groundwater Concentration (Bq/L)	Surface Water Concentration Nearfield (Bq/L)	Surface Water Concentration Farm A Intake (Bq/L)
Actinium-225	87,200	5.26×10^{-07}	4.08×10^{-13}	7.61×10^{-15}
Actinium-227	157,200	5.44×10^{-07}	4.22×10^{-13}	7.94×10^{-15}
Bismuth-210	204,000	1.52×10^{-03}	1.18×10^{-09}	2.17×10^{-11}
Calcium-41	19,500	7.08×10^{-02}	5.49×10^{-08}	1.03×10^{-09}
Carbon-14	1,006	$1.48 \times 10^{+03}$	1.02×10^{-03}	1.93×10^{-05}
Chloride-36	162	2.27×10^{-04}	1.58×10^{-10}	2.97×10^{-12}
Gadolinium-152	204	2.22×10^{-12}	1.54×10^{-18}	2.90×10^{-20}
Iodine-129	170	1.52×10^{-02}	1.05×10^{-08}	1.98×10^{-10}
Lead-210	206,200	3.79×10^{-05}	2.94×10^{-11}	5.52×10^{-13}
Neptunium-237	40,700	1.94×10^{-03}	1.50×10^{-09}	2.83×10^{-11}
Nickel-59	486,000	$1.76 \times 10^{+00}$	1.36×10^{-06}	2.56×10^{-08}
Niobium-94	646,000	6.44×10^{-16}	4.99×10^{-22}	9.39×10^{-24}
Plutonium-239	106,400	7.91×10^{-03}	6.14×10^{-09}	1.15×10^{-10}
Plutonium-240	66,200	1.91×10^{-05}	1.49×10^{-11}	2.79×10^{-13}
Polonium-210	199,800	3.95×10^{-01}	3.06×10^{-07}	5.75×10^{-09}
Protactinium-231	159,200	5.45×10^{-07}	4.23×10^{-13}	7.95×10^{-15}
Protactinium-233	40,400	2.58×10^{-06}	2.00×10^{-12}	3.75×10^{-14}
Radium-223	157,700	9.18×10^{-06}	7.12×10^{-12}	1.33×10^{-13}
Radium-224	1,903,000	5.71×10^{-11}	4.43×10^{-17}	8.13×10^{-19}
Radium-225	87,300	4.51×10^{-06}	3.50×10^{-12}	6.54×10^{-14}
Radium-226	203,700	8.70×10^{-06}	6.75×10^{-12}	1.27×10^{-13}
Radium-228	936,000	5.73×10^{-11}	4.44×10^{-17}	8.35×10^{-19}
Silver-108m	3,661	3.39×10^{-06}	2.49×10^{-12}	4.69×10^{-14}
Technetium-99	10,600	1.46×10^{-01}	1.14×10^{-07}	2.13×10^{-09}
Thorium-227	160,000	1.01×10^{-06}	7.80×10^{-13}	1.46×10^{-14}
Thorium-228	1,090,000	1.24×10^{-11}	9.64×10^{-18}	1.81×10^{-19}

Table 6.4.2-13: Predicted Radionuclide Concentrations in the Winnipeg River at the Nearfield and Farm A Intake

Radionuclide	Time of Maximum (yr)	Maximum Groundwater Concentration (Bq/L)	Surface Water Concentration Nearfield (Bq/L)	Surface Water Concentration Farm A Intake (Bq/L)
Thorium-229	89,300	9.91×10^{-07}	7.69×10^{-13}	1.45×10^{-14}
Thorium-230	200,400	1.90×10^{-06}	1.48×10^{-12}	2.78×10^{-14}
Thorium-231	117,000	1.31×10^{-06}	1.02×10^{-12}	1.76×10^{-14}
Thorium-232	632,000	1.24×10^{-11}	9.59×10^{-18}	1.80×10^{-19}
Thorium-234	115,400	9.08×10^{-06}	7.04×10^{-12}	1.32×10^{-13}
Tritium	67	$3.66 \times 10^{+05}$	2.54×10^{-01}	4.77×10^{-3}
Uranium-233	74,500	1.44×10^{-04}	1.11×10^{-10}	2.09×10^{-12}
Uranium-234	126,500	4.52×10^{-04}	3.50×10^{-10}	6.59×10^{-12}
Uranium-235	118,000	1.84×10^{-04}	1.43×10^{-10}	2.69×10^{-12}
Uranium-236	117,900	2.48×10^{-04}	1.93×10^{-10}	3.62×10^{-12}
Uranium-238	116,600	1.27×10^{-03}	9.88×10^{-10}	1.86×10^{-11}

Bq/L = Becquerels per litre.

Non-radionuclide concentrations estimate in the Nearfield and at Farm A surface water intake were compared to the lowest available guideline, which are presented in Table 6.4.2-5 and Table 6.4.2-6. There was no guideline available for sulphur and guidelines were not applicable for the Noble gasses, such as argon, helium and xenon, because they volatilize out of the surface water immediately. Background concentrations are from Table 6.4.2-5 and Table 6.4.2-6, available from the WL site (CNL 2016b) and Pine Falls (WQMS 2016 and 2020).

For non-radionuclides without background concentrations, the groundwater concentrations were diluted six and eight orders of magnitude lower at the Nearfield and Farm A intake, respectively. The river concentrations for parameters with background concentrations were equal to background. Surface water concentrations of barium, chromium, copper and lead exceed the lowest available guideline. These exceedances are due to background concentrations measured from the Winnipeg River, and not the potential groundwater seep from the WRDF.

Table 6.4.2-14: Predicted Non-Radionuclide Concentrations in the Winnipeg River at the Nearfield and Farm A Intake

Non-Radionuclide	Lowest Guideline (µg/L)	Background (µg/L)	Time of Maximum (yr)	Maximum Groundwater Concentration (µg/L)	Surface Water Concentration Nearfield (µg/L)	Surface Water Concentration Farm A Intake (µg/L)
Barium	4.00×10^{-01}	$1.10 \times 10^{+01}$	10,740,000	2.62×10^{-07}	$1.10 \times 10^{+01}$	$1.10 \times 10^{+01}$
Bismuth	2.50×10^{-01}	$<2.00 \times 10^{-01}$	78,800	1.61×10^{-07}	$<2.00 \times 10^{-01}$	$<2.00 \times 10^{-01}$
Boron	$1.50 \times 10^{+03}$	$1.00 \times 10^{+01}$	4,235	2.84×10^{-03}	$1.00 \times 10^{+01}$	$1.00 \times 10^{+01}$
Cadmium	7.87×10^{-02}	1.00×10^{-02}	203,000	$5.35 \times 10^{+00}$	1.00×10^{-02}	1.00×10^{-02}
Chromium	$1.00 \times 10^{+00}$	$1.70 \times 10^{+00}$	19,998,000	3.49×10^{-02}	$1.70 \times 10^{+00}$	$1.70 \times 10^{+00}$
Cobalt	9.00×10^{-01}	2.00×10^{-01}	93,800	3.05×10^{-01}	2.00×10^{-01}	2.00×10^{-01}
Copper	$2.00 \times 10^{+00}$	$1.40 \times 10^{+01}$	876,000	7.89×10^{-03}	$1.40 \times 10^{+01}$	$1.40 \times 10^{+01}$
Gadolinium	$1.50 \times 10^{+00}$	NV	213	1.04×10^{-04}	7.25×10^{-11}	1.36×10^{-12}
HB-40	$2.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	10,200	$5.84 \times 10^{+02}$	4.53×10^{-04}	8.52×10^{-06}
Lead	9.93×10^{-01}	$2.60 \times 10^{+00}$	5,596,000	$7.27 \times 10^{+01}$	$2.60 \times 10^{+00}$	$2.60 \times 10^{+00}$
Manganese	$7.94 \times 10^{+02}$	$1.10 \times 10^{+01}$	354,500	1.20×10^{-03}	$1.10 \times 10^{+01}$	$1.10 \times 10^{+01}$
Mercury	2.60×10^{-02}	1.00×10^{-02}	6,546,000	6.00×10^{-04}	1.00×10^{-02}	1.00×10^{-02}
Molybdenum	$7.30 \times 10^{+01}$	2.00×10^{-01}	17,900	1.69×10^{-01}	2.00×10^{-01}	2.00×10^{-01}
Nickel	$2.50 \times 10^{+01}$	$1.78 \times 10^{+00}$	840,000	6.94×10^{-04}	$1.78 \times 10^{+00}$	$1.78 \times 10^{+00}$
Nitrogen	$1.00 \times 10^{+03}$	NV	17,900	7.84×10^{-03}	6.08×10^{-09}	1.14×10^{-10}
Palladium	$5.70 \times 10^{+00}$	NV	121,000	$1.51 \times 10^{+00}$	1.17×10^{-06}	2.20×10^{-08}
Potassium	$5.30 \times 10^{+03}$	$9.07 \times 10^{+02}$	13,000	4.72×10^{-06}	$9.07 \times 10^{+02}$	$9.07 \times 10^{+02}$
Potassium Hydroxide	$5.30 \times 10^{+03}$	NV	142	5.37×10^{-01}	5.32×10^{-07}	1.00×10^{-08}
Ruthenium	$1.00 \times 10^{+01}$	NV	374,100	8.87×10^{-08}	6.88×10^{-14}	1.29×10^{-15}
Samarium	7.40×10^{-01}	NV	20,000,000	5.26×10^{-11}	4.08×10^{-17}	7.68×10^{-19}
Sulphur	NV	NV	193	1.14×10^{-10}	2.65×10^{-17}	4.98×10^{-19}
Xylene	$3.00 \times 10^{+01}$	NV	202	$6.96 \times 10^{+01}$	4.83×10^{-05}	9.08×10^{-07}
Zirconium	$4.00 \times 10^{+00}$	NV	20,000,000	2.18×10^{-09}	1.69×10^{-15}	3.18×10^{-17}

Note: Available guidelines and background values are from Table 6.4.2-5 and Table 6.4.2-6.

NV – No value (data source did not include this non-radionuclide).

The CSA N288.1-14 (CSA Group 2014) provides a model for sediment concentrations based on surface water concentrations. The surface water concentration is multiplied by the partition coefficient of the specific parameter (Clause 7.8.1). This approach assumes sediments and water are in equilibrium, and that sediments are fine grain, remain stationary or accumulate. As the Winnipeg River is erosional, with a hard clay bottom strewn with sand, gravel, cobble and boulders (AECL 2001a), it is likely that this model overestimates the contribution of groundwater to concentrations in sediment.

Predicted radionuclide concentrations are presented in Table 6.4.2-15 with NSRDR Unconditional Clearance Levels. The maximum concentrations in sediment were calculated by running the model with the maximum release rates presented in Table 6.4.2-9. Predicted sediment concentrations are lower than their respective Clearance Levels.

Table 6.4.2-15: Predicted Maximum Radionuclide Concentrations in Sediment at the Nearfield and Farm A Intake

Radionuclide	NSRDR Unconditional Clearance Level (Bq/kg)	Maximum Sediment Concentration Nearfield (Bq/kg (dw))	Maximum Sediment Concentration Farm A Intake (Bq/kg (dw))
Actinium-225	NV	6.94×10^{-10}	1.29×10^{-11}
Actinium-227	1.00×10^{3}	7.18×10^{-10}	1.35×10^{-11}
Bismuth-210	NV	5.88×10^{-06}	1.09×10^{-07}
Calcium-41	NV	1.04×10^{-05}	1.96×10^{-07}
Carbon-14	1.00×10^{3}	0.051233	0.000964
Chloride-36	1.00×10^{3}	3.16×10^{-09}	5.94×10^{-11}
Gadolinium-152	NV	1.53×10^{-15}	2.87×10^{-17}
Iodine-129	1.00×10^{1}	4.64×10^{-05}	8.73×10^{-07}
Lead-210	1.00×10^{3}	3.82×10^{-08}	7.18×10^{-10}
Neptunium-237	1.00×10^{3}	1.50×10^{-08}	2.83×10^{-10}
Nickel-59	1.00×10^{5}	0.001908	3.59×10^{-05}
Niobium-94	1.00×10^{2}	8.49×10^{-19}	1.60×10^{-20}
Plutonium-239	1.00×10^{2}	0.001474	2.77×10^{-05}
Plutonium-240	1.00×10^{2}	3.56×10^{-06}	6.70×10^{-08}
Polonium-210	1.00×10^{3}	3.98×10^{-07}	7.48×10^{-09}
Protactinium-231	1.00×10^{3}	2.28×10^{-09}	4.29×10^{-11}
Protactinium-233	1.00×10^{4}	1.08×10^{-08}	2.03×10^{-10}
Radium-223	1.00×10^{3}	5.27×10^{-08}	9.84×10^{-10}
Radium-224	1.00×10^{3}	3.28×10^{-13}	6.02×10^{-15}
Radium-225	1.00×10^{4}	2.59×10^{-08}	4.84×10^{-10}
Radium-226	1.00×10^{3}	4.99×10^{-08}	9.39×10^{-10}
Radium-228	1.00×10^{5}	3.29×10^{-13}	6.18×10^{-15}
Silver-108m	NV	2.37×10^{-07}	4.46×10^{-09}
Technetium-99	1.00×10^{3}	5.68×10^{-07}	1.07×10^{-08}
Thorium-227	1.00×10^{3}	1.48×10^{-07}	2.77×10^{-09}
Thorium-228	1.00×10^{3}	1.83×10^{-12}	3.44×10^{-14}
Thorium-229	1.00×10^{2}	1.46×10^{-07}	2.75×10^{-09}

Table 6.4.2-15: Predicted Maximum Radionuclide Concentrations in Sediment at the Nearfield and Farm A Intake

Radionuclide	NSRDR Unconditional Clearance Level (Bq/kg)	Maximum Sediment Concentration Nearfield (Bq/kg (dw))	Maximum Sediment Concentration Farm A Intake (Bq/kg (dw))
Thorium-230	1.00×10^{3}	2.81×10^{-07}	5.28×10^{-09}
Thorium-231	NV	1.94×10^{-07}	3.35×10^{-09}
Thorium-232	1.00×10^{3}	1.82×10^{-12}	3.43×10^{-14}
Thorium-234	1.00×10^{3}	1.34×10^{-06}	2.51×10^{-08}
Uranium-233	1.00×10^{3}	5.57×10^{-09}	1.05×10^{-10}
Uranium-234	1.00×10^{3}	1.75×10^{-08}	3.30×10^{-10}
Uranium-235	1.00×10^{3}	7.14×10^{-09}	1.34×10^{-10}
Uranium-236	1.00×10^{4}	9.63×10^{-09}	1.81×10^{-10}
Uranium-238	1.00×10^{3}	4.94×10^{-08}	9.29×10^{-10}

NSRDR Unconditional Clearance Level = *Nuclear Substances and Radiation Devices Regulations* Unconditional Clearance Level (SOR/2000-207)

Bq/kg – Becquerels per kilogram; dw = dry weight; NV – No value (data source did not include this non-radionuclide).

Table 6.4.2-16 presents the predicted non-radionuclide sediment concentrations with federal sediment quality guidelines. The surface water background and maximum surface water concentrations from Table 6.4.2-10 were used to calculate sediment concentrations.

Where background concentrations of surface water were available, predicted sediment concentrations at the Nearfield and Farm A Intake were the same as sediment concentrations derived from background. Predicted sediment concentrations at Farm A Intake were two orders of magnitude lower than concentrations predicted in the Nearfield, for parameters without background available. Predicted sediment concentrations from background surface water concentrations exceeded available guidelines as background surface water concentrations are high and lead to high predicted background sediment concentrations.

Table 6.4.2-16: Predicted Non-Radionuclide Concentrations in Sediment at the Nearfield and Farm A Intake

Non-Radionuclide	CCME Sediment Quality Guidelines (mg/kg)	Sediment Concentration From Background Surface Water (mg/kg)	Maximum Sediment Concentration Nearfield (mg/kg)	Maximum Sediment Concentration Farm A Intake (mg/kg)
	Probable Effect Level			
Barium	—	$2.20 \times 10^{+07}$	$2.20 \times 10^{+07}$	$2.20 \times 10^{+07}$
Bismuth	—	$1.00 \times 10^{+06}$	$1.00 \times 10^{+06}$	$1.00 \times 10^{+06}$
Boron	—	$5.00 \times 10^{+05}$	$5.00 \times 10^{+05}$	$5.00 \times 10^{+05}$
Cadmium	$3.50 \times 10^{+00}$	$5.00 \times 10^{+03}$	$5.00 \times 10^{+03}$	$5.00 \times 10^{+03}$
Chromium	$9.00 \times 10^{+01}$	$2.21 \times 10^{+08}$	$2.21 \times 10^{+08}$	$2.21 \times 10^{+08}$
Cobalt	—-	$8.60 \times 10^{+06}$	$8.60 \times 10^{+06}$	$8.60 \times 10^{+06}$
Copper	$1.97 \times 10^{+02}$	$7.00 \times 10^{+06}$	$7.00 \times 10^{+06}$	$7.00 \times 10^{+06}$
Gadolinium	—	NV	7.17×10^{-5}	1.35×10^{-6}
HB-40	—	$0.00 \times 10^{+00}$	$5.01 \times 10^{+03}$	$9.43 \times 10^{+01}$
Lead	$9.13 \times 10^{+01}$	$3.38 \times 10^{+06}$	$3.38 \times 10^{+06}$	$3.38 \times 10^{+06}$
Manganese	$1.10 \times 10^{+03}$ ‡	$1.43 \times 10^{+09}$	$1.43 \times 10^{+09}$	$1.43 \times 10^{+09}$
Mercury	$4.86 \times -^{01}$	$1.60 \times 10^{+03}$	$1.60 \times 10^{+03}$	$1.60 \times 10^{+03}$
Molybdenum	—	$2.00 \times 10^{+04}$	$2.00 \times 10^{+04}$	$2.00 \times 10^{+04}$
Nickel	$7.50 \times 10^{+01}$ ‡	$2.49 \times 10^{+06}$	$2.49 \times 10^{+06}$	$2.49 \times 10^{+06}$
Nitrogen	—	NV	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$
Palladium	—	NV	$6.33 \times 10^{+00}$	1.19×10^{-01}
Potassium	—	$0.00 \times 10^{+00}$ †	$0.00 \times 10^{+00}$ †	$0.00 \times 10^{+00}$ †
Potassium Hydroxide	—	$0.00 \times 10^{+00}$ †	$0.00 \times 10^{+00}$ †	$0.00 \times 10^{+00}$ †
Ruthenium	—	NV	2.20×10^{-06}	4.14×10^{-08}
Sulphur	—	NV	2.92×10^{-12}	5.48×10^{-14}
Xylene	—	NV	7.49×10^{-01}	1.41×10^{-02}
Zirconium	—	NV	1.69×10^{-09}	3.18×10^{-11}

Note:

CCME Sediment Quality Guidelines = Canadian Council of Ministers of the Environment Sediment Quality Guidelines (CCME 1999b).

† Assumed potassium and potassium hydroxide are extremely soluble and would not be found in sediment.

‡ Values are the severe effect level from the Ontario Sediment Quality Guidelines (MOE 2008).

NV – No value (data source did not include this non-radionuclide); — = no guideline.

Potential groundwater seepage into the Winnipeg River from the WRDF was predicted to produce surface water concentrations of radionuclides six orders of magnitude lower than groundwater concentrations in the Nearfield. Non-radionuclides in the potential groundwater seep were predicted to have no effect on existing elevated surface water concentrations for all parameters with available background concentrations. Similarly, predicted sediment concentrations from radionuclides were below NSRDR Unconditional Clearance Levels and non-radionuclides predicted sediment concentrations were dominated by background surface water contributions. The potential groundwater seep is predicted to have a negligible residual effect on the Winnipeg River surface water quality.

6.4.2.8 Prediction Confidence and Uncertainty

Potential sources of uncertainty in the assessment of surface water quality include:

- the accuracy and representativeness of the groundwater loadings;
- the accuracy and representativeness of the inputs used in the dispersion model; and
- the accuracy of formulations within the river dispersion model.

Uncertainty related to the groundwater loadings is discussed in Section 6.3.2.8 Prediction Confidence and Uncertainty (hydrogeology assessment). In summary, the bedrock was considered to be a single hydrostatic unit and no discrete features (fractures) present in any material. The cover, grout and foundation were assumed to degrade at rates comparable to other projects (i.e., Savannah River), which increased groundwater flow through time, resulting in total failure (degradation) of grout by year 10,000. Parameters outside the reactor were assumed to be instantly released. Partition coefficients to bedrock were applied to parameters, where available, and solubility was only applied to HB-40 and lead. From these inputs, groundwater loadings are likely overestimated since all parameters outside of the reactor were instantly soluble when in contact with groundwater. The exceptions, HB-40 and lead, had a solubility applied from recent toxicity testing (EcoMetrix 2017), that was only achieve through extreme agitation (emulsified), and solubility testing on groundwater from a WL groundwater well (CNL 2017c), respectively. The degradation of the cover, grout and building foundation may occur at different rates than those used in the model, which may mean the peak loadings would occur sooner than predicted. The model was run for 500,000 years to ensure most parameters achieved groundwater loading peaks (past maximum load).

Uncertainty in both the groundwater flow and solute transport modelling is recognized and was evaluated through the completion of a sensitivity analysis. The sensitivity analysis included the evaluation of the effect of 13 various model assumptions on model results as discussed in detail in Golder (2021). One of the key assumptions of the solute transport modelling that was evaluated through the sensitivity analysis was that the source mass was distributed evenly throughout the grout block and that solute transport occurred through the foundation, which was conceptualized as a 1 m thick concrete material, or equivalent barrier. This assumption is conservative, as the grout itself is anticipated to provide some additional separation between the source mass (most of which is confined within the metal components of the reactor) and the downstream environment. Results of the sensitivity analysis indicate that inclusion of the grout as a barrier to solute migration resulted in considerably (5x for conservative species) lower peak mass loadings and significant increases (5x for conservative species) to the arrival time for peak mass loadings relative to the base case. For solutes with relatively short half-lives (e.g., tritium), the mass loadings were reduced by more than one order of magnitude. These changes reflect the additional time required for solute mass to migrate through the grout prior to reaching the foundation.

Dispersion models employ assumptions that simplify the random processes associated with water flow and turbulence. Values for the parameters input into the model were selected to represent the Winnipeg River in the vicinity of the WL site. Historical data collected in the WL site area was used for modelling. To determine if a significant difference of model inputs would change the surface water concentration, the model using the maximum predicted groundwater concentrations was run multiple times varying flow and river depth in a sensitivity analysis. The minimum and maximum of the average daily flows (458 m^3/s and 1,538 m^3/s, respectively) from the 1987 to 2014 from the Water Survey of Canada at the McArthur Generating Station were used (WSC 2016).

Elevations above sea level of the river taken at the WL site varied approximately 1 m. From another source the Winnipeg River in the vicinity of the WL site was reported as 7.7 m deep. The relationship between the river elevation and the reported depth is unknown. Therefore, the water level at the farm was varied 1 m above and below 7.7 m, with water levels of 6.7 and 8.7 m to test sensitivity. This is a conservative approach, as water levels do not vary more than one metre currently. For the Nearfield, water levels were varied 0.05 m, with 0.15 m and 0.05 m used to test sensitivity. Model runs included: 1) low flow and low water level; 2) high flow and low water level; 3) high flow and low water level; and 4) high flow and high-water level.

The groundwater seepage enters the river over a broad area extending into the river. If the groundwater intercepts the full depth of the river, the spatial extent of the influx could extend over 200 m width across the river by 95 m length along the river. This conceptual model differs from the model assumed in CSA N288.1-14 (CSA Group 2014), which assumes an influx over a 95 m length along the riverbank. Assuming an area source, the estimated dilution could be in the order of 283,000:1 if the plume rises 1 cm from the bottom and 1,400,000:1 if the plume rises 5 cm from the bottom. In either case, the available dilution is sufficient to render the plume indistinguishable from ambient river water.

6.4.2.9 Monitoring and Follow-up

As part of CNL's licence (NRTEDL-W5-8.00/2024) with the CNSC, CNL will implement an Environmental Assessment Follow-up Program for the Project to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. This monitoring will be integrated with that for the existing Environmental Assessment Follow-up Program for the WL site, where practical.

The existing Environmental Assessment Follow-up Program for the WL site includes collecting water samples at one location 17 km upstream near Pinawa (US on Figure 6.4.2-3), 2 km downstream at the site boundary (DS on Figure 6.4.2-3), 10 km downstream at the town of Lac du Bonnet water intake (LB on Figure 6.4.2-3) and 28 km downstream at the Great Falls generating station (CNL 2016c; Figure 6.4.2-2). Surficial sediment is also collected at two locations upstream, at the outfall and nine locations downstream (CNL 2016a; Figure 6.4.2-3). In addition, CNL has committed to collecting cores in depositional areas in 2026, 2046 and 2066 at Sylvia Lake and upstream and downstream of the waterbody at Lac du Bonnet, which are part of the Winnipeg River system. It is proposed that these same monitoring locations be used to support the Environmental Assessment Follow-up Program for the Project, coordinating with the existing program, where practical. Follow-up monitoring during the post-closure phase is summarized in Table 6.4.2-17.

It is noted that data generated by the monitoring program will be evaluated on an ongoing basis within an adaptive management framework. Within this framework, modifications to the program may be appropriate to confirm data continue to fulfill program objectives. For example, should a contaminant of potential concern reach concentrations outside the range predicted in the EIS or Decommissioning Safety Assessment Report, including the findings from the Ecological Risk Assessment, the frequency of sampling may be increased and additional locations may be sampled to investigate the source of the increased concentrations. Conversely, cessation of a monitoring activity might be appropriate once it has been shown that an effect has stabilized or has been reduced to a level where it is no longer considered significant with respect to regulatory requirements or community concerns. Any proposals for modifications to the monitoring program and the rationale for the modifications will be communicated to the CNSC prior to implementation. Additional information on the Environmental Assessment Follow-up Program for the Project can be found in Section 11.0 Summary of Monitoring and Follow-up Programs.

CNL will continue to proactively seek, engage, and support meaningful discussion on issues and opportunities related to the Project, including the monitoring and follow-up program, with First Nations and the Manitoba Métis Federation and communities of interest. CNL has also had discussions with First Nations and the Manitoba Métis Federation on how future monitoring on the WL site could incorporate Indigenous interests, such as monitoring of country harvested foods. CNL will continually evaluate both the process and the outcome of the ongoing engagement and communication activities, to address and manage issues as they arise.

Table 6.4.2-17: Monitoring and Follow-up Programs for Surface Water Quality

Valued Component	Project Phase, Potential Effect and Conceptual Monitoring Program	Monitoring Program Objective	Suggested Duration	Implementing Program
Surface Water Quality	**Potential Source(s) of Effects:** ■ Changes to surface water quality from the release of solutes into the groundwater as the grout and reactor components gradually deteriorate over time during the post-closure phases. **Proposed Monitoring:** ■ Monitor the quality of water in the Winnipeg River to evaluate whether the quality of the water is affected by the ISD reactor facility ■ Monitor the quality of water in on-site ditches to verify the hydrogeological model **Trigger for further action:** ■ Investigation (e.g., sediment analyses) if parameters above predictions, applicable guidelines, or indication of poor maintenance.	■ Verify effects predictions related to surface water quality. ■ Demonstrate compliance with regulatory requirements.	■ Surface water and ditch system water will be sampled on a semi-annual basis at one upstream and two downstream locations. Frequency of recurrence will be assessed based on performance data. ■ Water quality monitoring will continue through closure phase and post-closure phase (i.e., during institutional control).	■ Surface water monitoring in the receiving environment is integrated into the CNL Environmental Monitoring Program and will be compliant with *CSA Standard N288.4-10: Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills* (CSA Group 2010).No new surface water quality monitoring is proposed for the Project.

6.4.2.10 Conclusions

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). Acknowledging that changes to surface water quality is an important aspect of the natural and human environment, and may potentially result in effects to other VCs, surface water quality is referred to as an intermediate VC. Indigenous engagement confirmed the importance of surface water quality. Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations were concerned as the Project may indirectly discharge water into the Winnipeg River. Surface water quality measurement indicators include estimated concentrations of surface water parameters in the Winnipeg River. Indigenous peoples did not identify any additional valued components as it relates to the surface water quality assessment.

Residual effects during the Post-closure phase have been identified as the primary linkage to potentially affect surface water quality (Table 6.4.2-18). Groundwater may encounter the WRDF and then flow to the Winnipeg River, resulting in changes to surface water and sediment quality. The predicted maximum radionuclide concentrations in surface water at both the Nearfield and the Farm A Intake on the Winnipeg River are orders of magnitude lower than background groundwater concentrations. Predicted sediment concentrations of radionuclides are lower than their respective clearance levels. The potential groundwater seep is predicted to have a negligible residual effect on the Winnipeg River surface water quality.

Predicted maximum non-radionuclide concentrations in surface water and sediment are driven by current river concentrations and some parameters exceed available surface water or sediment guidelines. For example, the background concentration for lead exceeds the lowest available guidelines for surface water and sediment, but the maximum sediment concentrations at both the Nearfield and the Farm A intake in both surface water and sediment show no change from the background level as a result of the Project.

Overall, the assessment of potential effects determined there are no residual adverse effects on surface water and sediment quality from changes in groundwater quality. This conclusion applies to the surface water quality interests and concerns raised by the engaged Indigenous Nations that were encompassed by the assessment (Table 6.4.2-1).

First Nations and the Red River Métis have interest in the current and future monitoring proposed for the Project. CNL will implement an Environmental Assessment Follow-up Program for WR-1 to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. CNL's current environmental monitoring program includes collecting water samples at one location upstream and three locations at varying distances downstream of the WL site. Surficial sediment is also collected at two locations upstream, at the outfall and nine locations downstream. In addition, CNL has committed to collecting cores in depositional areas in 2026, 2046 and 2066 at Sylvia Lake and upstream and downstream of the waterbody Lac du Bonnet. Follow-up monitoring during the post-closure phase is necessary to confirm predicted concentrations in surface water and sediment in the Winnipeg River and to provide information for use in adaptive management to address potential unforeseen effects.

CNL will continue to proactively seek, engage, and support meaningful discussion on issues and opportunities related to the Project, including the monitoring and follow-up program, with First Nations and the Manitoba Métis Federation and communities of interest. CNL has also had discussions with First Nations and the Manitoba Métis Federation on how future monitoring on the WL site could incorporate Indigenous interests, such as monitoring of country harvested foods. CNL will continually evaluate both the process and the outcome of the ongoing engagement and communication activities, to address and manage issues as they arise.

Table 6.4.2-18: Summary of Predicted Residual Adverse Effects for Surface Water Quality

Valued Component	Assessment Endpoint	Residual Effect	Phase Project Effect Occurs in	Contributing Project Activity	Proposed Mitigation	Significance
Surface Water Quality	Intermediate VC (i.e., it does not have an assessment endpoint)	Release of chemical and radiological contaminants in the long-term during the post-closure phase from the Project, which can alter surface water and sediment quality.	Post-Closure	Post-Closure Performance – Grout and reactor components gradually deteriorate over time	■ The planned decommissioning of the WR 1 Complex presently involves: ▪ removal the service area and infilling in these areas with compact soil; ▪ sealing of open conduits in the building foundation; and ▪ grouting the interior portion of the building (containing the remaining components of WR 1) to ground surface elevation. ■ As part of CNL's licence with the Canadian Nuclear Safety Commission (CNSC), environmental monitoring around the WL site is required and will continue for the Project during institutional control. ■ Follow up monitoring will be completed during institutional control to verify effect predictions and to provide information for use in adaptive management to address potential unforeseen effects.	Significance is not determined as VC does not have an assessment endpoint; rather the results provided to other disciplines for inclusion in their assessment.

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6.5 Aquatic Environment

This section of the Environmental Impact Statement (EIS) examines the potential residual effects of the Project on the physical aspects of the aquatic environment.

6.5.1 Scope of the Assessment

The scope of the assessment focuses on the evaluation of potential changes in the aquatic environment (the Winnipeg River) that may result from activities associated with the Project. Hydrology, surface water quality and sediment quality are discussed in detail in Section 6.4 Surface Water Environment, and risks to ecological health as the result of chemical and radiological exposures are discussed in Section 6.7 Human and Ecological Health. Results of these assessments are used to support the assessment of effects on the aquatic environment.

The aquatic environment assessment follows the overall environmental assessment approach and methods described in Section 6.1 Environmental Assessment Approach. The assessment is completed in the following steps:

- **Step 1 – Identify Valued Components (VCs) and define the spatial boundaries, temporal boundaries and assessment cases** (refer to Section 6.5.3 Valued Components and Section 6.5.4 Assessment Boundaries) for the aquatic environment assessment. The VCs, assessment endpoints and measurement indicators used to assess Project related changes to the aquatic environment, the spatial and temporal boundaries at which the assessment occurred, and the assessment cases considered are described.
- **Step 2 – Describe the existing conditions** (refer to Section 6.5.5 Description of the Environment). Existing conditions in the local and regional areas are described, including the combined effects of previous and existing developments (Base Case). The existing environment represents the historical and current environmental pressures that have shaped the observed patterns in the environment (i.e., natural variation).
- **Step 3 – Evaluate Project interactions and mitigation** (refer to Section 6.5.6 Project Interactions and Mitigation). Project components and/or activities with the potential to affect the aquatic environment (biota) are identified and mitigation options are presented to limit or avoid these effects. A pathways analysis is then used to focus on key interactions between the Project and the environment and determine if mitigation can limit or eliminate the predicted residual effects. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. Where effects are adequately mitigated and are not forwarded to further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are described.
- **Step 4 - Present the methods and results of the residual effects analysis**. This step was not required as no primary pathways were identified in the aquatic assessment.
- **Step 5 - Describe the level of certainty and management of uncertainty.** This step was not required as no primary pathways were identified in the aquatic assessment.
- **Step 6 – Classify and determine the significance of the predicted residual effects.** This step was not required as no residual effects to aquatic VCs were identified.
- **Step 7 – Identify monitoring and follow-up** (refer to Section 6.5.7 Monitoring and Follow-up) required to confirm effect predictions and address uncertainty.

- **Step 8 – Present a consolidated summary of conclusions and outcomes of the assessment** (refer to Section 6.5.8 Conclusions) of residual effects on the aquatic environment.

6.5.2 Indigenous Engagement Feedback – Key Interests and Concerns

Interests and concerns raised by Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations during engagement that are related to the aquatic environment assessment are summarized in Table 6.5.2-1. Other general concerns and questions raised during Indigenous engagement activities are documented in Section 4 Indigenous Engagement.

Table 6.5.2-1: Summary of Key Interests and Concerns Raised During Indigenous Engagement Activities Related to the Aquatic Environment Assessment

Interest and Concern	Inclusion Status	Additional information and Rationale
Effects on Fish ■ Deterioration of fish quality ■ Protection of fish in the Winnipeg River ■ Contamination of fish through water, aquatic plants and sediment.	Already included in the environmental assessment	■ Effects on fish health are summarized in Section 6.5.6 Project Interactions and Mitigation. ■ The detailed assessment of effects to fish health (including through water, aquatic plants and sediment) is provided in Section 6.7.2.7.2 Application Case – Post Closure.
Effects on Harvesters ■ Importance of the Winnipeg River for the harvesting of fish. ■ Effects of ingestion of fish, waterfowl, and plants on the human health	Already included in the environmental assessment	■ Effects on fish and fish habitat are assessed in Section 6.5.6 Project Interactions and Mitigation. ■ The socio-economic effects on harvesting of fish are assessed in Section 6.8.1.6 Project Interactions and Mitigation. ■ Human health effects resulting from harvesting fish, waterfowl and aquatic plants are assessed in Section 6.7.1.7 Application Case
Monitoring of Fish ■ How fish are tested ■ If contaminants can accumulate in fish over time ■ Interest in being more involved in fish monitoring on site.	Already included in the environmental assessment	■ Information on annual monitoring of radioactivity in fish is provided in Section 6.5.5.2.3 Radioactivity in Fish. ■ Information on monitoring related to fish is provided in Section 6.5.7 Monitoring and Follow-up.

6.5.3 Valued Components

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). For the aquatic environment, fish and fish habitat was selected as a VC as there is a potential for the Project activities to affect aquatic biota in the Winnipeg River (Table 6.5.3-1). Indigenous VCs aligned with fish and fish habitat for the aquatic environment. The Traditional Knowledge and Land Use Studies (Firelight Research and SFN 2018; BRFN, BON, and HWFN 2019; and SVS 2019) identified specific fish species of concern, as well as habitats supporting life history requirements including spawning, nursery, rearing and foraging. Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations identified sturgeon and sturgeon

spawning grounds, pickerel, pike, catfish, sunfish, sucker, goldeye, whitefish, perch, carp, and bass as species for inclusion in the assessment. The fish and fish habitat VC includes the fish species identified by Indigenous Nations that are occurring in the Winnipeg River Regional Study Area, as well as habitats supporting life history requirements including spawning, nursery, rearing and foraging (Sections 6.5.5.2.2 Fish Community and 6.5.5.2.5 Fish Habitat). Traditional Knowledge and Land Use Studies also identified food (such as wild rice) and medicines (such as Weekay) as VCs. Food and medicines are not considered within the aquatic environment assessment, but rather as part of Human and Ecological Health (Section 6.7).

Table 6.5.3-1: Valued Components for Aquatic Environment Assessment

Valued Component	Rationale for Selection
Fish and Fish Habitat	The Winnipeg River supports a diverse fish community, including species at risk and species that support recreational fisheries. This VC captures the fish species identified by Indigenous Nations. The migration of radionuclides to the Winnipeg River via groundwater may potentially affect fish and fish habitat.

Assessment endpoints are qualitative expressions used to assess the significance of residual effects on VCs and represent the key properties of the VC that should be protected for future generations. The assessment endpoint for the aquatic environment is the maintenance of self-sustaining and ecologically effective fish populations. Self-sustaining populations are healthy and viable and, by definition, robust and capable of withstanding environmental change and accommodating stochastic processes (Reed et al. 2003). Maintaining viable fish populations is a conservation target frequently applied by conservation biologists and resource managers (Fahrig 2001; Nicholson et al. 2006; Ruggiero et al. 1994; With and Crist 1995).

Measurement indicators represent the specific properties of the aquatic environment assessment endpoints and VCs that, when changed, could represent an effect on a VC. Measurement indicators also provide the primary factors for discussing the uncertainty of effects on VCs and, subsequently, are the key measures for study in follow-up and monitoring programs. The measurement indicators for the aquatic environment include measurable attributes that broadly represent various facets of the aquatic environment. These include fish habitat (quality and quantity), benthic invertebrate community structure and fish community structure (Table 6.5.3-2).

Table 6.5.3-2: Assessment Endpoints and Measurement Indicators for the Aquatic Environment Assessment

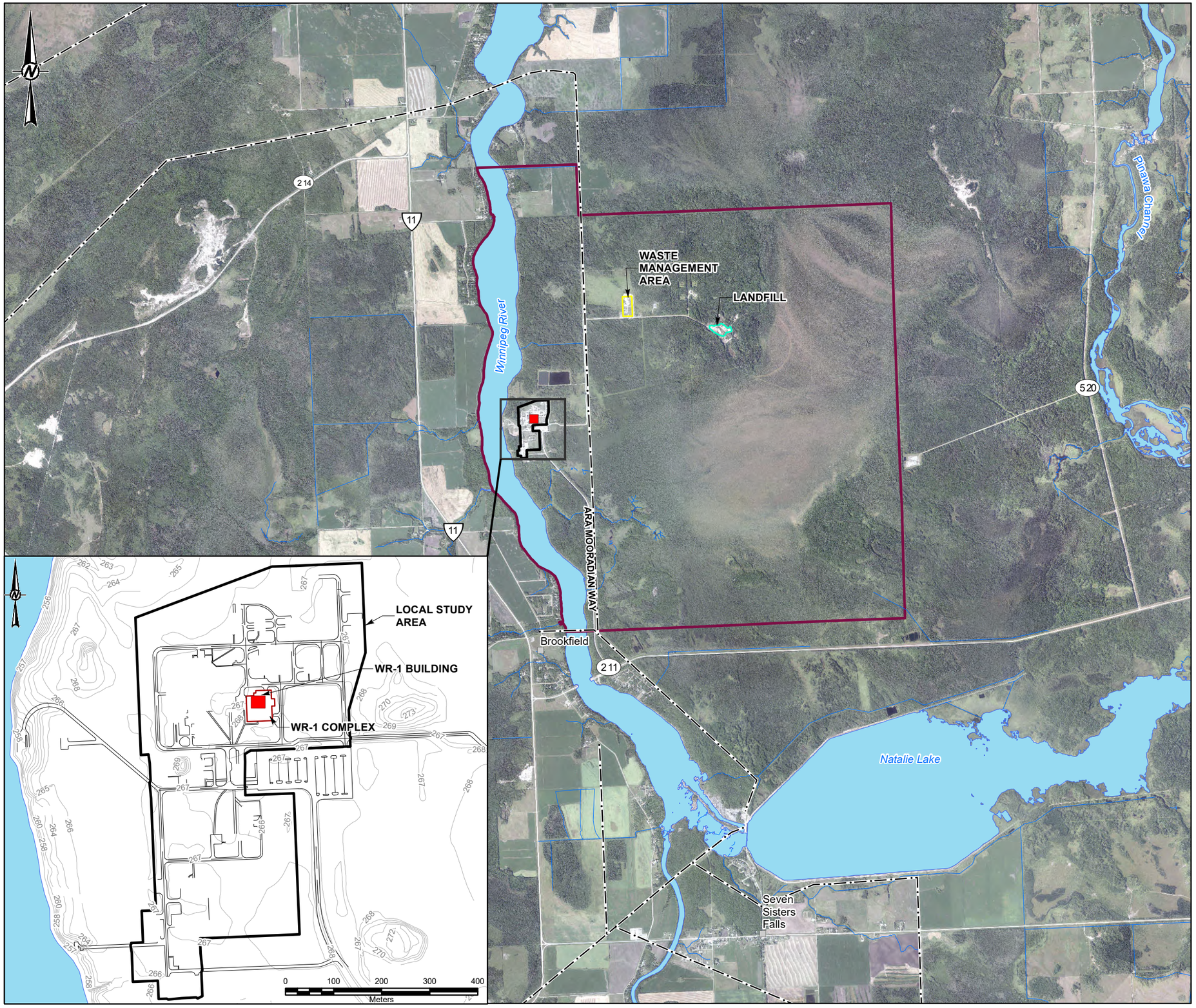
Valued Component	Assessment Endpoint	Measurement Indicators
Fish and Fish Habitat	Maintenance of self-sustaining and ecologically effective fish populations	■ Changes to quality and/or quantity of fish habitat ■ Changes in benthic macroinvertebrate community structure (diversity, abundance) ■ Changes in fish community structure (diversity, abundance) ■ Changes in fish flesh radiochemistry

6.5.4 Assessment Boundaries

6.5.4.1 Spatial Boundaries

The spatial boundaries selected for the aquatic environmental assessment are consistent with hydrology and surface water quality and are presented on Figure 6.5.4-1 and are described below:

- **Site Study Area (SSA):** is the Whiteshell Reactor 1 (WR-1) Building and represents the Project footprint (i.e., where project activities will be undertaken; 0.07 ha).
- **Local Study Area (LSA):** was selected in consideration of the SSA and the spatial extent of potential direct effects of the Project on hydrology, surface water quality and the aquatic environment. The LSA was selected to represent an area that is likely to be directly affected by the Project, helping to identify Project-specific (rather than cumulative effects of the Project in combination with other projects in the region). The LSA is represented by the fenced area of the WL main campus and includes the SSA. The LSA was based on the area of the WL main campus that is currently drained by roadside ditches and storm sewers. The approximate size of the LSA is 29 ha. The LSA does not include the Winnipeg River as direct effects to the aquatic environment from the Project on the Winnipeg River are anticipated to be negligible (i.e., the drainage area of the LSA is several orders of magnitude smaller than that of the Winnipeg River). Conversely, indirect residual effects to the surface water quality of the Winnipeg River may occur as a result of changes to groundwater quality resulting from the Project. As such, the Winnipeg River is considered as part of the Regional Study Area (RSA).
- **Regional Study Area:** is defined as the area within which maximum geographical extent of potential indirect effects of the Project may interact with the effects of other existing or reasonably foreseeable projects. For example, indirect effects on surface water quality from the Project include potential seepage of groundwater into the Winnipeg River. The plume from the discharged effluent during operation was previously assessed to hug the east bank of the river (AECL 1973) and it is assumed that a groundwater seep entering the river in generally the same area will behave similarly. Therefore, the south boundary of the RSA extends from the west shore of the Winnipeg River to the east fence on the property line about 400 m north of Provincial Highway 211. The eastern boundary of the RSA follows the fence on the property line to the north property line. The north boundary follows the north fence on the property line about 1.6 km and then turns north for about 400 m before turning west and extending to the west side of the Winnipeg River. This is to include the first farm downstream on the east bank because this is the most conservative potential water user. The west boundary follows the west bank of the Winnipeg River. The RSA has an approximate size of 3,710 ha.



LEGEND

- WR-1 BUILDING (SITE STUDY AREA)
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- WASTE MANAGEMENT AREA
- LANDFILL

BASE FEATURES

- CITY/TOWN
- TRANSMISSION LINE
- WATERCOURSE
- WATERBODY

0 1,000 2,000 3,000 4,000

1:60,000 METRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY (RSA) PROVIDED BY CNL (2016-11-22)
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT

CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT

EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE

SPATIAL BOUNDARIES FOR THE AQUATIC ENVIRONMENT ASSESSMENT

CONSULTANT

wsp GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0013	2	**6.5.4-1**

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Path: S:\Clients\Canada\an_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0013_EIS_Sec_6.5\20145046-0013-G-0001_Figure 6_5_4-1 Spatial Boundaries for the Aquatic Environment Assessment.mxd

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6.5.4.2 Temporal Boundaries

Temporal boundaries (i.e., project phases) represent the time period during which project activities are actively occurring and considers the duration of predicted residual effects and establishes the timeframe during which Project effects are assessed. The duration of an effect is defined as the amount of time between the start and end of a Project activity or stressor (which is related to the Project phases) plus the length of time required for the residual effect to be reversed. In some cases, a residual effect may be irreversible within the temporal boundaries of the Project if the effects were predicted to last so far into the future that they could not be predicted with any level of certainty (e.g., residual effect lasts for thousands of years). The following phases were identified for the Project:

- **Closure Phase:** Preparation and implementation of in situ disposal (ISD), which includes preparation for IDS, grouting of below-grade structures and systems, removal of above-grade WR-1 structures and systems, installation of the concrete cap and engineered cover, and environmental controls and final site restoration. These activities last from 2022 to 2027.
- **Post-closure Phase:** The post closure phase has two discrete periods: institutional control and post-institutional control. Institutional control is estimated to last 100 years during which long-term monitoring and maintenance activities will continue to demonstrate Whiteshell Reactor Disposal Facility (WRDF) performance is in compliance with the safety case assumptions and performance modelling. The 100 year timeframe is not related to the design life of the WRDF barriers. The 100-year active monitoring period was selected to ensure that sufficient opportunity is provided to verify the WRDF is performing as expected. Additionally, beyond 100 years, there is less confidence that institutional controls, like access restrictions, can be relied upon. Although the duration of institutional control is estimated at 100 years, it is recognized that it will continue until the CNSC, or the appropriate authority at the time, agrees it is no longer needed.
- Post-institutional control occurs after year 2127 and continues indefinitely. The post-closure phase will continue indefinitely; however, the timeframe defined for assessment of potential effects as part of the normal evolution of the Project is 10,000 years. This time period encompasses the phase in which peak effects are anticipated.

6.5.4.3 Assessment Cases

The assessment cases considered in the aquatic environment assessment include the Base Case, Application Case and the Reasonably Foreseeable Development (RFD) Case:

- **Base Case:** represents existing conditions and characterizes combined effects from previous and existing developments and activities. The Base Case reflects the effects of existing disturbances, such as forestry, transportation, agricultural, hydroelectric and residential and recreational development. Current effects to surface water and sediment quality from the existing facilities at the Whiteshell Laboratories (WL) site and operations are considered part of the Base Case (i.e., existing conditions). In addition, existing conditions of areas not affected by the WL site are also considered as part of the Base Case. Effects from the decommissioning and reclamation activities already completed at the WL site are also considered as part of the Base Case.

- **Application Case:** represents the effects of the Base Case combined with the predicted effects from the Project. The Application Case includes closure and post-closure activities, and therefore, the associated effects during these phases of the Project represents the bounding case.

- **RFD Case:** represents the predictions of the cumulative effects of the Application Case, plus projects that are currently under application review or that have officially entered a regulatory application process and which overlap with the aquatic environment RSA. Foreseeable developments in the aquatic RSA that are expected to overlap with residual effects on the aquatic environment from the Project includes the decommissioning of the remaining infrastructure and support facilities and remediation of affected lands at the WL site as per the existing decommissioning licence (Table 6.5.4-1). A Comprehensive Study Report (AECL 2001a) under the *Canadian Environmental Assessment Act* (1992) was completed for the decommissioning of the WL site. The Environmental Assessment decision to approve the Project was announced by the Minister of the Environment in March 2002 and a decommissioning licence was issued to Atomic Energy of Canada Limited (AECL) and subsequently to CNL.

Table 6.5.4-1: Reasonably Foreseeable Developments considered in the Aquatic Environment Assessment

Type of Project	Location	Description	Timeframe	Overlap with Valued Components
Infrastructure Decommissioning	WL	Decommissioning of remaining infrastructure on the WL site (includes ISD of the low-level waste trenches).	2016 to 2027	Yes – there is both spatial and temporal overlap of effects with the Project
Environmental Remediation	WL	Remediation of affected lands, with the exception of the low-level waste trenches.	2016 to 2027	Yes – there is both spatial and temporal overlap of effects with the Project

6.5.5 Description of the Environment

6.5.5.1 Methods

Baseline aquatic environment data were compiled from existing information. Sources included the *Whiteshell Laboratories Decommissioning Project Comprehensive Study Report* (AECL 2001a,b), as well as annual environmental monitoring reports (AECL 2012, 2013, 2014; CNL 2015, 2016, 2018a, 2020a). Internet searches were also performed to locate additional or more recent relevant information. Where applicable, radionuclide concentrations and radiological dose rates were compared to international, federal or provincial standards, objectives, or guidelines.

6.5.5.2 Results

6.5.5.2.1 General Overview

The principal aquatic habitat occurring within the RSA is the Winnipeg River. The Winnipeg River passes through the WL site, approximately 500 m the west of the WR-1 Building. In addition, there are several small, isolated ponds on the WL site that are fed by local runoff, and intermittent streams that flow primarily during the spring (AECL 2001a). The streams are associated with gullies that dissect the clay plains along the banks of the Winnipeg River. Beaver ponds are a common feature on the WL site; however, ponds rarely persist for more

than a few years, affording limited quality aquatic habitat. There is also a sewage lagoon, situated north of the main plant site that harbours a number of aquatic plants and animals, as well as man-made ditches that convey water during spring runoff, but are generally dry in summer.

Treated liquid effluent from the Active Liquid Waste Treatment Center, as well as stormwater is discharged to the Winnipeg River at an outfall located about 8 m offshore in approximately 5 m of water (AECL 2001a). The concentration of the dominant radionuclide associated with the discharge, caesium-137, in downstream river water was 0.005 Becquerels per litre (Bq/L) in 2015 (CNL 2016), and 0.014 Bq/L in 2019 (CNL 2020b), which for example is considerably lower than the current maximum acceptable concentration guideline for Canadian Drinking Water Quality of 10 Bq/L (Health Canada 2014) (see Section 6.7 Human and Ecological Health). In 2000, elevated radionuclide concentrations were measured in sediments in the immediate vicinity of the outfall (in an area approximately 20 m wide by 80 m downstream); however, the total radionuclide inventory was very low, approximately 1.3 Gigabecquerel (GBq). This level of activity was substantially less than the annual releases of caesium-137 prior to 1985 when the reactor was operating (AECL 2001a). Measured concentrations of caesium-137 were as high as 1,345 Bq/kg in sediments collected near the outfall in 2008 (AECL 2012). Subsequently, concentrations measured during annual environmental monitoring completed between 2009 and 2019 have ranged from 14 to 732 Bq/kg. Sediment concentrations 150 m downstream of the outfall were measured at 118 Bq/kg in 2009 and subsequently ranged from 5.3 to 53 Bq/kg between 2010 to 2019 (AECL 2013, 2014; CNL 2015, 2016, 2020a). Variation of activity is not unexpected for all samples due to the highly localized and spotty nature of the contamination in the river sediments at the outfall. Sample collection is difficult as the sediment layers are not consistent and areas of the river bottom are not uniformly covered with sediment, hence some sample locations will recover little to no sample.

The Winnipeg River supports a diverse fish community and affords spawning, rearing and foraging habitats. A total of 61 native species are reported for the river (Stewart and Watkinson 2004) and two species at risk are known to be present within the vicinity of the WL site: Lake Sturgeon (*Acipenser fulvescens*) and Carmine Shiner (*Notropis percobromus*) (COSEWIC 2019). Fish occurring within the study reach include species that are primarily resident (present year-round), as well as migratory (passing through). Fish habitat is generally similar throughout the RSA.

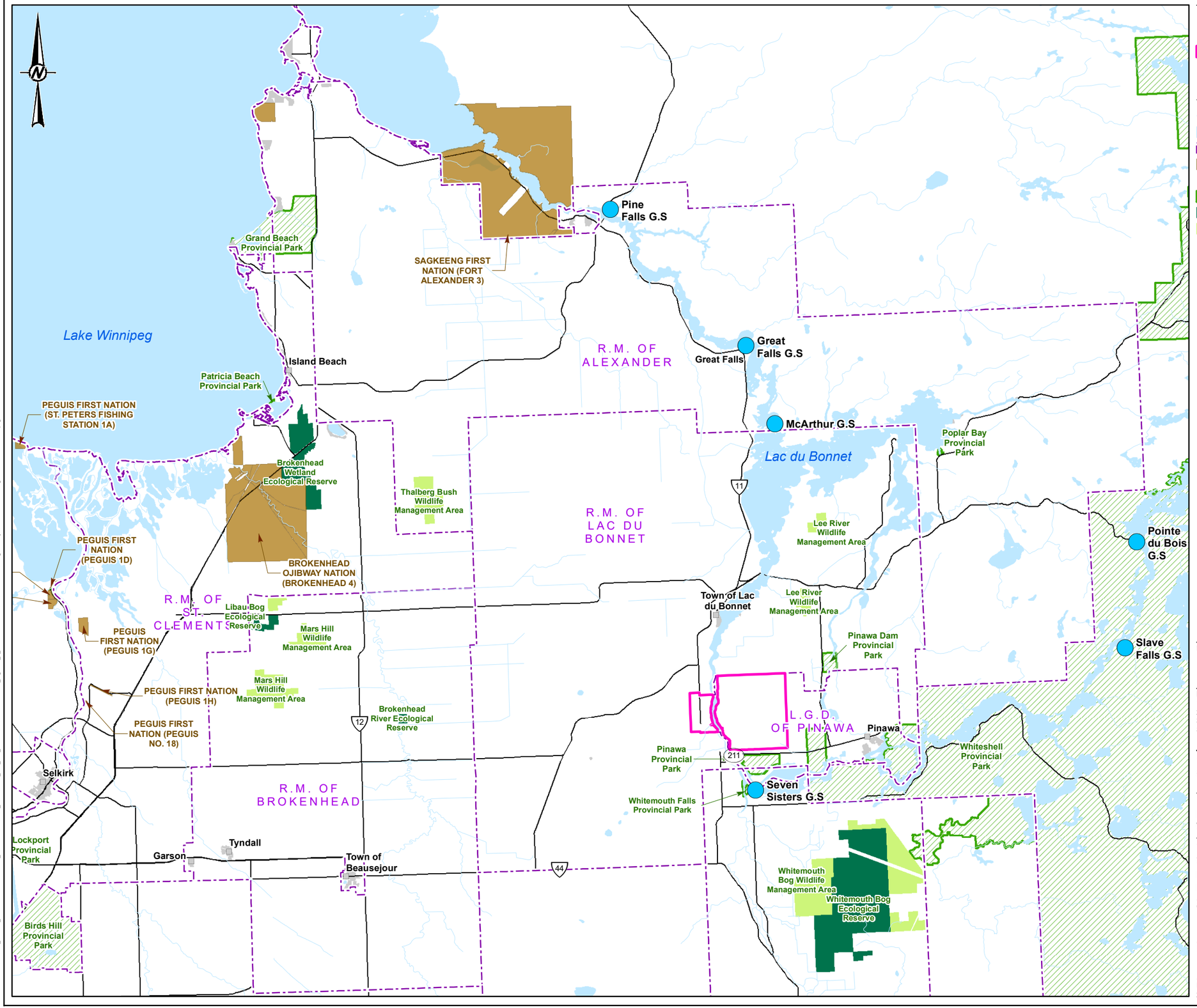
6.5.5.2.2 Fish Community

Of the 177 native freshwater fish species present in Canada, 94 species occur in the Hudson Bay drainage, which includes the Winnipeg River (Scott and Crossman 1973). A total of 79 native species are reported for Manitoba including 61 species for the Winnipeg River (Stewart and Watkinson 2004).

Many of the fish species occurring in the Winnipeg River within the vicinity of the WL site are forage fish including minnows (Cyprinidae), suckers (Catostomidae), sculpins (Cottidae) and darters (Percidae). Predatory fish species reported in the area include Walleye (*Sander vitreus*), Northern Pike (*Esox lucius*) and Smallmouth Bass (*Micropterus dolomieu*) (AECL 2001a). Walleye, Northern Pike, Lake Whitefish (*Coregonus clupeaformis*), Yellow Perch (*Perca flavescens*), Lake Sturgeon, Mooneye (*Hiodon tergisus*), Rock Bass (*Ambloplites rupestris*). White Sucker (*Catostomus commersonii*), and Shorthead Redhorse (*Moxostoma macrolepidotum*), are routinely captured upstream and downstream of the WL site, during annual environmental monitoring (CNL 2016). Other species occasionally encountered during annual monitoring between 2007 and 2017, include Smallmouth Bass, Burbot (*Lota lota*), Sauger (*Sander canadensis*), Black Crappie (*Pomoxis nigromaculatus*) and catfish (Ictaluridae) (CNL 2018a).

Thirty-six species of fish were reported from the Winnipeg River near Pointe du Bois Generating Station (situated approximately 55 km upstream of the WL site, see Figure 6.5.5-1) during fish community studies conducted between 2006 and 2010 (Manitoba Hydro 2011). The principal large-bodied species captured included Walleye, Sauger, Northern Pike, Yellow Perch, Burbot, Lake Whitefish, Cisco (*Coregonus artedi*), Longnose Sucker (*Catostomus catostomus*), White Sucker and Lake Sturgeon. Small-bodied species included Spottail Shiner (*Notropis hudsonius*), Emerald Shiner (*Notropis atherinoides*), Trout-perch (*Percopsis omiscomaycus*) and Logperch (*Percina caprodes*). The larvae of three families, Salmonidae (Cisco, Lake Whitefish), Percidae (Yellow Perch, Logperch, Walleye, Sauger) and Cottidae (sculpin) were captured in drift nets throughout the study area. Lake Sturgeon and Northern Pike larvae were collected in low abundance.

Two species at risk occur within the Winnipeg River in the vicinity of the WL site: Lake Sturgeon and Carmine Shiner. Lake Sturgeon (Saskatchewan – Nelson River populations) is designated as Endangered (COSEWIC 2019). Historically, populations supported a commercial fishery and prior to construction of the Seven Sisters Generating Station (situated approximately 7.5 km upstream of the WL site; see Figure 6.5.5-1) there was an important Lake Sturgeon spawning and nursery area located below the Seven Sisters Generating Station site (COSEWIC 2006). Currently, Lake Sturgeon remain relatively common within several kilometres downstream of the Seven Sisters Generating Station. Spawning occurs below the station and recruitment is occurring (Cleator et al. 2010). The current status of Lake Sturgeon in this reach of the Winnipeg River is thought to be cautious, although a population trend is unknown (DFO 2010). The Carmine Shiner is designated as Endangered by COSEWIC (2019) and is listed on Schedule 1 of the *Species at Risk Act* (SARA). The known distribution of the Carmine Shiner is limited to the Winnipeg River, at the base of Whitemouth Falls (located approximately 7 km upstream of the WL site; see Figure 6.5.5-1) and its tributaries (Whitemouth, Birch, Bird and Lee rivers; DFO 2013).



LEGEND

- GENERATING STATIONS
- WHITESHELL LABORATORIES SITE

BASE FEATURES

- CITY/TOWN
- MAJOR ROAD
- WATERCOURSE
- WATERBODY
- MUNICIPAL BOUNDARY
- FIRST NATION RESERVE

PROTECTED AREAS

- PROVINCIAL PARK
- ECOLOGICAL RESERVE
- WILDLIFE MANAGEMENT AREA

0 10 20

1:330,000 KILOMETRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY PROVIDED BY CNL (2016-11-22)
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT

CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT

EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE

WHITESHELL LABORATORIES SITE AND REGIONAL HYDROELECTRIC GENERATING STATIONS ON THE WINNIPEG RIVER

CONSULTANT

wsp GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0013	2	**6.5.5-1**

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Path: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0013_EIS_Sec_6.5\20145046-0001-G-0002_Figure 6_5_5-1 Whiteshell Laboratories Site and Regional Hydroelectric Generating Stations on the Winnipeg River.mxd

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6.5.5.2.3 Radioactivity in Fish

Fish consumption is the dominant exposure pathway of caesium-137 for people in the local area. CNL undertakes annual monitoring of radioactivity in fish flesh (muscle and tissue) collected from the Winnipeg River upstream and downstream of the WL site (CNL 2016, 2020a). Walleye, Northern Pike, Shorthead Redhorse, White Sucker and Lake Whitefish are usually captured and analyzed. It is important to note the Seven Sisters Generating Station, located approximately 7.5 km upstream from WL, acts as an effective barrier, separating fish populations downstream of WL from the upstream (control) populations.

Table 6.5.5-1 provides a summary of the caesium-137, potassium-40 and gross beta activity found in fish flesh at three locations on the Winnipeg River, from 1992 to 2019. Average concentrations of all three radionuclides were slightly greater for Walleye at downstream locations compared to upstream (CNL 2018a). However, for the White Sucker, on average radionuclide levels were slightly lower downstream of the WL site compared to upstream. Overall, no significant differences or trends in radionuclide concentrations were apparent among areas over the last five years. Based on an average Cs-137 level in Walleye from 1992 to 2019 at the 2 km downstream location of 1.5 mg/kg fw, the expected dose would be approximately $6x10^{-6}$ mG/d. This is a small fraction of the aquatic dose benchmark of 9.6 mGy/d (UNSCEAR 2011). In 2019, downstream fish were not collected due to unsafe conditions resulting from high river flows (CNL 2020a).

Table 6.5.5-1: Average Radioactivity in Flesh of Winnipeg River Fish, 1992 to 2019

Location and Year	Radioactivity (Bq/kg fresh weight)											
	White and Redhorse Sucker			Walleye			Northern Pike			Lake Whitefish		
	Cs-137	K-40	Gross Beta	Cs-137	K-40	Gross Beta	Cs-137	K-40	Gross Beta	Cs-137	K-40	Gross Beta
Upstream of WL Site (20 km upstream at Sylvia Lake, upstream of Seven Sisters Falls Hydro Dam)												
1992	0.56	125	92	1.11	105	87	2.26	122	98	1.29	118	99
1993	0.42	116	91	1.22	121	96	0.16	115	90	—	—	—
1994	0.45	110	97	1.22	113	94	0.69	114	98	0.17	118	95
1995	0.33	99	92	0.75	112	94	0.63	98	91	0.28	108	105
1996	0.4	124	98	0.98	132	97	0.66	116	90	0.58	134	105
1997	0.37	126	100	1.03	141	102	0.76	135	98	0.26	135	105
1998	0.57	162	97	1.44	119	89	1.74	132	89	0.24	159	100
1999	0.52	115	104	0.93	105	102	0.86	120	107	0.30	115	108
2000	0.72	131	103	1.71	128	99	1.83	121	93	0.50	136	109
2001	0.47	120	96	1.02	106	84	0.59	115	88	0.38	106	82
2002	0.63	113	87	0.86	131	98	0.98	115	101	0.63	143	100
2003	0.38	110	98	0.99	138	97	0.54	120	101	—	—	—
2004	0.3	118	96	0.84	121	90	0.52	101	98	0.3	119	99
2005	0.8	131	99	0.92	134	101	0.58	107	95	—	—	—
2006	0.55	114	80	0.85	148	99	0.38	88	87	0.58	108	109
2007	0.39	128	107	0.59	123	105	0.42	124	91	—	—	—
2008	0.25	120	117	0.61	110	113	0.49	106	114	—	—	—
2009	0.32	138	149	0.64	140	148	0.67	122	149	0.51	136	156
2010	0.30	134	150	0.34	123	145	0.37	113	133	0.58	125	161
2011	1.40	139	171	1.90	126	148	1.90	107	137	—	—	—
2012	<0.5	155	163	0.4	160	149	0.3	130	164	—	—	—
2013	0.4	139	135	0.4	104	107	0.4	137	130	0.4	185	148
2014	1.4	141	138	0.5	135	131	0.6	143	138	—	—	—
2015	<0.44	143	119	0.46	147	121	0.3	124	120	0.3	140	146
2016	1.1	107	154	1.3	105	150	0.4	94	128	<0.30	97	151
2017	<1.5	122	92	2.0	138	103	1.5	121	111	—	—	—
2018	<1.0	100	119	<1.3	143	1221	<1.00	123	122	—	—	—
2019	1.1	115	128	1.5	138	127	—	—	—	—	—	—
Average – 2010-2015	**0.74**	**142**	**146**	**0.67**	**133**	**134**	**0.65**	**126**	**137**	**0.43**	**150**	**152**
Average – 2014-2019	**1.1**	**121**	**125**	**1.2**	**134**	**309**	**0.76**	**121**	**124**	**0.30**	**119**	**149**
Average – 1992-2019	**0.61**	**125**	**113**	**0.99**	**127**	**150**	**0.80**	**117**	**110**	**0.45**	**128**	**116**

Table 6.5.5-1: Average Radioactivity in Flesh of Winnipeg River Fish, 1992 to 2019

Location and Year	Radioactivity (Bq/kg fresh weight)											
	White and Redhorse Sucker			Walleye			Northern Pike			Lake Whitefish		
	Cs-137	K-40	Gross Beta	Cs-137	K-40	Gross Beta	Cs-137	K-40	Gross Beta	Cs-137	K-40	Gross Beta
0 to 2 km Downstream of WL Site												
1992	1.65	115	87	3.66	110	90	2.54	115	90	4.28	127	87
1993	1.84	122	96	2.04	117	90	2.53	118	94	0.53	112	96
1994	1.81	112	104	2.35	116	101	2.62	103	100	0.55	111	102
1995	2.18	99	93	2.21	112	99	1.72	99	99	1.96	95	97
1996	2.87	120	92	3.26	136	103	4.63	114	99	1.56	121	90
1997	1.31	130	96	1.88	133	98	1.42	125	103	0.38	122	96
1998	1.03	109	87	1.96	150	108	1.94	118	98	0.45	140	115
1999	0.55	117	111	1.25	109	108	1.15	113	102	0.52	124	99
2000	0.71	117	88	1.12	124	93	1.12	112	88	—	—	—
2001	1.07	100	86	1.63	120	97	0.96	138	112	1.87	139	105
2002	0.70	139	99	1.69	135	99	1.04	137	103	0.59	139	100
2003	0.43	111	92	1.10	114	97	1.04	117	102	0.31	108	95
2004	0.51	118	101	1.13	144	109	0.76	111	103	0.56	142	111
2005	0.61	129	108	1	128	105	1.28	122	99	1.5	140	98
2006	0.61	114	95	1.07	103	97	0.8	112	91	0.67	115	95
2007	0.41	120	92	0.64	93	98	1.00	117	101	0.40	116	90
2008	0.37	118	119	1.01	123	120	0.93	110	135	0.22	105	124
2009	0.60	127	139	0.65	129	141	0.57	130	136	0.40	124	139
2010	0.57	131	136	0.86	128	130	—	—	—	—	—	—
2011	0.30	130	156	1.80	130	153	1.10	101	119	0.40	169	169
2012	0.4	130	152	0.7	123	148	0.2	139	156	0.4	155	156
2013	0.4	165	151	0.8	164	163	0.5	119	107	0.5	142	129
2014	0.3	147	145	1	143	144	0.4	105	112	0.4	140	146
2015	0.31	134	116	0.73	120	111	0.49	112	111	<0.29	127	120
2016	1	101	112	1.1	75	139	1.1	101	162	0.6	103	133
2017	<1.0	133	126	<2.5	150	139	2	103	108	2	99	136
2018	<1.0	129	113	<1.3	125	106	<1.0	121	94	—	—	—
2019	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Average – 2010-2015	**0.28**	**140**	**143**	**0.98**	**135**	**142**	**0.54**	**115**	**121**	**0.43**	**147**	**144**
Average – 2014-2019	**0.72**	**129**	**122**	**1.33**	**123**	**128**	**1.00**	**108**	**117**	**0.82**	**117**	**134**
Average – 1992-2019	**0.90**	**123**	**111**	**1.47**	**124**	**114**	**1.35**	**116**	**109**	**0.92**	**126**	**114**

Table 6.5.5-1: Average Radioactivity in Flesh of Winnipeg River Fish, 1992 to 2019

Location and Year	Radioactivity (Bq/kg fresh weight)											
	White and Redhorse Sucker			Walleye			Northern Pike			Lake Whitefish		
	Cs-137	K-40	Gross Beta	Cs-137	K-40	Gross Beta	Cs-137	K-40	Gross Beta	Cs-137	K-40	Gross Beta
5 km Downstream of WL Site												
1992	1.22	117	88	2.69	118	92	2.07	112	86	0.79	120	90
1993	1.56	120	96	2.46	122	100	1.32	62	91	0.66	120	100
1994	0.93	108	90	1.8	114	96	2.08	99	86	0.6	111	105
1995	1.41	102	93	1.9	109	97	1.53	99	95	0.51	91	91
1996	1.56	121	90	1.3	130	104	1.62	118	101	0.72	120	92
1997	—	—	—	—	—	—	—	—	—	—	—	—
1998	1.36	154	117	1.73	131	106	1.10	116	88	0.35	116	91
1999	0.56	109	101.88	1.85	128	104.8	1.22	111	99.39	0.39	99	83.23
2000	0.71	126	100	1.3	119	93	—	—	—	0.37	123	93
2001	0.94	128	101	1.77	143	100	0.94	118.9	93	0.33	131	103
2002	0.73	120	92	1.51	142	99	0.71	119	92	0.47	140	101
2003	0.65	114	99	0.95	130	100	0.74	125	103	0.32	109	95
2004	0.58	132	103	1	131	99	0.77	109	98	0.54	125	99
2005	0.78	125	104	1.6	140	107	0.94	121	96	—	—	—
2006	0.54	106	97	1.37	126	109	1.07	111	93	0.45	99	99
2007	0.35	122	93	0.97	134	95	0.90	112	94	0.5	122	105
2008	0.36	120	117	0.94	105	117	0.64	114.2	107	0.39	108	107
2009	0.43	120	144	0.64	132	144	0.57	107	127	0.37	125	132
2010	0.29	141	152	0.92	155	149	0.53	119	131	0.40	151	177
2011	0.27	130	156	1.32	124	140	0.79	107	138	0.50	141	161
2012	0.35	126	136	0.67	185	154	0.5	131	162	0.59	204	172
2013	0.47	134	151	0.86	136	137	0.65	128	116	0.4	138	128
2014	0.34	127	124	0.73	141	143	—	—	—	0.39	142	134
2015	<0.29	131	116	0.9	119	111	<0.52	106	103	<0.31	121	115
2016	1	89	151	<0.9	110	169	<0.3	84	166	0.7	102	158
2017	1.7	121	135	2.3	143	118	1.3	106	134	0.7	110	111
2018	<1.0	130	98	<1.0	143	115	1.5	111	112	1.4	125	132
2019	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Average – 2010-2015	**0.34**	**132**	**139**	**0.9**	**143**	**139**	**0.62**	**118**	**130**	**0.46**	**150**	**148**
Average – 2014-2019	**0.87**	**120**	**125**	**1.17**	**131**	**131**	**0.91**	**102**	**129**	**0.70**	**120**	**130**
Average – 1992-2019	**0.80**	**122**	**113**	**1.40**	**131**	**115**	**1.07**	**110**	**109**	**0.54**	**124**	**115**

Source: CNL 2018a (Table 6) and CNL 2020a.

— No data available; <= less than; Bq/kg = Becquerel per kilogram; Cs-137 = caesium-137; K-40 = potassium-40.

6.5.5.2.4 Benthic Macroinvertebrates and Zooplankton

The benthic macroinvertebrate community within a riverine system is often comprised of both infauna and epifauna. Typically, infauna are burrowing taxa that live in the sediment, whereas epifauna live on the sediment surface. Both types of macroinvertebrates can be important food sources for fish. Benthic fauna include protozoa, ostracods, nematodes, oligochaetes, leeches, mysids (opossum shrimp), crayfish, amphipods, mollusks (snails), bivalve clams (e.g., mussels) and immature stages of aquatic insects. The latter include dipteran larvae such as chironomids and *Chaoborus*, dragonflies nymphs, mayflies nymphs, caddisflies nymphs, true bugs and aquatic beetles (AECL 2001a).

Benthic invertebrate studies were undertaken on the Winnipeg River in the vicinity of the WL site by AECL (1973). The abundance and total beta activity of benthic organisms were determined during 1966 and 1967 upstream and downstream of the liquid effluent outfall. Tubificid worms, chironomid larvae and mayfly (*Hexagenia* spp.) nymphs were the most abundant species among a total of 20 benthic taxa collected. The radioactivity concentration ratios (total beta activity of organism/total beta activity of water) of these species was approximately 2. The range of individual diversity indices (d) obtained during the study was 2.45 to 2.94, indicative of mesotrophic conditions.

Wong et al. (1996) undertook studies downstream of the WL site near Pine Falls. Benthic invertebrates were collected in sediment dredge samples from the Winnipeg River, upstream and downstream of the Pine Falls pulp mill, and examined in order to assess the effects of mill effluent. Considerable organic enrichment was evident in sediments below the mill outfall based on ratios of organic carbon to total nitrogen. The zone below the outfall exhibited the highest density of invertebrates and the community was dominated by species noted to be tolerant to pollution. The benthic community below the outfall was comprised of 67% oligochaetes, 20% chironomids and 3% mayflies and caddisflies combined. In contrast, at upstream reference sites, oligochaetes comprised 18%, chironomids 23% and mayflies and caddisflies 44%. Visible deformities were evident in the mentum and mandibles of chironomids (*Chironomus)* collected below the outfall and the preponderance of deformities tended to decrease with increasing distance downstream of the mill. It was concluded that there was serious organic pollution along the south shore of the Winnipeg River for at least 2.5 km below the outfall.

The distribution of aquatic snails and their association with aquatic plants in nearby Whiteshell Provincial Park was documented by McKillop (1996).

Most recently, Manitoba Hydro (2011) undertook multi-year studies associated with the Pointe du Bois Generating Station that is situated approximately 55 km upstream of the WL site (see Figure 6.5.5-1). At Pointe du Bois, 42 sediment-dwelling macroinvertebrate taxa were collected. The majority of these were found in shallow habitats where sediments predominantly consisted of clay. Sediments in deeper habitats generally consisted of sand. For the most part, non-biting midges (Chironomidae) numerically dominated total benthic invertebrate abundance. Worms (Olichochaeta), amphipods (Amphipoda), mayflies (Ephemeroptera) and pea clams (Sphaeriidae) also were also common in sediments (Manitoba Hydro 2011). Macroinvertebrates collected in drift traps consisted of 64 discrete taxa, 44 of which were from the Class Insecta. During all years and within all study reaches, amphipods (Hyalellidae) and mites (Hydrachnidae) numerically dominated the non-insect group of the macroinvertebrates; whereas mayflies (Ephemeridae), stoneflies (e), caddisflies (Hydropsychidae) and non-biting midges (*Chironomidae*) were the numerically dominant insect groups.

A 2000 study found caesium-137 levels in clam shells and soft tissues collected downstream of the WL outfall to be slightly elevated compared to upstream (AECL 2001b). There was considerable variation in levels with slight trends to higher tissue concentrations nearer to the outfall and higher concentrations in larger (older) clams. The effect of exposure from radionuclides in sediments on aquatic biota was estimated in 2000 using

clams (AECL 2001b). The doses for the 99th and 99.9th percentile scenarios were 0.0106 milligray per day (mGy/day) and 0.0465 mGy/day (AECL 2001a), a small fraction of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR 2011) benchmark of 9.6 mGy/day and the limit at which no effect on aquatic populations would be expected.

Among the many species of zooplankton in Winnipeg River, rotifers, cladocera and copepod are usually dominant (AECL 2001a). Near Pointe du Bois Generating Station, total mean density (individuals/m^3) of zooplankton was relatively similar among years and Cyclopoida and Cladocera were the most abundant taxa, with Calanoida accounting for only 10% to 12% of the mean total collected (Manitoba Hydro 2011).

6.5.5.2.5 Fish Habitat

General physical habitat attributes of the river in the vicinity of the WL site include a width of approximately 0.3 km, a depth of 7 m and a flow velocity of approximately 0.3 m/s (AECL 2001a). Additional data on currents and velocities in the vicinity of the WL outfall are presented in AECL (1973). Typical baseflow at Seven Sisters Generating Station ranges seasonally between 600 and 1,200 m^3/s, but discharge rates in the order of 2,400 m^3/s and 220 m^3/s have been measured during flood and drought conditions, respectively (LWCB 2017). Downstream, channel width within the RSA reaches about 0.6 km. The shoreline consists of a steep clay till bank with frequent cobbles and some large boulders. The substrates are similar to the exposed stream banks and typical of an erosional habitat, largely comprised of gravel, cobbles and boulders, overlying dense clay (AECL 2001a). Gullies and ravines are found along the Winnipeg River. These gullies and ravines provide ideal habitat for beavers (Castor canadensis) and result in beaver ponds on-site. These ponds, however, are drained after a few years. The site also contains two sewage lagoons that support aquatic plants and animals. Man-made ditches that carry water during spring run-off are also present on the WL site but are not likely to provide an ideal aquatic habitat for plants and animals because they are dry in the summer (AECL 2001a).

Spawning habitat for several species, including Lake Sturgeon, Carmine Shiner, Walleye, Smallmouth Bass and suckers occurs 7 to 8 km upstream of the WL site, associated with the rapids downstream of the Seven Sisters Generating Station and Whitemouth falls (see Figure 6.5.5-1). Northern Pike spawning habitat would be more likely to occur downstream in Lac du Bonnet, although suitable spawning habitats may be present within the RSA, associated with the confluence of smaller tributaries. Optimal spawning habitat for Northern Pike is flooded vegetation in shallow, sheltered areas (Casselman and Lewis 1996), which is more often associated with lacustrine environments. Habitat use by fishes with the RSA would also include nursery, foraging and migration for species that spawn upstream.

Emergent macrophytes such as bulrushes (*Scirpus* spp.), cattails (*Typha* spp.) and wild rice (*Zizania palustris*) are found to a depth of about 1 m along the shores of the Winnipeg River. There are no major aquatic macrophyte beds on the WL site (AECL 2001a); however, in riverine environments, a relatively large amount of vascular plant and algal biomass is transported downstream by flowing water. A recent study undertaken upstream of the RSA, in the vicinity of Pointe du Bois Generating Station (see Figure 6.5.5-1), recorded at least 18 aquatic macrophyte taxa, collected from drift traps deployed in the main stem of the Winnipeg River (Manitoba Hydro 2011). Algae, mainly filamentous, were the most abundant type of vegetation collected in drift traps. Dominant macrophytes collected include pondweeds (*Potamogeton* spp.), grasses (Poaceae), sedges (Cyperaceae), rushes (Juncaceae), water milfoil (*Myriophyllum* spp.), wild celery (*Vallisneria americana)*, bladderworts (*Utricularia* spp.), spikerush (*Eleocharis acicularis*) and duckweed (*Lemna trisulca*). These aquatic plants would also be expected to occur within the RSA.

Phytoplankton (algae) of the Winnipeg River is comprised of a diverse assemblage of nearly all major algal taxonomic groups (AECL 2001a). Studies in upstream reaches have indicated the phytoplankton abundance and composition varies between years and among sites (Manitoba Hydro 2011). The overall mean phytoplankton biomass was 84,410 mg/m^3 and phytoplankton biomass peaked in August. Phytoplankton community composition dominance varied seasonally among chlorophytes, cyanophytes and diatoms.

6.5.5.2.6 Indigenous Traditional Knowledge

This section summarizes observations and concerns shared by Indigenous Nations in their Traditional Land Use and Occupancy Studies. The following are quotes relevant to the aquatic environment.

From the Sagkeeng First Nation:

> "*There's a lot of pickerel in there [Winnipeg River], so that was kind of a delicacy besides the sturgeon, eh? Most of the time … if you got sturgeon, they wouldn't cook it or do anything with it there. They'd always take it home and freeze it and whatever, keep for the winter kind of thing. Or send it to Winnipeg with the other family members, the ones that are going back to Winnipeg."* (Firelight Group Inc and Sagkeeng Anicinabe 2018)
>
> *"In that whole area, in that whole area of the Lac du Bonnet, Bird River…we would catch fish… [our father] used to catch sturgeon, and that's what we lived on… But I know that my dad used to come up into the Silver Falls area, up that way. There's an area just above the—between the two dams, I guess. And there used to be a lot of sturgeon there."* (Firelight Group Inc and Sagkeeng Anicinabe 2018)
>
> *"Yeah, he [husband] caught – I believe it was four pickerel or something but I don't believe he got any sturgeon. And because of what my dad had said [about contamination], we threw them back...we didn't keep them because we were still at that stage being told by my dad, although we were living in Winnipeg, we were told that the fish is not going to be good, like you were taking a chance eating that fish... We had already heard stories of deformed fish and things like that."* (Firelight Group Inc and Sagkeeng Anicinabe 2018)
>
> *"A lot of this fish [in the Winnipeg River] is spoiling…not that much at the spawns anymore because of oil and stuff getting into the – in the water, on the beds of these, where they spawn. It's just water and oil coming from the creeks and stuff like that. Where people, you know, farmers dump their oils and stuff like that instead of properly disposing them in, you know, where old oil should go and stuff like that. They just throw them in their creeks and stuff like that."* (Firelight Group Inc and Sagkeeng Anicinabe 2018)

From Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation:

> *My brother-in-law and sister-in-law are catching fish with deformities. They look at it and won't eat. That's pollution coming down the river. I'm concerned about the fish. That's how they make their living in Hollow Water."* (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019)
>
> *"It's not just about our drinking water. It's also got to do with our fisherman that fish in the lake. The fish have growths on them. Where does that come from? I can't rule out this Pinawa site as part of the problem."* (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019)

From the Manitoba Métis Federation:

> *"Interviewee: "I'll mention that it's all very good sturgeon habitat too. We don't harvest it. But the population was depleted, but the population is coming back up and hopefully someday we can start harvesting again."*
>
> *Interviewer 2: "In that same area?"*
>
> *Interviewee: "Oh yeah, in that same area right from CNL upstream, downstream, anywhere there.""* (SVS 2019)

For further information on how CNL incorporated traditional knowledge into the EIS refer to Section 4.3 Influence of Traditional Knowledge on the Environmental Assessment and to Section 5.0 of the Indigenous Engagement Report (CNL 2022) Traditional Land and Resources Use.

6.5.6 Project Interactions and Mitigation

6.5.6.1 Methods

This section describes the process by which interactions between Project components/activities and the aquatic environment were evaluated. Potential effect pathways were identified and mitigation developed, where possible, to eliminate and/or reduce effects. A pathways analysis was then used to focus the assessment on key interactions between the Project and the environment by evaluating the different effect pathways to assess if, after incorporating mitigation, there remained a potential to cause residual effects. Where effects were adequately mitigated and were not forwarded for further analysis (i.e., secondary pathways, or where mitigation removed the pathway altogether), the rationale for concluding the assessment at this stage were articulated. Primary pathways that may lead to residual effects after incorporation of mitigation are further characterized. As such, this section helps to focus the remainder of the assessment on those interactions (effects pathways) likely to result in residual adverse effects.

The first part of the analysis was to identify the potential effects pathways for all stages of the Project. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. The next step in the analysis was the development of environmental design features and mitigation practices that could be incorporated into the Project to eliminate and/or reduce effects to the aquatic environment. Environmental design features included design elements, environmental best practices and management policies and procedures.

After incorporation of mitigation, potential pathways were evaluated into the following categories using scientific knowledge, logic, experience with similar developments and the effectiveness of environmental design features and mitigation:

- **No linkage pathway** – pathway is removed by environmental design features or mitigation such that the Project would not be expected to result in a measurable environmental change relative to the Base Case, and therefore would have no residual effects on the aquatic environment.
- **Secondary pathway** – the pathway could result in a measurable minor change to features of the aquatic environment, but these changes would represent a negligible residual effect relative to the Base Case and are not expected to contribute cumulatively to other Project effects or to the effects of other past, present or reasonably foreseeable developments to cause a significant effect.

- **Primary pathway** – the pathway is likely to result in an environmental change relative to the Base Case that could contribute to residual effects to the aquatic environment.

Environmental design features and mitigation that have been or could be incorporated into the Project to eliminate and/or reduce adverse effects to the aquatic environment were considered. Potential pathways that were completely removed due to implementation of environmental design or mitigation were not assessed further. Pathways that were assessed to be secondary and demonstrated to have a negligible residual effect on the aquatic environment through simple qualitative or semi-quantitative evaluation of the pathway were also not advanced for further assessment. Primary pathways are carried forward for more detailed quantitative and qualitative effects analysis to characterize the residual effects of the Project on the aquatic environment.

6.5.6.2 Results

Pathways through which the Project may interact with the aquatic environment and result in changes to the fish and fish habitat VC are summarized in Table 6.5.6-1. Project activities are described in more detail in Section 3.5 Project Components.

Table 6.5.6-1: Pathways Analysis for Aquatic Environment Valued Components

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
Activities associated with in situ disposal of WR-1 and demolition of above-ground structures of the WR-1 Building	During closure activities, there is the potential for the transport of site runoff to the Winnipeg River.	■ Wastewater from decommissioning activities is collected and tested, and based on the results, is directed either to our waste treatment center, domestic drain, processed drain, ditch systems or is sent for evaporation and/or solidification and disposal. ■ Existing surface water management systems at the WL site will remain in place to manage site runoff.	No Linkage
Activities associated with in situ disposal of WR-1 and demolition of above-ground structures of the WR-1 Building	Non-radiological air emissions and dust emissions (including sulphur dioxide, nitrogen oxides [NOx/NO2] and particulate matter) and subsequent deposition.	■ Implementation of CNL's *Environmental Protection* (CNL 2021a) and *Management and Monitoring of Emissions* (CNL 2018b), which includes operational control monitoring, air verification monitoring and environmental monitoring. ■ Implementation of dust management techniques to control dust generated by the Project, consistent with the current Environmental Assessment Follow-up Program. ■ Use of contamination immobilization agents, containment, ventilation and HEPA filters to control generation of airborne emissions during decontamination or removal of contaminated systems or structures. ■ Use of dust suppression methods during building demolition or soil remediation activities to control airborne emissions and nuisance dust during building demolition or soil remediation. Methods may include: ▪ wetting techniques during demolition to limit mobility of dust; ▪ wind restrictions during demolition to stop work or apply wetting techniques; and ▪ hydro seeding during backfilling and landscaping to reduce soil erosion. ■ Road watering and chemical dust suppressant when necessary. Dust suppressant is already used annually at the site for select unpaved roads. ■ Removal of accumulations of particulates (e.g., dirt) on road as soon as possible. ■ On-site vehicles and equipment engines will meet Tier 3 emission standards, where possible, and be maintained in good working order. ■ Limit idling of vehicles on-site and speed on roads. ■ Use of tarps or 3-sided enclosures for raw material storage.	Secondary
Installation of concrete cap and engineered cover over grouted WR-1 Building during closure and final restoration	Installation of concrete cap and engineered cover at the WR-1 Building may alter drainage rates and flow patterns.	■ The Project site and engineered cover will be graded to promote drainage to the Winnipeg River.	Secondary

Table 6.5.6-1: Pathways Analysis for Aquatic Environment Valued Components

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
Closure of the entire WL site	Decommissioning and reclamation of the entire WL site, including the Project, may alter drainage rates and flow patterns.	■ The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-states. ■ The drainage system for the reclaimed WL site will have physical characteristics similar to the natural drainage systems in the general geographic region in terms of dynamic stability, robustness and longevity.	Secondary
Post-closure Performance	Release of chemical and radiological contaminants in the long-term during the post-closure phase from the Project.	■ The planned decommissioning of the WR-1 Building presently involves: ▪ removal the service area and infilling in these areas with compact soil; ▪ sealing of open conduits in the building foundation; and ▪ grouting the interior portion of the building (containing the remaining components of WR-1) to ground surface elevation. ■ As part of CNL's licence with the Canadian Nuclear Safety Commission, environmental monitoring around the WL site is required and will continue for the Project during the post-closure phase. ■ Follow-up monitoring during the post-closure phase will be completed to verify effects predictions and to provide information for use in adaptive management to address potential unforeseen effects.	Secondary
	Release of chemical and radiological contaminants in the long-term from the closure of the entire WL site, in combination with the Project.		Secondary

6.5.6.2.1 No Linkage Pathway

The following pathway was assessed as having no measurable environmental change and hence, no linkage to residual effects on VCs for the aquatic environment.

- **During closure activities, there is the potential for the transport of site runoff to the Winnipeg River.**

Drainage from the LSA is to the Winnipeg River. During closure phase activities, specifically those that are demolition-related, there is the potential for the transport of site runoff to the aquatic environment in the Winnipeg River in the vicinity of the WL site. Unabated, this runoff could negatively affect the aquatic environment through indirect habitat degradation (e.g., increase in suspended solids levels in water, increase in metal concentrations in water, swamping of the benthic environment through the settling of solids) that could result in reductions in diversity and abundance of aquatic biota in the nearshore area.

All wastewater generated at the LSA is managed in accordance with CNL's *Management and Monitoring of Emissions* (CNL 2018b) and is discharged in accordance with CNL's *Acceptability Criteria for Routine and Non-Routine Discharge of Liquids at CNL sites* (CNL 2021b). Wastewater from radiological drains and building sumps in nuclear buildings is collected by the Low Level Liquid Waste (LLLW) treatment systems in the individual buildings, where it is sampled, tested and approved for release to the Winnipeg River via the outfall station. Wastewater from non-radiological drains and process drains is directed to the stormwater system where it flows out to the outfall. Groundwater collected in building sumps of non-nuclear buildings is discharged into the stormwater system to the outfall station. Rainwater collected by the building roofs, paved areas, roads, and stormwater catchments is collected by the stormwater system and is directed to the outfall station. Building sanitary sewer systems drain to the site lagoon that consists of two interconnected cells, allowing water to flow freely between them. Annually, the cells are isolated from each other, so that the effluent in the secondary cell can settle and waste broken down. The secondary cell is then sampled and tested to ensure effluent water is safe to permit discharging into the ditch system that leads to the Winnipeg River. Mixed wastewater at the outfall is sampled and tested regularly.

Wastewater produced by decommissioning activities where potential radiological hazards exist, including excavation dewatering, is collected at the site in totes where it is sampled and tested to determine a discharge pathway. Wastewater is directed to the ground or ditch system only when the wastewater is tested to confirm that all contaminants are below concern levels. Where contaminants are above the release levels, the water is processed in the LLLW systems and then discharged to the river.

As per *Management of Land, Habitat and Wildlife* (CNL 2018c), any work within 30 m of rivers, streams and lakes must have preventative measures and mitigation in place. Best management practices already exist and will be fully implemented. General provisions adopted for work at CNL sites in or near a watercourse incorporate appropriate sediment retention measures such as silt curtains and straw bales.

It is also noted that closure phase activities will occur well away from the river and its riparian zone and therefore no direct habitat loss, either in terms of quality or quantity, will result. Consequently, this interaction was determined to have no effect on the maintenance of self-sustaining and ecologically effective fish populations, including species at risk.

6.5.6.2.2 Secondary Pathways

The following pathways were assessed as potentially having a measurable minor environmental change, but negligible residual effect on the aquatic environment relative to Base Case.

- **Installation of concrete cap and engineered cover at the WR-1 Building may alter drainage rates and flow patterns.**

Installation of concrete cap and engineered cover at the WR-1 Building may alter drainage rates and flow patterns, and consequently the discharge volume to Winnipeg River. This could in turn affect the quality and quantity of fish habitat in the Winnipeg River. Following the completion of closure activities, the Project site and engineered cover will be graded to promote drainage to the Winnipeg River. Run-off control for the cover is designed to limit erosion and infiltration of water into the grouted structure. This is achieved by sloping the cover surface to maintain slope toward the edges and the collection of water by the existing surface water management systems at the WL site. As part of the closure of the WL site, a storm water management plan will be developed using best management practices and taking into consideration the effect of the site's drainage following the demolition of the infrastructure (e.g., buildings, roads, catch basins, storm drainage system). Alternate drainage works (e.g., swales, ditches, culverts) along with aligning landscaping to the lines and grades so that proper drainage is achieved would be an output of this plan. Typically, the storm water will be directed to the Winnipeg River using existing topography's drainage paths (creeks) to the greatest extent possible.

Although the installation of the concrete cap and engineered cover at the WR-1 Building is expected to slightly alter the drainage rates and flow patterns and discharge volume to the Winnipeg River; the changes are expected to be within the natural range of variation (Section 6.4.1.5.2.3). As such, changes to the hydrology from the installation of the cover at closure is predicted to have a negligible effect on the maintenance of self-sustaining and ecologically effective fish populations, including species at risk.

- **Decommissioning and reclamation of the entire WL site, including the Project, may alter drainage rates and flow patterns.**

The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-states. The drainage system for the reclaimed WL site will have physical characteristics similar to the natural drainage systems in the general geographic region in terms of dynamic stability, robustness and longevity. The contribution to site runoff from the Project is expected to be minor relative to the entire decommissioned WL site. Similar to the decommissioning plan for the Project, the WL site will be graded to promote drainage to the Winnipeg River; therefore, limiting changes to fish and fish habitat in the Winnipeg River. Although closure of the WL site may slightly alter the drainage rates and flow patterns and discharge volume to the Winnipeg River; the changes are expected to be within the natural range of variation. As such, changes to hydrology from the closure of the WL site, including the Project, are predicted to have a negligible effect on the maintenance of self-sustaining and ecologically effective fish populations, including species at risk.

- **Release of chemical and radiological contaminants in the long-term during the post-closure phase from the previous activities completed at the WL site.**

The Comprehensive Study Report (AECL 2001a) indicated residual effects on surface water, particularly the Winnipeg River, are related to discharges from the Active Liquid Waste Treatment Centre and the sewage lagoon. No decrease in water quality is expected and effluent emissions to the Winnipeg River are expected to decline to virtually zero following decommissioning. Re-suspension of contaminated sediments is also not expected to lead

to a decrease in water quality. As part of CNL's licence with the Canadian Nuclear Safety Commission (CNSC), environmental monitoring around the WL site will continue for the Project. Follow-up monitoring during the post-closure phase will continue to verify effect predictions and to provide information for use in adaptive management to address potential unforeseen effects. Consequently, changes to surface water quality from the closure of the WL site, are predicted to have a negligible effect on the maintenance of self-sustaining and ecologically effective fish populations, including species at risk.

- **Non-radiological air emissions and dust emissions (including sulphur dioxide, nitrogen oxides [NOx/NO_2] and particulate matter) and subsequent deposition.**

Construction and operation of the Project will generate air and dust emissions such as carbon monoxide (CO), oxides of sulphur (SO_x includes sulphur dioxide [SO_2]), oxides of nitrogen (NO_x includes nitrogen dioxide NO_2), particulate matter ($PM_{2.5}$, PM_{10}) and suspended particulate matter (SPM). Air emissions, such as SO_x and NO_x, can result from the use of fossil fuels in generators, vehicles and machinery. Vehicle exhaust and fugitive dust from roads is the largest contributor to particulate matter (SPM, PM_{10} and $PM_{2.5}$) during both construction and operations phases (Section 6.2.1.7.2).

Examples of mitigation implemented to limit predicted residual effects from Project emissions to air quality (and subsequently surface water quality) include:

- implementation of CNL's Environmental Protection Program and *Management and Monitoring of Emissions*, which includes operational control monitoring and air verification monitoring;
- use of dust suppression methods during building demolition or soil remediation activities to control airborne emissions and nuisance dust during building demolition or soil remediation. Methods may include:
  - wetting techniques during demolition to limit mobility of dust;
  - wind restrictions during demolition to stop work or apply wetting techniques; and
  - hydro seeding during backfilling and landscaping to reduce soil erosion.
- apply road watering and chemical dust suppressant when necessary (dust suppressant is already used annually at the site for select unpaved roads);
- removal of accumulations of particulates (e.g., dirt) on road as soon as possible; and
- use of tarps or 3-sided enclosures for raw material storage.

The predicted residual effects air quality were estimated to increase because of the Project. Fugitive dust from roads is the largest contributor to SPM emissions. Material handling from demolition is the largest contributor to PM_{10} emissions. Non-road equipment exhaust emissions are the largest contributors to $PM_{2.5}$ and NOx (as NO_2) emissions. Finally, the largest contributor to SO_2 and CO emissions is fuel combustion for emergency power generators. Predicted concentrations for the Application Case are below applicable air quality guidelines and/or standards (Section 6.2.1.7.2).

Mitigation of fugitive dust emissions is provided in Table 6.2.1-10 (Pathways Analysis for the Air Quality Valued Component) and includes the use of contamination immobilization agents, containment, ventilation and High-efficiency Particulate Air (HEPA) filters to control generation of airborne emissions during decontamination or removal of contaminated systems or structures. In addition, use of dust suppression methods during building demolition or soil remediation activities will be implemented to control airborne emissions and nuisance dust during

building demolition or soil remediation. Consequently, air emissions are predicted to be below applicable air quality guidelines and/or standards as discussed in Section 6.2.1.7.2 (Application Case Results), and will not impact the surrounding aquatic environment.

CNL recently demolished a number of other buildings at the WL site. The mitigation listed above was applied and successfully reduced SPM emissions which ultimately reduce subsequent deposition. It is expected that this same mitigation will also be effective during the demolition of the WR-1 building. Therefore, with the implementation of CNL's *Management and Monitoring of Emissions*, air and dust emissions and subsequent deposition are expected to result in local, minor changes to soil quality relative to Base Case conditions. As such, this pathway is determined to result in a negligible effect on the maintenance of self-sustaining and ecologically effective aquatic populations, including species at risk.

- **Release of chemical and radiological contaminants in the long-term during the post-closure phase from the Project.**

Successful closure of the WR-1 Building will require that the dose limit is not exceeded for the protection of aquatic health. The planned decommissioning of the WR-1 Building presently involves removal the service area and infilling in these areas with compact soil, sealing of open conduits in the building foundation and grouting the interior portion of the building (containing the remaining components of WR-1) to ground surface elevation.

An Ecological Risk Assessment (EcoMetrix 2021) was completed to evaluate the potential for adverse effects on aquatic health associated with exposure to chemical and radiological contaminants from the Project (Section 6.7.2) in the long-term. For the post-closure phase, the relevant chemical and radiological contaminants may be released over time by a combination of diffusion and advection through the grout and concrete barriers to groundwater and subsequent migration of groundwater to surface water at the Winnipeg River. The risk assessment utilized groundwater release rates (see Section 6.4.2.7.1.1 Groundwater Release Rates) and dispersion modelling to estimate radionuclide concentrations in surface water (see Section 6.4.2.7.1.2 Dispersion Modelling), to calculate dose rates to aquatic biota. These dose rates were compared to international standards (UNSCEAR 2011) and used as a surrogate to assess effects to resident fish and benthos.

The incremental change in radionuclide levels in the Winnipeg River as the result of the transport of radionuclides from the WR-1 Building to the Winnipeg River via groundwater in the post-closure phase is predicted to be not practically distinguishable from background levels (see Section 6.4.2.7.2 Application Case Results) and, therefore, no negative effects on the quality or quantity of available fish habitat in the RSA are anticipated as the result of decommissioning.

During the closure and post-closure phases, there are no exceedances of the 9.6 mGy/day radiation benchmark for the aquatic biota in the Winnipeg River. All predicted doses are well below these levels. Therefore, based on the assessment completed in Section 6.7.2.7 Residual Effects Analysis, it is unlikely there would be significant adverse effects on aquatic populations or communities as a result of radionuclide releases from closure activities or in the long-term during the post-closure phase.

There are no exceedances of the HQs identified for exposure of the aquatic receptors to cadmium, lead, HB-40 (with the exception of benthic invertebrates in groundwater) and xylene. The HQs for cadmium, lead and HB-40 exceeded 1 for the scenario where benthic invertebrates are exposed directly to groundwater. However, this does not necessarily imply a significant adverse effect. Sessile organisms, such as benthic invertebrates may be more directly exposed to groundwater, if inhabiting the point of discharge. The assessment conservatively assumes the

organisms spend their entire lives in the peak discharge zone, and that no dilution of the groundwater occurs in the shallow sediment layers where most benthic organisms reside. Moreover, the seepage area represents a small part of the benthic community habitat, and the maximum groundwater concentration assumed represents the worst case time period. As such, a realistic benthic invertebrate population is not likely to be at risk due to cadmium, lead and HB-40 exposure, and any adverse effects will be spatially and temporally limited. Overall, the changes in water quality and sediment quality are expected to result in a negligible residual effect to the benthic invertebrate population relative to existing conditions.

Table 6.5.6-2: Post-closure Maximum Total Radiological Dose to Aquatic Biota in the Winnipeg River

Aquatic Biota	Maximum Total Dose (mGy/day)
Carmine Shiner	1.14×10^{-04}
Lake Sturgeon	1.14×10^{-04}
Walleye	4.10×10^{-06}
Aquatic Macrophytes	4.26×10^{-06}
Benthic Invertebrates (River Water)	5.77×10^{-04}
Benthic Invertebrates (Groundwater)	5.71
Benchmark (UNSCEAR 2011)	**9.6**

mGy = milligray.

The dominant contributor to the total dose is caesium-137 due to external exposure to sediment; however, the caesium-137 sediment concentrations are based on existing conditions and do not result from the source-term in the post-closure period. Based on the source-term concentrations expected to be released to groundwater during post-closure, the largest contributor to dose during post-closure is carbon-14. Baseline data for carbon-14 in fish flesh were not available. It is expected that the predicted incremental change in carbon-14 in fish flesh (5.8 Bq/kg fresh weight) is not a measurable change from baseline, because carbon-14 global background levels are high, supported by natural production due to cosmic irradiation in the upper atmosphere. Carbon-14 is readily exchanged between atmospheric radioactive carbon dioxide and stable carbon in surface water and fish flesh. A typical background level measured in Great Lakes fish is 240 Bq/kg-carbon (OPG 2013; Bruce Power 2013), which is equivalent to approximately 29,000 Bq/kg fresh weight, much higher than the predicted change. Plutonium-239 and tritium (tritiated water and organically bound tritium) are minor contributors to dose (1% or less). Tritium is also unlikely to be detectable against the natural background in fish flesh.

In consideration of these results, decommissioning of the WR-1 Building is not expected to adversely affect radionuclide levels in aquatic biota flesh during the post-closure phase. As part of CNL's licence with the CNSC, environmental monitoring around the WL site is required. The current program includes collecting fish flesh at one location upstream and two locations downstream of the WL site (CNL 2016). Follow-up monitoring might include both carbon-14 and tritium in the radiochemical analyses of fish, to confirm that there is no measurable upstream-downstream difference, as expected. Monitoring of both surface water quality and fish flesh will continue into the post-closure period. Overall, changes to surface water quality from the Project, are predicted to have a negligible effect on the maintenance of self-sustaining and ecologically effective fish populations, including species at risk.

- **Release of chemical and radiological contaminants in the long-term from the closure of the entire WL site, in combination with the Project.**

Historically, liquid effluent from the Active Liquid Waste Treatment Center was discharged to the Winnipeg River and elevated radionuclide concentrations were measured in sediments in the local outfall area (AECL 2001a). Exposure pathways to aquatic biota include radiation from nuclides in the water and sediment. An immeasurable increase in radionuclide concentrations in water and sediments are anticipated once groundwater from the WL site reaches the river (during the post-closure period). The effect of exposure from radionuclides in sediments on aquatic biota was estimated in 2000 using clams (AECL 2001b). The study found caesium-137 concentration in shells and tissues collected downstream of the WL outfall to be slightly elevated (AECL 2001b). Given the erosional nature of the Winnipeg River in the vicinity of WL site, it would be highly unlikely that residual sediment contamination would persist for a century. Regardless, cumulative (residual plus incremental groundwater concentrations from the Project during the post-closure period) doses to aquatic biota would remain a small fraction of the UNSCEAR (2011) benchmark of 9.6 mGy/day and the limit at which no effect on aquatic populations would be expected. Follow-up monitoring during the post-closure phase will be completed to confirm radionuclide concentrations in both surface water quality and fish flesh will verify the anticipated low effects (or lack thereof) and provide information for use in adaptive management to address potential unforeseen effects. Overall, changes to surface water quality from the closure of the WL site, including the Project, are predicted to have a negligible effect on the maintenance of self-sustaining and ecologically effective fish populations, including species at risk.

6.5.6.2.3 Primary Pathways

No primary pathways were identified between the Project and the aquatic environment. As discussed in Section 6.5.6.2.2, the dose and risk to fish from predicted loadings to the Winnipeg River were well below the dose benchmark from UNSCEAR (2008) and the HQ target value from *CSA N288.6-12: Environmental Risk Assessment at Class 1 Nuclear Facilities and Uranium Mines and Mills* (CSA Group 2012). As such, a residual effects analysis and determination of significance has not been completed for the aquatic environment assessment.

6.5.7 Monitoring and Follow-up

Monitoring and follow-up programs for the aquatic environment are not identified specific to the Project as there are no predicted residual effects to fish and fish habitat. However, CNL will implement an Environmental Assessment Follow-up Program for the Project as identified for other environmental components (e.g., groundwater quality and surface water quality) to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. For example, environmental monitoring will be completed throughout the institutional control period to confirm that the WRDF barriers are functioning as intended. This monitoring will be integrated into the overall CNL WL Groundwater Monitoring Program to verify that changes to surface water quality, and subsequently fish and fish habitat, as a result of groundwater are negligible. In addition, CNL's *Management and Monitoring of Emissions* will include monitoring objectives air quality to verify that air emissions during closure have a negligible effect on surface water quality, and subsequently fish and fish habitat. This monitoring will be integrated with that for the existing Environmental Assessment Follow-up Program for the WL site, where practical.

As part of CNL's licence (NRTEDL-W5-8.00/2024), CNL's existing Environmental Monitoring Program includes water monitoring and collecting fish flesh at one location upstream and two locations downstream of the WL site (CNL 2016). Although not specific to the Project, this monitoring will also verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. CNL will continue to carry out the existing Environmental Assessment Follow-up Program for the WL site as it is a requirement of CNL's current licence (NRTEDL-W5-8.00/2024) with the CNSC.

It is noted that data generated by the monitoring program will be evaluated on an ongoing basis within an adaptive management framework. Within this framework, modifications to the program may be appropriate to confirm data continue to fulfill program objectives. For example, should a contaminant of potential concern reach concentrations outside the range predicted in the EIS or the Decommissioning Safety Assessment Report (Golder 2021), including the findings from the Ecological Risk Assessment, the frequency of sampling may be increased and additional locations may be sampled to investigate the source of the increased concentrations. Conversely, cessation of a monitoring activity might be appropriate once it has been shown that an effect has stabilized, or has been reduced to a level where it is no longer considered significant with respect to regulatory requirements or community concerns. Any proposals for modifications to the monitoring program and the rationale for the modifications will be communicated to the CNSC prior to implementation. Additional information on the Environmental Assessment Follow-up Program for the Project can be found in Section 11.0 Summary of Monitoring and Follow-up Programs.

- CNL continues to adapt their environmental monitoring approach in support of fish monitoring and protection of the Winnipeg River. CNL presented on their environmental monitoring program during a fish monitoring workshop with Sagkeeng First Nation representatives, including topics on how fish are sampled, explanation of the results, and trends and what they mean. CNL environmental protection staff also engaged with the Manitoba Métis Federation, Brokenhead Ojibway Nation, Black River First Nation, Hollow Water First Nation, and Wabaseemoong Independent Nations and explained the annual monitoring campaign that has occurred since the inception of the site, such as fish sampling. The CNSC conducted an independent monitoring campaign with assistance from Sagkeeng First Nation. The independent program included collecting and analyzing fish caught near Sagkeeng First Nation. The results of the independent monitoring campaign concluded that fish in the vicinity of the WL site are protected.
- CNL will continue to proactively seek, engage, and support meaningful discussion on issues and opportunities related to the Project, including the monitoring and follow-up program, with First Nations and the Manitoba Métis Federation and communities of interest. CNL has also had discussions with First Nations and the Manitoba Métis Federation on how future monitoring on the WL site could incorporate Indigenous interests, such as monitoring of country harvested foods. CNL will continually evaluate both the process and the outcome of the ongoing engagement and communication activities, to address and manage issues as they arise.

6.5.8 Conclusions

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). For the aquatic environment, fish and fish habitat was selected as a VC, as there is a potential for the Project activities to affect aquatic biota in the Winnipeg River. The fish and fish habitat VC includes the fish species identified by Indigenous Nations that are occurring in the Winnipeg River, as well as habitats supporting life history requirements including spawning, nursery, rearing and foraging The assessment endpoint for the aquatic environment is the maintenance of self-sustaining and ecologically effective fish populations. Fish habitat, benthic macroinvertebrate community structure, fish community structure and fish flesh radiochemistry were selected as the measurement indicators for the aquatic environment VCs.

During closure, potential effects to fish and fish habitat during closure include the transport of site runoff to the aquatic environment in the Winnipeg River in the vicinity of the WL site, changes in drainage rates and flow patterns due to the installation of the concrete cap and engineered cover at the WR-1 Building, and air emissions from demolition activities. As part of the closure of the WL site, a storm water management plan will be developed using best management practices and taking into consideration the effect of the site's drainage following the demolition of the infrastructure (e.g., buildings, roads, catch basins, storm drainage system). Alternate drainage works (e.g., swales, ditches, culverts) along with aligning landscaping to the lines and grades so that proper drainage is achieved would be an output of this plan. With Implementation of CNL's *Management and Monitoring of Emissions*, air and dust emissions and subsequent deposition are not predicted to impact the surrounding aquatic environment. As such, closure activities are predicted to have a negligible effect on the maintenance of self-sustaining and ecologically effective fish populations, including species at risk.

For the post-closure phase an Ecological Risk Assessment (EcoMetrix 2021) was completed to evaluate the potential for adverse effects on aquatic health associated with exposure to chemical and radiological contaminants from the Project in the long-term. In the post-closure phase, there are no exceedances of the 9.6 mGy/day radiation benchmark for the aquatic biota in the Winnipeg River and all predicted doses are well below this level. Therefore, based on the assessment completed in Section 6.7.2, it is unlikely there would be significant adverse effects on aquatic populations or communities as a result of radionuclide releases from closure activities or in the long-term during the post-closure phase.

There are no exceedances of the HQs identified for exposure of the aquatic receptors to cadmium, lead, HB-40 (with the exception of benthic invertebrates in groundwater) and xylene. The HQs for cadmium, lead and HB-40 exceeded 1 for the scenario where benthic invertebrates are exposed directly to groundwater. However, this does not necessarily imply a significant adverse effect. Sessile organisms, such as benthic invertebrates may be more directly exposed to groundwater, if inhabiting the point of discharge. The assessment conservatively assumes the organisms spend their entire lives in the peak discharge zone, and that no dilution of the groundwater occurs in the shallow sediment layers where most benthic organisms reside. Moreover, the seepage area represents a small part of the benthic community habitat, and the maximum groundwater concentration assumed represents the worst-case period. As such, a realistic benthic invertebrate population is not likely to be at risk due to cadmium, lead and HB-40 exposure, and any adverse effects will be spatially and temporally limited. Overall, the changes in water quality and sediment quality are expected to result in a negligible residual effect to the benthic invertebrate population relative to existing conditions.

First Nations and the Manitoba Métis Federation have interest in the current and future monitoring proposed for the Project. CNL continues to adapt their environmental monitoring approach in support of fish monitoring and protection of the Winnipeg River. CNL will continue to proactively seek, engage, and support meaningful discussion on issues and opportunities related to the Project, including the monitoring and follow-up program, with First Nations and the Red River Métis and communities of interest.

6.6 Terrestrial Environment

This section of the Environmental Impact Statement (EIS) characterizes potential residual effects of the Project on the terrestrial environment, including potential effects on the ecological and biological processes that connect species with each other and their physical environment.

6.6.1 Scope of the Assessment

The scope of the assessment focuses on the evaluation of potential changes in the terrestrial environment that may result from activities associated with the Project. Risks to ecological health as the result of chemical and radiological exposures are discussed in detail in Section 6.7 Human and Ecological Health. Results of this assessments are used to support the assessment of effects on the terrestrial environment.

The terrestrial environment assessment follows the overall environmental assessment approach and methods described in Section 6.1 Environmental Assessment Approach. The assessment is completed in the following steps:

- **Step 1 – Identify Valued Components (VCs) and define the spatial boundaries, temporal boundaries and assessment cases** (refer to Sections 6.6.3 Valued Components and Section 6.6.4 Assessment Boundaries) for the terrestrial environment assessment. The VCs, assessment endpoints and measurement indicators used to assess project-related changes to the terrestrial environment, the spatial and temporal boundaries at which the assessment occurred, and the assessment cases considered are described.
- **Step 2 – Describe the existing conditions** (refer to Section 6.6.5 Description of the Environment). Existing conditions in the local and regional areas are described, including the combined effects of previous and existing developments (Base Case). The existing environment represents the historical and current environmental pressures that have shaped the observed patterns in the environment (i.e., natural variation).
- **Step 3 – Evaluate Project interactions and mitigation** (refer to Section 6.6.6 Project Interactions and Mitigation). Project components and/or activities with the potential to affect the terrestrial environment are identified and mitigation options are presented to limit or avoid these effects. A pathways analysis is then used to focus on key interactions between the Project and the environment and determine if mitigation can limit or eliminate the predicted residual effects. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. Where effects are adequately mitigated and are not forwarded for further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are described.
- **Step 4 - Present the methods and results of the residual effects analysis**. This step was not required as no primary pathways were identified in the terrestrial assessment.
- **Step 5 - Describe the level of certainty and management of uncertainty.** This step was not required as no primary pathways were identified in the terrestrial assessment.
- **Step 6 – Classify and determine the significance of the predicted residual effects.** This step was not required as no residual effects to terrestrial VCs were identified.
- **Step 7 – Identify monitoring and follow-up** (refer to Section 6.6.7 Monitoring and Follow-up) required to confirm effects predictions and address uncertainty.

- **Step 8 – Present a consolidated summary of conclusions and outcomes of the assessment** (refer to Section 6.6.8 Conclusions) of residual effects on the terrestrial environment.

6.6.2 Indigenous Engagement Feedback – Key Interests and Concerns

Interests and concerns raised by Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations during engagement related to the terrestrial environment assessment are summarized in Table 6.6.2-1. Other general concerns and questions raised during Indigenous engagement activities are documented in Section 4 Indigenous Engagement.

Table 6.6.2-1: Summary of Key Interests and Concerns Raised During Indigenous Engagement Activities Related to the Terrestrial Environment Assessment

Interest and Concern	Inclusion Status	Additional information and Rationale
Migratory Birds	Already included in the environmental assessment	Migratory birds are encompassed by assessment of most sensitive species (Golden-winged warbler and barn swallow). See Section 6.6.3 Valued Components.
Effects on Harvesters ■ Consuming deer and Moose ■ Consuming harvested foods and medicinal plants ■ Importance of the Winnipeg River for the harvesting of waterfowl	Already included in the environmental assessment Moose and weekay were added to the Harvester's diet in post-closure Assessment	Effects on harvesters during the closure and post-closure phases from the consumption of deer, moose and plants are assessed in 6.7.1.7Residual Effects Analysis. The effects on the ability to harvest and hunt foods is assessed in Section 6.8.1.6 Project Interactions and Mitigation.
Effects on the Health of Plants and Wildlife Important to Indigenous People ■ White-tailed Deer ■ Moose ■ Weekay ■ Berries	White-tailed deer and berries were already included in the environmental assessment Weekay was already included in the environmental assessment through the 'Aquatic Plants' VC. Moose was added as a VC to the Ecological Health Assessment	The VCs assessed in the Ecological Health Assessment are listed in Section 6.7.2.3 Valued Components. Effects on wildlife health are summarized in Section 6.7.2.7 Residual Effects Analysis (Tables 6.7.2-8 and 6.7.2-10). Weekay is an aquatic plant and is represented by the Freshwater Plant category in Section 6.7.2.7.2.2. Forage plants, grasses and fruits (berries) are addressed in Section 6.7.2.7.1.2.

6.6.3 Valued Components

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). They are elements of the environment that are considered to have economic, social, biological, conservation, aesthetic and/or ethical value. Identifying VCs helps to focus the assessment on the most important or representative components of the environment that are likely to be affected by the Project. This section describes how VCs were selected for the terrestrial environment assessment and identifies the assessment endpoints and measurement indicators that were used to assess the effects of the Project on each VC. Because this assessment is for a designated project, as described in the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) and is regulated by the Canadian Nuclear Safety Commission (CNSC), VC selection considered guidance from Appendix A of the CNSC's *REGDOC-2.9.1, Environmental Principles, Assessments and Protection Measures* (CNSC 2020). Specifically, VC selection focused on providing a "*full accounting of effects on species with elevated conservation status and their habitat*" (CNSC 2020).

Based on the nature of this project and limited pathway of effects on natural terrestrial ecosystems, the focus of this assessment is at a species-level and primarily focuses on wildlife species identified on Schedule 1 of the federal *Species at Risk Act* (SARA). On a federal level, designations for species at risk occurring in Canada are initially determined by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). If approved by the federal Minister of the Environment, species are added to the federal List of Wildlife Species at Risk under Schedule 1 of SARA. Once included on Schedule 1, it is prohibited to kill, harm, harass, capture, possess, collect, buy, sell, or trade individuals, as well as damage or destroy the residence of a species listed as Extirpated, Endangered or Threatened. Furthermore, species that are included on Schedule 1 as Extirpated, Endangered or Threatened are afforded protection of species-specific critical habitat on federal lands (such as the WL site), once critical habitat is defined in a recovery strategy.

Baseline wildlife data were compiled for the WL site based on incidental observations by staff collected from 2014 to 2021, targeted surveys for species at risk in 2015 (i.e., bats and barn swallow), song bird automated recording unit acoustic surveys during the late breeding period from June 12 to July 3, 2018 and early breeding period from May 9 to June 10, 2019 (Dillon 2019a,b), and daytime visual searches for roosting bats in the interior of the WR-1 building conducted by CNL staff in 2021 on 4 dates (July 20, 21, 27 and 28) (McKinnon et al. 2022). There has also been a spatial query conducted by Manitoba Conservation Data Centre to determine the potential for 33 species at risk (animals and plants), to occur within the RSA (CNL 2016a). Staff observation records and wildlife surveys have confirmed the presence of nine terrestrial wildlife species at risk listed on Schedule 1 of SARA within the WL site (Appendix 6.6-1).

All SARA-listed species identified in Appendix 6.6-1 with confirmed observation records within the WL site (the Regional Study Area: RSA), as well as all species returned from the Manitoba Conservation Data Centre query with the potential to occur within the WL site, were considered as potential VCs at the species level. Each species was evaluated to determine whether or not its presence was likely within the Site Study Area (SSA) or the Local Study Area (LSA) defined for the terrestrial environment assessment (Section 6.6.4.1 Spatial Boundaries). Species with a very low likelihood of occurrence, for which habitat was not present in the LSA, or for which measurable effects from the Project were unlikely or suitably considered by another indicator species, were excluded as VCs. Rationale for inclusion or exclusion species at risk with confirmed or potential presence within the WL site is presented in Appendix 6.6-1.

Species at risk identified as VCs for the terrestrial environment assessment are presented in Table 6.6.3-1. Individual species for which the potential effects of the Project are similar were grouped into a single VC (e.g., bats; Table 6.6.3-1). Both avian VC species (barn swallow and golden-winged warbler) are also protected by additional federal legislation (*Migratory Birds Convention Act, 1994* [MBCA]). Section 5 of the MBCA prohibits the disturbance, destruction or removal of a nest or related shelter, or egg of a migratory bird, or possession of a live migratory bird, or a carcass, nest or egg of a migratory bird. The Project has the potential to affect migratory birds and adherence to the MBCA 1994 is required as part of the Project works. Because the RSA is a federally owned site, the applicable legislation for wildlife species protection is SARA. However, CNL also recognizes the importance of protecting species designated under provincial legislation (i.e., the provincial *Endangered Species and Ecosystems Act, C.C.S.M. c. E111*; ESEA).

Most of the VCs identified for the terrestrial assessment can also be used as indicators for broader groups of species. For example, golden-winged warbler represents migratory bird species that may breed in the edge habitat within adjacent forested areas and could be affected by decommissioning-related noise. Snapping turtle represents herptile species vulnerable to mortality on roadways. Consequently, understanding the potential effects of the Project on the selected VCs provides inferences about effects on other wildlife species or guilds with similar life history traits and habitat requirements (Appendix 6.6-1).

Predicted doses of radiation through relevant pathways to deer (closure phase) and waterfowl (post-closure phase) were assessed in the Environmental Risk Assessment (see Section 6.7 Human and Ecological Health). Potential risks to waterfowl were only assessed for the post-closure phase because there was determined to be an absence of a significant aquatic source in the closure phase. Potential risks to deer were assessed for the closure phase, but not post-closure phase since exposure to radionuclides were predicted to be minimal (i.e., only from drinking water from the Winnipeg River). The Environmental Risk Assessment found the predicted doses would be far below any effect level to these wildlife groups. As a result, because there was predicted to be no potential for adverse effects, large mammals (such as deer) and waterfowl were not selected as VCs for assessment of effects on the terrestrial environment.

Table 6.6.3-1: Valued Components for Terrestrial Environment Assessment

Valued Component	Rationale for Selection
Barn Swallow	■ Barn swallow (*Hirundo rustica*) has been recently downgraded to Special Concern by COSEWIC, but is federally listed as Threatened under SARA (as amended February 2022) and is listed under the MBCA. It has legal individual and habitat protection provisions under SARA and individual and nest protection under the MBCA. ■ Because the WL site is federally-owned, critical habitat of the species will be afforded protection under SARA, once the features of critical habitat have been defined in a federal recovery strategy. A federal recovery strategy for barn swallow has not yet been prepared. ■ There is the potential for barn swallow to be indirectly and directly affected by the Project through sensory disturbance, habitat loss and mortality. Barn swallows have been observed nesting within the WL main campus.

Table 6.6.3-1: Valued Components for Terrestrial Environment Assessment

Valued Component	Rationale for Selection
Golden-winged warbler	■ Golden-winged warbler (*Vermivora chrysoptera*) is federally listed as Threatened under SARA (as amended February 2022) and listed under the MBCA. It has legal individual and habitat protection provisions under SARA and individual and nest protection under MBCA. ■ As the RSA is federally-owned, this species is afforded protection of critical habitat because it is listed as Threatened on Schedule 1 of SARA. Critical habitat has been partially defined for this species in the federal recovery strategy. ■ There is the potential for golden-winged warbler to be indirectly affected by the Project through sensory disturbance (i.e., noise created by decommissioning activities). ■ Avian species with the potential to occur within the WL site (no confirmed observation records to-date), that represents a guild of edge habitat specialists.
Bats ■ Little brown myotis ■ Northern myotis	■ Little brown myotis (*Myotis lucifugus*) and northern myotis (*M. septentrionalis*) have observation records within the WL main campus. Both bat species are federally listed as Endangered (as amended February 2022) and have legal individual protection provisions under the federal SARA. ■ As the WL site is federally-owned, these bat species are afforded protection of critical habitat because they are listed as Endangered on Schedule 1 of SARA. ■ Critical habitat has only been “partially identified”, for one life history requirement and habitat type (overwintering habitat), as the largest threat to these species is associated with that habitat type. No active hibernacula have been identified in the WL site and the geological conditions make the presence of caves or exposed bedrock highly unlikely (See Section 6.3.1.5 Description of the Environment). ■ Other critical habitat types that are identified, but not yet legally defined and protected as “critical habitat”, include: roosting, foraging and swarming habitat. ■ Maternity roost habitat for little brown myotis and northern myotis is potentially present in the treed areas of the WL site surrounding the WL main campus. There is the potential for both species to be indirectly affected by the Project through sensory disturbance and related habitat avoidance (caused by noise associated with decommissioning activities and potential roost abandonment). ■ Maternity roost habitat for little brown myotis is also potentially present in the WR-1 Building, and little brown myotis have the potential to be indirectly and directly affected by the through disturbance, habitat loss and mortality. ■ Represents small mammal species recorded in the WL main campus that may utilize buildings for part of their life history (maternity roosting, diurnal roosting and evening roosting).
Snapping Turtle	■ Snapping turtle (*Chelydra serpentina*) have been observed within the WL site. They are federally listed as Special Concern under SARA (as amended February 2022), but they do not have legal individual protection provisions under the Act, nor do they receive protection of critical habitat. ■ There is the potential for snapping turtle to be indirectly and directly affected by the Project through sensory disturbance (noise) and mortality (i.e., vehicle strike on roads). All snapping turtle observations to-date within the WL site have been on roads. ■ Represents herpetile species that are vulnerable to mortality on roadways.

Note: Each VC was assessed using the assessment endpoints and measurement indicators listed in Table 6.6.3-2. COSEWIC = Committee on the Status of Endangered Wildlife in Canada; SARA = *Species at Risk Act*; MBCA = *Migratory Birds Convention Act, 1994*; WL = Whiteshell Laboratories; RSA = Regional Study Area; VC = valued component

Traditional Knowledge and Land Use Studies (Firelight Research and SFN 2018, BRFN, BON, and HWFN 2019, and SVS 2019) and Indigenous engagement with Sagkeeng First Nation, the Manitoba Métis Federation, Brokenhead Ojibway Nation, Black River First Nation, Hollow Water First Nation, and Wabaseemoong Independent Nations identified additional VCs for consideration in the terrestrial effects assessment (Table 6.6.3-2). Table 6.6.3-2 provides the rationale for why the identified Indigenous VCs for the terrestrial environment were not included in the assessment.

Table 6.6.3-2: Rationale for Why Specific Indigenous Valued Components Were Not Assessed for the Terrestrial Environment

Valued Component	Rationale for Why the Indigenous Valued Component Was Not Assessed for the Terrestrial Environment
White-tailed Deer, Moose, and Elk	White-tailed deer and other ungulates were not selected as VCs for the terrestrial assessment because: ■ Project activities occur within the WL site on previously disturbed areas; therefore, there are no direct effects to habitat availability and distribution for white-tailed deer, moose, and elk. ■ Indirect effects of the building demolition works (noise, equipment use) was deemed to be of low risk to wildlife in natural areas adjacent to the fenced campus, and they were considered to be unlikely to occur within the fenced campus. ■ Vehicle collision risk on Ara Mooradian Way is addressed by implementation of existing employee and contractor standard safety training and environmental awareness training, enforcement of existing speed limits on access roads, and monitoring of wildlife collisions with vehicles. Although the road mortality mitigation program is directed at snapping turtles, it will serve to benefit all wildlife species potentially affected by vehicle collisions. The monitoring program will provide feedback for adaptive management (and the potential need for more signage, extension of existing fencing, or other fencing to restrict wildlife access to road surfaces). ■ White-tailed deer and moose populations are not at risk in Manitoba (elk are considered special concern in the province), and none of these species are considered endangered, threatened or special concern on the *Species at Risk Act* (SARA). ■ Consideration of health risks to white-tailed deer and moose are included in the effects assessment for Ecological Health (Section 6.7.2).
Porcupine	Porcupine was not selected as a VC for terrestrial assessment because: ■ Project activities occur within the WL site on previously disturbed areas; therefore, there are no direct effects to habitat availability and distribution for porcupine. ■ Indirect effects of the building demolition works (noise, equipment use) was deemed to be of low risk to wildlife in natural areas adjacent to fenced campus, and they were considered to be unlikely to occur within the fenced campus where direct effects would be possible and be affected by the works. ■ The common porcupine species population is not at risk in Manitoba, and not considered endangered, threatened or special concern on the *Species at Risk Act* (SARA).
Furbearers, including Fox, Lynx, Marten, Fisher, Weasel, Chipmunks, Rabbit, Squirrel, Beaver, Muskrat, and Otter.	These furbearers were not selected as VCs for terrestrial assessment because: ■ Project activities occur within the WL site on previously disturbed areas; therefore, there are no direct effects to habitat availability and distribution for furbearers. ■ Indirect effects of the building demolition works (noise, equipment use) was deemed to be of low risk to wildlife in natural areas adjacent to fenced campus, and they were considered to be unlikely to occur within the fenced campus where direct effects would be possible and be affected by the works. ■ Most of these species populations are not at risk in Manitoba (of this list, long-tailed weasel and eastern fox squirrel are considered special concern in the province), and none are considered endangered, threatened or special concern on the *Species at Risk Act* (SARA). ■ The red fox is considered to be the representative species for terrestrial mammals and is included in the effects assessment for Ecological Health (Section 6.7.2). ■ Mink is considered to be the representative species for riparian mammals and is included in the effects assessment for Ecological Health (Section 6.7.2).

Table 6.6.3-2: Rationale for Why Specific Indigenous Valued Components Were Not Assessed for the Terrestrial Environment

Valued Component	Rationale for Why the Indigenous Valued Component Was Not Assessed for the Terrestrial Environment
Grouse	Grouse was not selected as a VC for terrestrial assessment because: ■ Project activities occur within the WL site on previously disturbed areas; therefore, there are no direct effects to habitat availability and distribution for grouse. ■ Indirect effects of the building demolition works (noise, equipment use) was deemed to be of low risk to wildlife in natural areas adjacent to fenced campus, and they were considered to be unlikely to occur within the fenced campus where direct effects would be possible. ■ Grouse species populations (sharp-tailed, ruffed, spruce) are not at risk in Manitoba, and not considered endangered, threatened or special concern on the *Species at Risk Act* (SARA).
Geese, Ducks, and Waterfowl	Geese and other aquatic bird species were not selected as VCs for terrestrial assessment because: ■ The direct effects of the building demolition works (noise, equipment use) was deemed to be of low risk to birds potentially occurring in the sewage lagoons, Winnipeg River, or in natural areas adjacent to fenced campus, and they were considered to be unlikely to occur in proximity to the building demolition works where indirect effects would be possible. ■ Horned grebe and mallard are considered to be the representative species for riparian birds and is included in the effects assessment for Ecological Health (Section 6.7.2).

VC = valued component

Table 6.6.3-3: Assessment Endpoints and Measurement Indicators for the Terrestrial Environment Assessment

Valued Component	Assessment Endpoints	Measurement Indicators
Barn Swallow	Maintenance of self-sustaining and ecologically effective populations	■ Habitat availability ■ Habitat distribution ■ Survival and reproduction
Golden-winged warbler		
Bats		
Snapping Turtle		

Assessment endpoints represent the key properties of each VC that should be protected. The assessment endpoint for the terrestrial environment is the maintenance of self-sustaining and ecologically effective wildlife populations. Self-sustaining populations are healthy and viable and, by definition, robust and capable of withstanding environmental change and accommodating stochastic processes (Reed et al. 2003). Maintaining viable wildlife populations is a conservation target frequently applied by conservation biologists and resource managers (Fahrig 2001; Nicholson et al. 2006; Ruggiero et al. 1994; With and Crist 1995).

Changes in measurement indicators were used to evaluate potential changes in the status of each VC relative to the assessment endpoints. Each measurement indicator was assessed quantitatively where sufficient information existed to support a numerical assessment and qualitatively where necessary. Habitat availability, habitat distribution and survival and reproduction were selected as the measurement indicators for the terrestrial environment species VCs. The measurement indicators are defined as follows:

- **habitat availability**: changes to the amount (e.g., hectares) and quality (e.g., probability of use by animals) of different habitats;
- **habitat distribution**: changes to spatial configuration and connectivity of habitats and changes to the spatial distribution and movement of animals; and,

- **survival and reproduction:** changes to abundance caused by altering survival and/or recruitment.

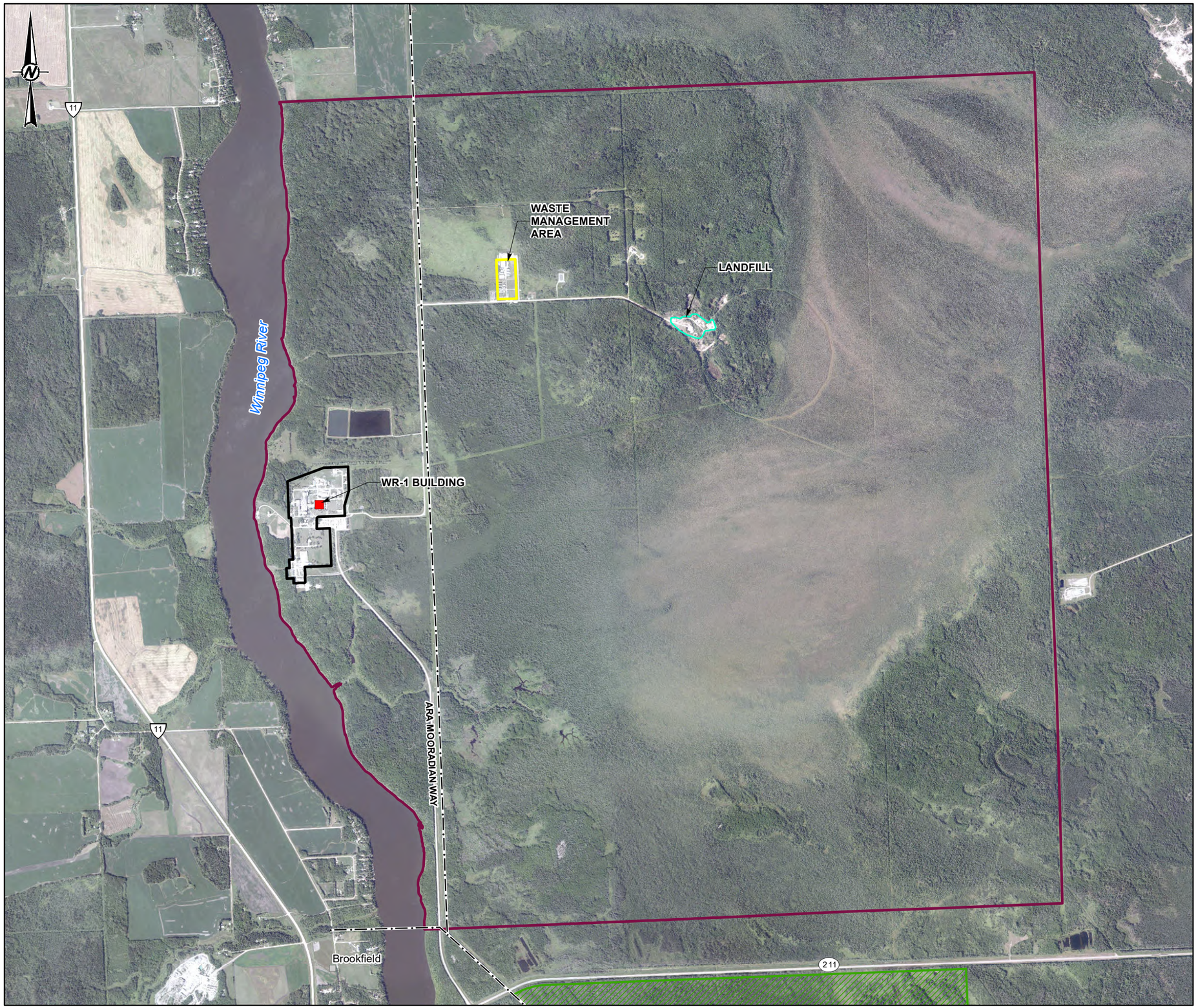
6.6.4 Assessment Boundaries

6.6.4.1 Spatial Boundaries

The spatial boundaries selected for the terrestrial environment assessment were chosen because they permit description of Base Case conditions in sufficient detail to enable potential project-VC interactions and effects to be identified, understood and assessed, including understanding and assessing the contribution of the Project to cumulative effects.

The spatial boundaries selected for the terrestrial environment assessment are presented on Figure 6.6.4-1 and are described below:

- **Site Study Area**: the SSA is the Project footprint, which accounts for the direct physical disturbance and alteration of potential wildlife habitat caused by demolition and reclamation of the WR-1 Building (0.07 ha).
- **Local Study Area**: was selected in consideration of the SSA and the spatial extent of potential direct effects of the Project on the terrestrial environment. The LSA was selected to represent an area that is likely to be directly affected by the Project, helping to identify Project-specific (rather than cumulative effects of the Project in combination with other projects in the region). The LSA includes the fenced area of the WL main campus, which includes the SSA. This spatial area was chosen as it represents an area under the highest anthropogenic activity levels that is distinct from, and also separated from, the surrounding area by a physical barrier (i.e., a six-foot high chain-link fence). Ground-based VC species (i.e., snapping turtle) have restricted access to, or from, the LSA, although movement of aerial VC species (i.e., birds, bats) is less constrained by the presence of the fence. The spatial extent of project-related physical disturbances to wildlife VCs (through noise) is also highest within this defined area. The approximate size of the LSA is 29 ha.
- **Regional Study Area**: is defined as the area within which the maximum geographical extent of potential indirect effects of the Project may interact with the effects of other existing or reasonably foreseeable projects. The RSA is the 3,710 ha portion of the WL site on the east side of the Winnipeg River (Figure 6.6.3-1). This federally-owned property is not fenced around the perimeter, which means there is no physical barrier restricting access to or from the area by ground-based wildlife from the north, east, or south. The Winnipeg River itself represents a partial barrier to (primarily ground-based) wildlife access from the west. The RSA is relevant to the evaluation of effects on wildlife VCs because it is under distinct management and ownership relative to the surrounding landscape. The entire area is under ownership by CNL, and because there are nuclear facilities within the area, it is managed differently from the surrounding landscape (i.e., with respect to active fire suppression and prevention). The RSA also represents a suitable scale to assess potential cumulative effects on wildlife VCs. Cumulative effects of beyond regional disturbance factors (e.g., forestry and climate change) are considered if they are likely to affect populations of wildlife VCs with ranges that are much larger than, but overlap the RSA.



LEGEND

- WR-1 BUILDING (SITE STUDY AREA)
- LOCAL STUDY AREA
- REGIONAL STUDY

WHITESHELL LABORATORIES

- WASTE MANAGEMENT
- LANDFILL

BASE FEATURES

- CITY/TOWN
- TRANSMISSION LINE
- PROVINCIAL PARK

0 1,000 2,000

METRES

1:30,000

NOTE(S)

1. SPATIAL EXTENT OF SSA FOR TERRESTRIAL ECOLOGY WILL BE BROADENED TO INCLUDE THE DIMENSIONS OF ADDITIONAL GROUND DISTURBING PROJECT COMPONENTS INCLUDING A GROUT BATCH PLANT, CONSTRUCTION TRAILERS AND LAYDOWN AREAS

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY(RSA) PROVIDED BY CNL (2016-11-22)
3. ORTHO IMAGERY - CNL, 2016 (ACQUIRED 2014)
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT

CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT

EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE

SPATIAL BOUNDARIES FOR TERRESTRIAL ENVIRONMENT ASSESSMENT

CONSULTANT

WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/RRD
REVIEWED	KL
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0014	2	**6.6.3-1**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm 0

Path: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0014_EIS_Sec_6.6\20145046-0014-RT-0001_Figure 6_6_3-1_Spatial Boundaries for Terrestrial Environment Assessment.mxd

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6.6.4.2 Temporal Boundaries

The temporal boundaries of the assessment are the timeframe during which Project activities are actively occurring and the duration of predicted residual effects. The duration of an effect is defined as the amount of time between the start and end of a Project activity or stressor (which is related to the Project phases) plus the time required for the residual effect to be reversed. In some cases, a residual effect may be irreversible within the temporal boundaries of the Project if the effect is predicted to last so far into the future that the duration cannot be predicted with any level of certainty (e.g., residual effect lasts for thousands of years). The following phases were identified for the Project:

- **Closure Phase:** Preparation and implementation of ISD, which includes preparation for ISD, grouting of below-grade structures and systems, removal of above-grade WR-1 structures and systems, installation of the concrete cap and engineered cover, and environmental controls and final site restoration. These activities last from 2022 to 2027.
- **Post-closure Phase:** The post closure phase has two discrete periods: institutional control and post institutional control. Institutional control is estimated to last 100 years during which long-term monitoring and maintenance activities will continue to demonstrate Whiteshell Reactor Disposal Facility (WRDF) performance is in compliance with the safety case assumptions and performance modelling. The 100 year timeframe is not related to the design life of the WRDF barriers. The 100-year active monitoring period was selected to ensure that sufficient opportunity is provided to verify the WRDF is performing as expected. Additionally, beyond 100 years, there is less confidence that institutional controls, like access restrictions, can be relied upon. Although the duration of institutional control is estimated at 100 years, it is recognized that it will continue until the CNSC, or the appropriate authority at the time, agrees it is no longer needed.

  Post-institutional control occurs after year 2127 and continues indefinitely. The post-closure phase will continue indefinitely; however, the timeframe defined for assessment of potential effects as part of the normal evolution of the Project is 10,000 years. This time period encompasses the phase in which peak effects are anticipated.

6.6.4.3 Assessment Cases

The assessment cases considered in the terrestrial environment assessment include the Base Case, Application Case and the Reasonably Foreseeable Development (RFD) Case:

- **Base Case:** represents existing conditions and characterizes combined effects from previous and existing developments and activities. The Base Case reflects the effects of existing disturbances, such as forestry, transportation, agricultural, mining and residential and recreational development. Current effects from the existing facilities and operations at the Whiteshell Laboratories (WL), for example, are considered part of the Base Case. In addition, existing conditions of areas not affected by the WL site are also considered as part of the Base Case. Effects from the decommissioning and reclamation activities already completed at the WL site are also considered as part of the Base Case.
- **Application Case**: represents predictions of the effects that may results from the Project combined with the existing effects of the Base Case.

- **RFD Case**: represents the effects of the Base Case combined with the predicted incremental effects from the Project, as well as effects from other RFDs within the RSA that are currently under application review or that have officially entered a regulatory application process. There are no RFDs expected in the RSA other than the continued decommissioning of the remaining facilities at the WL site, as described in the Comprehensive Study Report (AECL 2001). The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-states. The Comprehensive Study Report indicated that no effects were identified for terrestrial biota, as natural vegetation will re-establish following completion of decommissioning and reclamation activities. Airborne emissions from decommissioning activities are likely to be less than in the past and no effect from this exposure pathway is expected (see Section 6.3.5 of AECL 2001). Overall, decommissioning of these structures is anticipated to positively affect the terrestrial environment. Species such as barn swallow may be negatively affected through the loss of anthropogenic habitat on the WL site through the decommissioning of structures; however, implementation of habitat offsetting (e.g., installation of nesting structures for barn swallow in 2018) in advance of additional decommissioning is designed to proactively address this potential.

  Effects of RFDs in the RSA are expected to be primarily positive, because activities will focus on decommissioning existing infrastructure. Once existing infrastructure is removed and the RSA is reclaimed the level of anthropogenic disturbance within RSA will be reduced, benefiting the terrestrial environment of the RSA. Because RFD identified in the RSA is expected to have a generally positively effect on the terrestrial environment, an RFD Case is not presented as part of this assessment (Table 6.6.4-1).

Table 6.6.4-1: Reasonably Foreseeable Developments Considered in the Terrestrial Environment Assessment

Type of Project	Location	Description	Timeframe	Overlap with Valued Components
Infrastructure Decommissioning	WL	Decommissioning of remaining infrastructure on the WL site (includes in situ disposal of the low-level waste trenches).	2016 to 2027	Yes – however, potential future effects to species that use anthropogenic habitat have been addressed through implementation of habitat offsetting (e.g., installation of nesting structures for barn swallow) in advance of additional decommissioning in the LSA and, remaining effects may be positive (which are therefore not assessed)
Environmental Remediation	WL	Remediation of affected lands, with the exception of the low-level waste trenches.	2016 to 2027	Yes – however, effects are considered to be positive and therefore, are not assessed

6.6.5 Description of the Environment

6.6.5.1 General Overview

The RSA is located within the larger Boreal Shield Ecozone, Lake of the Woods Ecoregion and Stead Ecodistrict (Smith et al. 2001). In general, this ecoregion has a large number of forest types characterized by tall, closed stands of jack pine (*Pinus banksiana*), trembling aspen (*Populus tremuloides*), paper birch (*Betula papyrifera*), white spruce (*Picea glauca*), eastern white cedar (*Thuja occidentalis*), black ash (*Fraxinus nigra*) and American elm (*Ulmus americana*) (Smith et al. 2001). The English, Winnipeg and Rainy rivers are the dominant waterways, with small to large bedrock-shore lakes in the northern portion of the ecoregion. Wildlife are diverse and abundant and characteristic regional species include: gray wolf (*Canis lupus*), American black bear (*Ursus americanus*), moose (*Alces americanus*), snowshoe hare (*Lepus americanus*), hooded merganser (*Lophodytes cuculata*), turkey vulture (*Cathartes aura*) and ruffed grouse (*Bonasa umbellus*) (Smith et al. 2001). This description of the characteristic habitat types and wildlife species of the Lake of the Woods Ecoregion has been provided as context for the RSA, which is described below.

The RSA is located on the east bank of the Winnipeg River (Figure 6.6.4-1), at an elevation of approximately 267 metres above sea level. It lies within a broader zone at the convergence of prairie grassland to the southwest and boreal forest to the northeast and is also on the edge of the Precambrian Shield (AECL 2001). The surrounding area consists of cleared lands with areas of peat bog. Whiteshell Provincial Park, the largest provincial park in Manitoba, is located on the east side of the RSA; Pinawa and Whitemouth Falls Provincial Parks are both immediately south of the RSA.

There is a relatively high degree of diversity in terrestrial habitat within the RSA (Figure 6.6.4-1). The RSA is primarily under treed cover (83% of total area), consisting of a mixture of wetlands and forests of broadleaf, mixed and coniferous stand types. A large area (1,946 ha, or 52% of the total area) contains a complex of bog, fen and swamp wetlands spanning the center and east portions of the RSA, from north to south. Black spruce dominates large portions of this wetland habitat and it is reported that stands may be over 100 years old (AECL 2001). Black spruce-dominated bog wetlands have understories of tamarack (*Larix* sp.), willow sp. (*Salix* sp.), blueberry (*Vaccinium* sp.), common Labrador tea (*Rhododendron groenlandicum*), horsetail sp. (*Equisetum* sp.) and mosses. The herbaceous wetland types contain mannagrass sp. (*Glyceria* sp.), cattail sp. (*Typha* sp.), sedge sp. (*Carex* sp.) and bulrush sp. (*Schoenoplectus sp.*). A ridge of well-drained sandy soil within the wetland area contains jack pine dominated forest stands. To the west of the wetland area, forests dominated by black ash and poplar sp., are present on poorly drained clay plains (AECL 2001). There are also areas of unutilized farm fields and areas where vegetation height is controlled, that contain a mixture of regenerating grasses and shrub species such as bluegrass (*Poa* sp.), sedge sp., strawberry (*Fragaria* sp.), clover sp. (*Trifolium* sp.) and aster sp. (*Aster* sp.). The area near the Field Irradiator Gamma site contains upland mixed forests with jack pine and trembling aspen dominant stands, as well as spruce sp., fir sp. (*Abies* sp.), birch and an understory of common Labrador tea, hazelnut (*Corylus* sp.), wild plum (*Prunus americana*) and blueberry. There is a broadleaf forest dominated by trembling aspen with an understory of willow sp., rose (*Rosa* sp.), alder sp. (*Alnus* sp.), currant (*Ribes* sp.) and dogwood (*Cornus* sp.) on the west half of the RSA, with gullies and ravines adjacent to the Winnipeg River.

There have been few formal wildlife inventories within the RSA. The focus of this terrestrial environment assessment is therefore based on known ranges of wildlife species, habitat suitability incidental observations by WL staff from 2014 to 2021, with incorporation of data from acoustic and visual surveys conducted for bats in 2015 and 2021 and for birds in 2018 and 2019. White-tailed deer (*Odocoileus virginianus*) are reportedly common, with established wintering areas on site, and beaver (*Castor canadensis*) activity is common within the gullies adjacent to the Winnipeg River (AECL 2001). Permits have been obtained by WL staff for dam removal on numerous occasions. Other commonly observed mammal species within the RSA include black bear, red fox and groundhog (a.k.a., woodchuck; *Marmota monax*). The two bat VC species (little brown myotis and northern myotis) were confirmed to occur within the LSA based on acoustic surveys conducted in 2015 (Murrant 2016) with two additional incidental observation records of unconfirmed bat species made by staff in July 2018 (on a pallet near B412) and in August 2021 (observed on the north brick wall exterior of B100 building that houses the WR-1 reactor). No bats have been confirmed within the WR-1 building based on targeted surveys to-date. Detailed surveys to confirm bat roosting habitat presence have not yet been completed.

Commonly observed amphibian and reptile species include northern leopard frog (*Lithobates pipiens*) and gartersnake (*Thamnophis* sp.), and there have also been observations of snapping turtle and western painted turtle (*Chrysemys picta bellii*). According to the Comprehensive Study Report (AECL 2001), there are important bird migration staging areas on, or near the RSA, centering on the Winnipeg River. The Winnipeg River is an important migratory corridor for many species including common loon (*Gavia immer*), red-necked grebe (*Podiceps grisegena*), horned grebe (*P. auritus*), double-crested cormorant (*Phalacrocorax auritus*), American white pelican (*Pelecanus erythrorhynchos*), Bonaparte's gull (*Chroicocephalus philadelphia*), common tern (*Sterna hirundo*), Caspian tern (*Hydroprogne caspia*), lesser scaup (*Aythya affinis*), greater scaup (*A. marila*) and bald eagle (*Haliaeetus leucocephalus*) (AECL 2001). Bird species recorded within the RSA by WL staff since 2014 have included many federally secure (i.e., not at risk) species. There have been observations of passerines such as cliff swallow (*Petrochelidon pyrrhonota*) and American robin (*Turdus migratorius*), woodpeckers such as pileated woodpecker (*Dryocopus pileatus*) and northern flicker (*Colaptes auratus*), owls including great gray owl (*Strix nebulosa*) and great horned owl (*Bubo virginianus*), as well as sandhill crane (*Grus canadensis*) and bald eagle. Observations of federal species at risk have included trumpeter swan (*Cygnus buccinator*), barn swallow, loggerhead shrike (*Lanius ludovicianus*), Peregrine falcon (*Falco peregrinus*) and red-headed woodpecker (*Melanerpes erythrocephalus*) and are described in Appendix 6.6-1.

Automated recording unit acoustic surveys for birds were conducted in 2018 and 2019 (See map of monitoring stations in Figure 6.6.4-2 and description in Appendix 6.6-1). These acoustic surveys confirmed the presence of Canada warbler (*Cardellina canadensis*) and auditory breeding evidence based on calls recorded at a monitoring location on the east side of the LSA in 2018 (station 3) and at two monitoring locations at the northeast and southeast corners of the LSA in 2019 (stations 5 and 1). The acoustic surveys from 2019 also confirmed the presence of olive-sided flycatcher (*Contopus cooperi*) and auditory breeding evidence based on calls recorded at monitoring locations at the northwest and northeast corners of the LSA (stations 6 and 5). Field surveys to confirm the precise locations of where the calls originated from were not conducted (i.e., the actual breeding habitat in use was not precisely located or confirmed with visual observation).

The Base Case for each wildlife VC represents the outcome of past and present effects of natural disturbances and anthropogenic activities on the environment. Wildfire was likely the primary disturbance factor in the RSA before the 1890s and remains the primary disturbance and stand determining agent in forested areas of the Boreal Shield Ecozone (Smith et al. 2001). Human development in the area around Lac du Bonnet began in 1898 when a large number of mining claims were staked in the area (Lac du Bonnet Pioneer Club 1980). The road from Molson to Lac du Bonnet was finished in the fall of 1899 as far as Milner Ridge, and wood and

lumber operations were started soon after (Lac du Bonnet Pioneer Club 1980). The construction of the Pinawa power plant began in 1903 and was completed in 1906 (Manitoba Historical Society 2017). Most roads in the Lac du Bonnet area were built after 1917, when the rural municipality of Lac du Bonnet was formed (Lac du Bonnet Pioneer Club 1980). The WL site was established by AECL in the early 1960s as a nuclear research facility. Since the 1960s, land uses within the RSA have been limited to operations and activities undertaken at the WL site (AECL 2001).

As part of the Comprehensive Study Report, the WL site was divided into “affected” and “unaffected” land. Affected land was defined as areas where nuclear development, operations or supporting activities are conducted and includes land potentially affected by such activities (AECL 2001). This area includes the LSA derived for the terrestrial environment assessment, plus some surrounding areas with supporting infrastructure. Outside of this area, the majority of the WL site consists of unaffected land. These broad categories are also applicable to the likely extent of noise-related effects on wildlife; with the areas beyond the affected land having low likelihood of being subject to noise levels that would have effects on wildlife.

Anthropogenic disturbance of the RSA and current activity (e.g., the WL main campus area, access roads and waste management areas) is largely concentrated in the northwest quarter of the RSA. Disturbance in the form of roads is primarily within the far western portion of the RSA, with the main access road for employees (Ara Mooradian Way) aligned north-south, with a few secondary roads branching off the main Plant Road to various locations (i.e., landfill, sewage lagoons and waste management area). There is one cleared and maintained hydroelectric corridor for a 115 kV transmission line through the WL site. The transmission line corridor spans the north-south length of the WL site and is in the western portion of the RSA.

The LSA (main campus area) comprises a small proportion of the RSA (less than 1% of the RSA) and is located on the west side of the RSA, on the east bank of the Winnipeg River (Figure 6.6.4-2). As of 2016, it contained 10 major buildings and support facilities (a total of 61 structures) within a chain link fenced perimeter. Since 2016 there has been on-going decommissioning with buildings, storage sheds, and covered access / sampling points in various stages from occupied or in use, to active demolition. Infrastructure and paved areas comprise 25% of the total area and the remaining 74% is primarily landscaped and maintained turfgrass lawn (Figure 6.6.4-2). A small proportion of the area contains broadleaf forest (less than 1%).

Overall, the operation of WL and federal ownership of the RSA have likely allowed for conditions of the terrestrial environment to improve over time, as the majority of the lands owned have not been disturbed from WL related development and activity for the last 50+ years. Consequently, much of the RSA, with the exception of the LSA itself, sustains a high value terrestrial environment in the Base Case, including habitat for the VCs identified for this assessment.

6.6.5.2 Methods

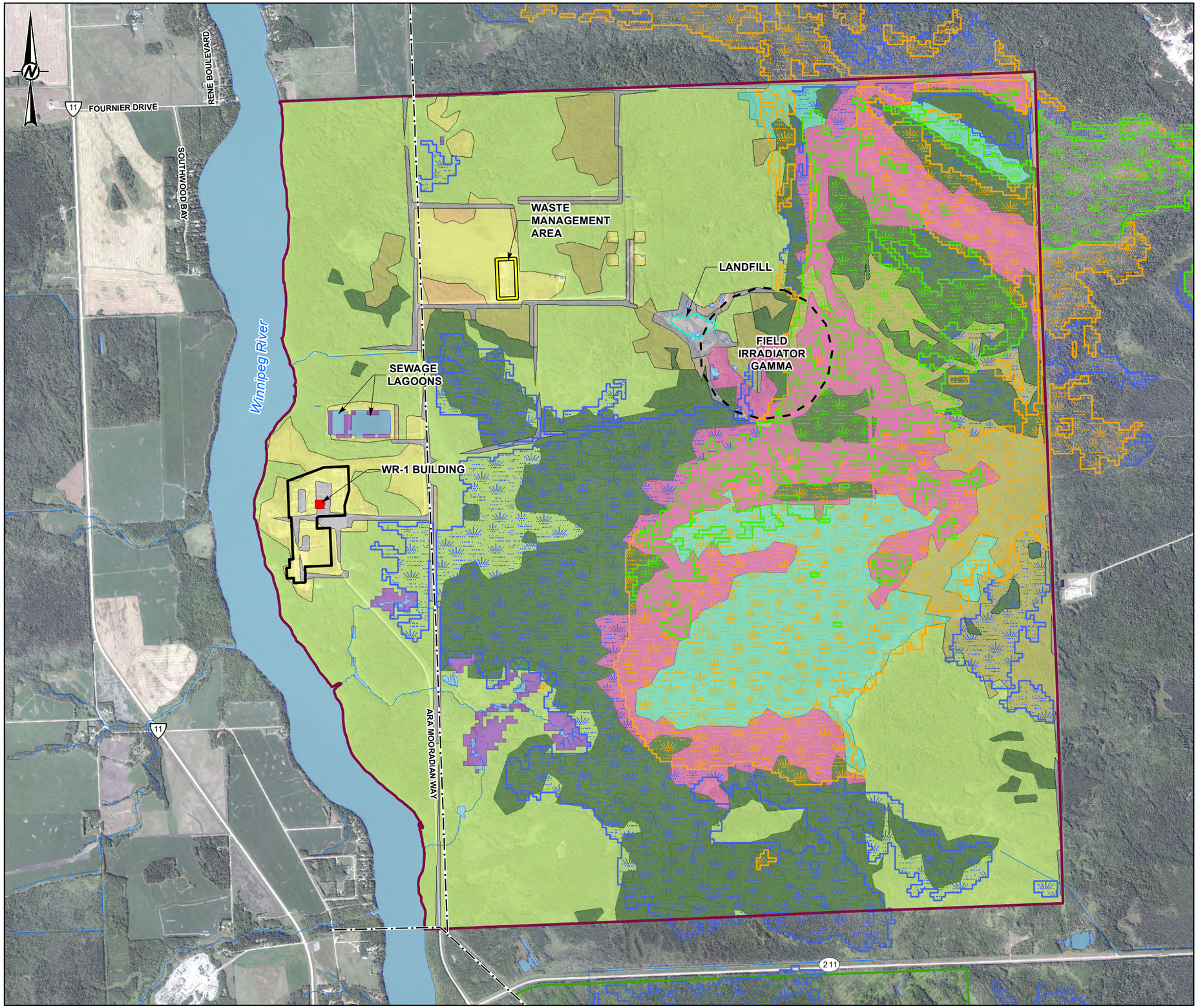
The following information sources were used to describe Base Case conditions for terrestrial environment VCs:

- species at risk file data file, assumed to be compiled through a spatial query by the Manitoba Conservation Data Centre (CNL 2016);
- incidental wildlife species observations recorded by WL staff (CNL 2022b);
- results of bat acoustic monitoring surveys conducted from June to August 2015 (22 acoustic monitoring sites) (Murrant 2016) and visual surveys and acoustic monitoring surveys conducted in the WR-1 building in July 2021 (McKinnon et al. 2022);

- results of avian automated recording unit acoustic surveys conducted during the late breeding period from June 12 to July 3, 2018 and early breeding period from May 9 to June 10, 2019 (6 monitoring station locations used for both years) (Dillon 2019a,b);
- studies published in scientific journals and reports providing information on VC habitat preferences, current stressors and threats to populations and documented effects caused by anthropogenic disturbances;
- previous environmental assessments conducted for the WL site (primarily the Comprehensive Study Report, AECL 2001);
- federal recovery strategies for VCs available in Environment and Climate Change Canada's (ECCC) Species at Risk database (Government of Canada 2019);
- Manitoba Breeding Bird Atlas 2010-2014 (MBBA 2016);
- eBird web-based bird observation database hosted by the Cornell Lab of Ornithology and National Audubon Society (eBird 2016, 2017);
- Manitoba Herps Atlas (Manitoba Herps Atlas 2016);
- landcover and buildings spatial data (CNL 2016b); and
- wetlands spatial data (MLI 2013).

A description of the Base Case conditions is provided for each terrestrial environment VC in the following sections. Base Case conditions are described according to the measurement indicators selected for each VC (Table 6.6.3-1).

For each wildlife VC, landcover and wetlands spatial data were used to provide descriptions of habitat availability and distribution under existing conditions, representing an estimate of suitable habitat available as a result of past and present development and activities. A review of habitat requirements and species ecology was completed for each wildlife VC to identify habitat that is most likely to be limiting for the species in the RSA and the loss of which would be most likely to result in change to its abundance in the RSA. The limiting habitat was selected as the focus of the assessment.



LEGEND

- WR-1 BUILDING (SITE STUDY AREA)
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

WHITESHELL LABORATORIES

- WASTE MANAGEMENT AREA
- LANDFILL
- FIELD IRRADIATOR GAMMA
- SITE ROADS

BASE FEATURES

- CITY/TOWN
- TRANSMISSION LINE
- WATERCOURSE
- WATERBODY
- PROVINCIAL PARK

VEGETATION COMMUNITIES (SOURCE: CNL 2016 LANDCOVER)

- BROADLEAF DENSE
- CONIFEROUS (DENSE AND OPEN)
- MIXEDWOOD DENSE
- GRASS
- HERBACEOUS
- DEVELOPED
- EXPOSED LAND
- WETLAND - SHRUB
- WETLAND - TREED

WETLAND TYPE (SOURCE: MLI 2013 WETLAND INVENTORY)

- BOG
- FEN
- MARSH
- SWAMP

0 1,000 2,000

1:30,000 METRES

NOTE(S)

1. SPATIAL EXTENT OF SSA FOR TERRESTRIAL ECOLOGY WILL BE BROADENED TO INCLUDE THE DIMENSIONS OF ADDITIONAL GROUND DISTURBING PROJECT COMPONENTS INCLUDING A GROUT BATCH PLANT, CONSTRUCTION TRAILERS AND LAYDOWN AREAS

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY (RSA) PROVIDED BY CNL (2016-11-22) AND VEGETATION COMMUNITES PROVIDED BY CNL IN THE GIS DATA PACKAGE SUPPLIED ON 2016-11-18
3. ORTHO IMAGERY - CNL, 2016 (ACQUIRED 2014)
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
TERRESTRIAL ENVIRONMENT EXISTING CONDITIONS IN THE RSA - BASE CASE

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/RRD
REVIEWED	KL
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0014	2	**6.6.4-1**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm 0

Path: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0014_EIS_Sec_6.6\20145046-0014-RT-0002_Figure 6_6_4-1_Terrestrial Environment Existing Conditions in the RSA - Base Case.mxd

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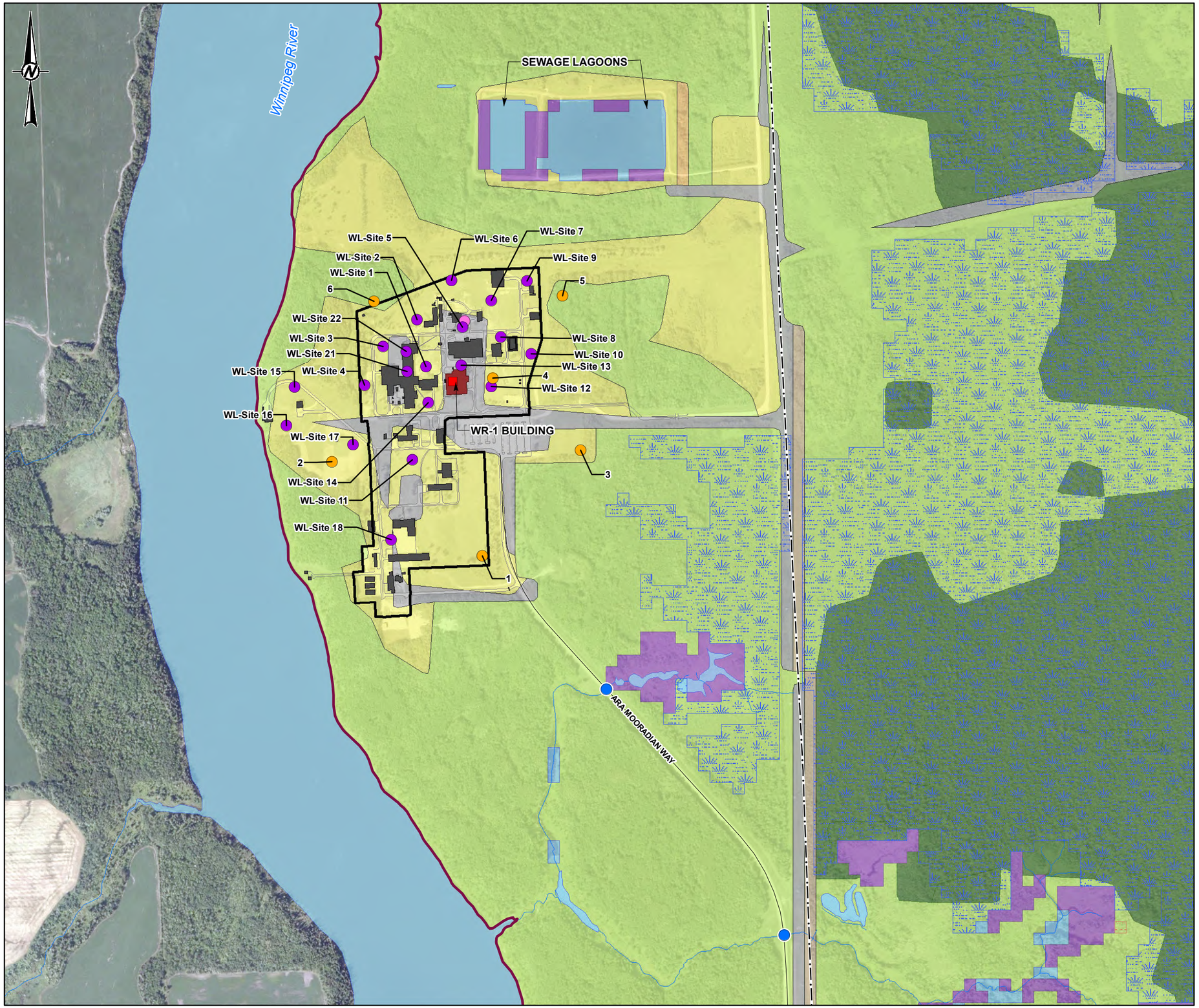

LEGEND

- WR-1 BUILDING (SITE STUDY AREA)
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

WHITESHELL LABORATORIES

- BUILDINGS - PRESENT AS OF 2016
- SITE ROADS

BASE FEATURES

- TRANSMISSION LINE
- WATERCOURSE
- WATERBODY
- LIKELY SNAPPING TURTLE ROAD CROSSING LOCATIONS AND SUITABLE AQUATIC HABITAT FEATURES

WILDLIFE OBSERVATION

- LOCATION OF BARN SWALLOW NESTING ACTIVITY - JUNE 2016[2]
- AVIAN ACOUSTIC MONITORING STATION
- BAT ACOUSTIC MONITORING STATION

VEGETATION COMMUNITIES (SOURCE: CNL 2016 LANDCOVER)

- BROADLEAF DENSE
- CONIFEROUS (DENSE AND OPEN)
- MIXEDWOOD DENSE
- GRASS
- HERBACEOUS
- DEVELOPED
- EXPOSED LAND
- WETLAND - SHRUB
- WETLAND - TREED

WETLAND TYPE (SOURCE: MLI 2013 WETLAND INVENTORY)

- BOG
- FEN
- MARSH
- SWAMP

0 250 500 750

1:10,000 METRES

NOTE(S)

1. SPATIAL EXTENT OF SSA FOR TERRESTRIAL ECOLOGY WILL BE BROADENED TO INCLUDE THE DIMENSIONS OF ADDITIONAL GROUND DISTURBING PROJECT COMPONENTS INCLUDING A GROUT BATCH PLANT, CONSTRUCTION TRAILERS AND LAYDOWN AREAS
2. PRECISE LOCATION OF MARINE CONTAINER WHERE BARN SWALLOW NESTING OCCURRED TO BE VERIFIED BY CNL STAFF.

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY (RSA) PROVIDED BY CNL (2016-11-22) AND VEGETATION COMMUNITES PROVIDED BY CNL IN THE GIS DATA PACKAGE SUPPLIED ON 2016-11-18
3. ORTHO IMAGERY - CNL, 2016 (ACQUIRED 2014)
4. AVIAN ACOUSTIC MONITORING LOCATIONS PROVIDED BY DILLON 2018; 2019 - MEMO: 2018 BIRD SONG IDENTIFICATION - CNL PINAWA, MB (LECLAIR AND KALINOVICH); MEMO: 2019 BIRD SONG IDENTIFICATION - CNL PINAWA, MB (RUSSUM AND KALINOVICH)
5. BAT STATION PROVIDED BY CNL 2016 - MEMO: RESULTS OF 2015 BAT SURVEY AT WHITESHELL LABS (MURRANT 2016)
6. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
TERRESTRIAL ENVIRONMENT EXISTING CONDITIONS IN THE LSA - BASE CASE

CONSULTANT
wsp GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/RRD
REVIEWED	KL
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0014	2	**6.6.4-2**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm 0

Path: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0014_EIS_Sec_6.6\20145046-0014-RT-0003_Figure 6_6_4-2_Terrestrial Environment Existing Conditions in the LSA - Base Case.mxd

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6.6.5.3 Barn Swallow

6.6.5.3.1 Habitat Availability

The breeding range of barn swallow overlaps the RSA. Breeding habitat for barn swallow typically includes three components: a vertical or horizontal substrate (often enclosed) for the nest site itself, open habitat (e.g., fields, meadows) for foraging and a body of water that provides mud for nest building (Brown and Brown 2019). Barn swallow nests are typically found inside or outside of buildings, under bridges and in road culverts. As of 2016, there were a total of 128 buildings and permanent structures of various sizes within the RSA and 61 buildings and permanent structures within the LSA. Decommissioning and demolition has been on-going since that time. Common foraging habitat includes open riparian areas, road rights-of-way, urban and residential areas and clearings in wooded areas (Brown and Brown 2019; Heagy et al. 2014).

This species is listed as Threatened under SARA but does not yet have legally defined critical habitat described in a recovery strategy. It has also been recently downgraded by COSEWIC to Special Concern. A pair of nesting barn swallows was observed with eggs in a nest within the LSA, in a temporary storage facility housed in a marine container (approximate location of marine container on Figure 6.6.4-2). Although a nest survey completed in the summer of 2015 found no nesting activity observed on the outside of the WR-1 Building (CNL 2016c), the 2015 survey did confirm 13 barn swallow nests on other WL main campus buildings in the LSA.

For the purposes of this assessment, a conservative approach has been taken and all mapped buildings in the RSA and LSA were considered suitable nesting habitat for barn swallow. As of 2016, there were a total of 128 buildings of various sizes in the RSA and 61 buildings in the LSA. A total of 4 ha (0.1%) and 3 ha (11%) of suitable nesting habitat for barn swallow is estimated to be present in the RSA and LSA, respectively, in the Base Case (Table 6.6.5-1). There is also likely additional nesting habitat located in the culverts at any watercourse crossings, particularly at the three watercourse crossings at Ara Mooradian Way, south of the LSA (two of which are visible on Figure 6.6.5-2). Although not quantified, the other two required habitat components are most likely met within the RSA: the sewage lagoons and Winnipeg River represent likely locations of potential mud sources and there is open foraging habitat within the LSA and non-treed portions of the RSA.

Table 6.6.5-1: Nesting Habitat Availability for Barn Swallow in the Base Case

Habitat Suitability	Regional Study Area		Local Study Area	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)
Suitable	4	0.1	3	11.0
Unsuitable	3,706	99.9	26	89.0
Total	**3,710**	**100.0**	**29**	**100.0**

Disturbances can have both positive and negative effects on barn swallow breeding habitat availability. Past and present anthropogenic development has most likely increased the amount of nesting habitat in the LSA for barn swallow by providing suitable substrate for nest building (e.g., buildings and culverts). Vegetation clearing can also improve breeding habitat by creating open areas for foraging (Brown and Brown 2019; Heagy et al. 2014). Utility and road corridors and the open turfgrass lawn areas of the campus likely provide suitable foraging habitat for barn swallow in the Base Case. Fire suppression activities have likely had negative effects on barn swallow foraging habitat availability relative to what was historically available for this species in the RSA, as barn swallow require open areas for foraging.

6.6.5.3.2 Habitat Distribution

The range of barn swallow in Manitoba is largely unknown; this species is considered widespread in southern Manitoba but is considered to be a very local breeder in northern Manitoba (Brown and Brown 2019). At Base Case, suitable barn swallow nesting habitat (i.e., buildings) is patchily distributed throughout the RSA (Figure 6.6.5-1) and LSA (Figure 6.6.5-2). Habitat may be a limiting factor for barn swallow in the Base Case because this species relies heavily on buildings for nest sites; however, this species is highly mobile and can establish territories in new areas.

Narrow linear disturbances, such as road corridors in the LSA and RSA, generally do not represent barriers to bird movement (Desrochers and Hannon 1997). Existing disturbances in the RSA do not likely function as dispersal barriers for this species in the Base Case. Habitat fragmentation is not thought to be a limiting factor for barn swallow (Gaines et al. 2003), likely because of their high mobility and use of open areas for foraging.

6.6.5.3.3 Survival and Reproduction

Canada is thought to support approximately 22% of the North American population of barn swallow (10.9 million individuals) and 6% of the global population (COSEWIC 2011). As of 1999, Manitoba supported approximately 1.5 million individuals of the species (COSEWIC 2011). Long-term Breeding Bird Survey (BBS) data show a decline of barn swallow abundance in Manitoba of 2.78% per year from 1970 to 2012 (overall 69% decline; Environment Canada 2014).

Because the barn swallow population in Canada has declined by 69% from 1970 to 2012, it is considered a priority species under the Bird Conservation Strategy for the region, which has the objective of doubling current abundance (Environment Canada 2014). The barn swallow was designated as Threatened by COSEWIC in 2011 and is listed under SARA).

Barn swallow is recorded as a confirmed breeder in the Manitoba Breeding Bird Atlas squares that overlap the RSA (squares 14QA06 and 14QA16). Breeding activity was confirmed within the LSA in June 2016 in a marine container located west of Building 411 (see approximate location of the marine container with documented nesting activity on Figure 6.6.4-2).

The main threats to barn swallow populations in Canada are not well understood. Habitat loss and degradation of breeding grounds, large scale changes in insect prey abundance, climate change, interspecific competition for nest sites from invasive species, nest parasitism and human-caused nest destruction and removal are all threats that may be affecting barn swallow populations (COSEWIC 2011).

Barn swallow primarily feed on flying insects. Insect populations are declining worldwide, and this may be contributing to barn swallow declines (COSEWIC 2011). Many aerial-foraging insectivorous birds, such as barn swallow, have experienced large declines since the 1980s (Blancher et al. 2009; NABCIC 2019). The declines suggest a single cause related to insect abundance as both forest and non-forest aerial-foraging birds are declining (Blancher et al. 2009; Nebel et al. 2010; Nocera et al. 2012; Paquette et al. 2014). Potential causes of reduced availability of insects include habitat loss, changes to timing of peak food abundance from climate change and pesticide use (Nebel et al. 2010; Nocera et al. 2012; Paquette et al. 2014). Insect and bird populations in the RSA have likely been affected by all of these factors at Base Case.

6.6.5.4 Golden-winged Warbler

6.6.5.4.1 Habitat Availability

The breeding range for golden-winged warbler overlaps the RSA. Golden-winged warbler is a habitat specialist that relies on early successional habitat (10 to 30 years after disturbance) (COSEWIC 2006). Forest type appears to be less important for this species than habitat structure (Confer et al. 2011), with most individuals found in shrubby, deciduous habitats (Beaudry et al. 2010). Golden-winged warblers prefer habitats with low to moderate tree canopy cover and moderate shrub and herb cover (Confer et al. 2011). Critical habitat has been partially identified in the federal recovery strategy for this species to be a combination of habitat suitability and habitat occupancy, where suitable breeding and foraging habitat has been identified as the interface (shared edge) between young forest and open habitat within an appropriately sized and specific type of forest landscape (ECCC 2016a). Forest cover must be at least 50% to 75% within a 5 km by 5 km area with primarily deciduous or mixed tree composition (greater than 50%), and no more than 30% coniferous forest composition (ECCC 2016a). The edges of wetland habitat including bogs and fens with greater than 15% sapling and shrub cover is also considered breeding and foraging habitat for this species (ECCC 2016a). Nests are often located within 200 m on either side of a forest edge (ECCC 2016a). Edges can also be located along cutblocks, transmission line rights-of-way and other anthropogenic disturbances if there is sufficient cover of tall grass (i.e., not mown turf-grass lawn), herb and shrub species (ECCC 2016a).

The available land cover and wetlands spatial data were used to map suitable breeding and foraging habitat for golden-winged warbler in the LSA and RSA as follows:

- confirmation of suitable forest cover on the local landscape (minimum 50% to 75% forest cover with some openings of shrub / herbaceous habitat, no more than 30% coniferous forest type) that spans a minimum of 5 km by 5 km area overlapping the RSA;
- if the above criterion is met, broadleaf dense forest stands within 200 m of the forest polygon edge where it abuts open habitat (wetland – all [i.e., bog, fen, marsh, swamp], waterbody, herbaceous);
- if the above criterion is met, mixedwood dense forest stands within 200 m of the forest polygon edge where it abuts open habitat (wetland – all, waterbody, herbaceous); and
- 200 m buffer into the following polygon types where they abut broadleaf dense or mixedwood dense forest stands:
  - Wetland – all; and
  - Herbaceous.

Suitable breeding and foraging habitat for golden-winged warbler consists of early successional habitat at the interface of forest and open habitat (i.e., edge habitat). Availability of breeding and foraging habitat for golden-winged warbler was predicted at Base Case using the available land cover and wetlands spatial data.

The dimensions of the RSA are approximately 5 km by 6.5 km, with a total of 83% tree cover (meeting the minimum size criterion and exceeding the minimum total forest cover criterion of 50%). There is 23% coniferous forest cover, which meets the criterion of less than 30% coniferous forest cover. Within the edge habitats between mixedwood and broadleaf forest and open / shrubby habitat, there is no suitable habitat for golden-winged warbler in the LSA in the Base Case, but 986 ha (27%) of suitable habitat estimated in the RSA (Table 6.6.5-2). The federal recovery strategy identifies focal areas across the species' range that contain core populations that sustain the current

breeding distribution and are important for expanding the population into adjacent areas (ECCC 2016a). The RSA falls within focal area GL3 and within a grid square identified to contain critical habitat for this species (ECCC 2016a). The BBS data for Manitoba found no breeding evidence of Golden-winged Warbler within Manitoba Breeding Bird Atlas squares 14QA06 or 14QA16 that overlap the RSA; however, there is possible breeding evidence for this species in the areas surrounding these two squares. No eBird sightings of golden-winged warbler have been reported in the LSA or RSA; however, there has been a recent sighting of a male individual approximately 11 km to the southeast of the RSA in August 2016, near Pinawa (eBird 2017).

Table 6.6.5-2: Breeding Habitat Availability for Golden-winged Warbler in the Base Case

Habitat Suitability	Regional Study Area		Local Study Area	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)
Suitable	986	26.6	0	0.0
Unsuitable	2,723	73.4	29	100.0
Total	**3,710**	**100.0**	**29**	**100.0**

Note: Some of the numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

Disturbances can have both positive and negative effects on golden-winged warbler habitat availability. Fire suppression activities within the RSA since the 1960s have likely had negative effects on golden-winged warbler habitat relative to what was historically available for this species in the RSA, because golden-winged warblers are reliant on early successional habitat. Maturation of young forests is considered a threat to golden-winged warbler populations in Canada (ECCC 2016a). Stand ages for the RSA were not provided with the land cover dataset; therefore, the age of forests in the RSA is not known precisely. It can be assumed they are at least 60 years old, as there has not been active tree harvesting activity throughout the majority of the WL site since opening in the 1960s.

Vegetation clearing can improve habitat around the disturbance perimeter by creating early succession habitats that are positively associated with species abundance (Askins 1994; Beaudry et al. 2010; Confer et al. 2011). However, vegetation clearing can also result in a net loss of habitat. Disturbances with higher edge-to-interior ratios (e.g., long and narrow disturbance area as opposed to circular) are more likely to have positive effects on golden-winged warbler habitat availability.

6.6.5.4.2 Habitat Distribution

At Base Case, suitable breeding and foraging habitat for golden-winged warbler is distributed throughout the RSA, primarily along the edges of the wetland complex that spans north-south through the centre of the WL site (Figure 6.6.4-1), and is absent within the LSA (Figure 6.6.4-2). There are many areas where broadleaf and mixedwood forest stands are adjacent to open / shrub habitat in the RSA. Avian automated recording unit acoustic surveys conducted during the late breeding period from June 12 to July 3, 2018 and early breeding period from May 9 to June 10, 2019 (6 monitoring station locations used for both years) (Dillon 2019a,b) found no evidence of golden-winged warbler presence within the WL site. Golden-winged warblers are edge habitat specialists, and edge habitat suitable for this species is increased with some types of linear development (i.e., transmission line rights-of-way that maintain some level of natural ground cover in the form of grasses, herbaceous and shrub species). Therefore, past anthropogenic activities within the RSA have likely positively affected the distribution of habitat for golden-winged warbler, due to the increased level of habitat fragmentation from linear disturbances present in the RSA. There is a maximum amount of potential benefit that linear development can have for golden-winged warbler, as extensive habitat fragmentation resulting in small forest patches may negatively affect this species. One study found golden-winged warblers do not use forest patches smaller than 10 ha (Confer and Knapp 1981). Although some forms of linear disturbance can create suitable habitat for golden-winged warbler, gaps in forest cover can also create barriers to the movement of songbirds, if they become too large. Narrow linear disturbances generally do not represent barriers to bird movement (Desrochers and Hannon 1997) and are less likely to be perceived as movement barriers by edge species such as golden-winged warblers, compared to other species of songbirds that are interior-forest specialists. There is potentially a maximum width for linear disturbances beyond which they become a barrier to bird movement; it has been shown that songbirds often avoid crossing gaps in forest cover greater than 45 m wide (Tremblay and St. Clair 2009).

Within the RSA, the availability of breeding and foraging habitat does not appear to be a limiting factor for golden-winged warbler. Linear disturbances in the RSA are generally less than 30 m wide and the RSA is composed mostly of forested habitat in patches larger than 10 ha. The linear disturbances in the RSA do not likely function as dispersal or movement barriers for this species. However, the LSA itself, which contains the WL campus, is a larger gap in forest cover that is approximately 800 m wide at the widest point. It contains a dense cluster of buildings, parking lot areas and mown / maintained turf-grass lawn. The landfill is also approximately 500 m wide at the widest point. Both areas likely serve as local barriers to golden-winged warbler movement, as they contain ground cover that is unsuitable for their nesting and foraging needs.

6.6.5.4.3 Survival and Reproduction

Canada is estimated to support 17% of the global population of golden-winged warbler, with most individuals occurring in Ontario (ECCC 2016a). Historical analysis of golden-winged warblers noted a dramatic population decline of 79% between 1993 and 2002; however, more recent analysis of BBS data suggests that golden-winged warbler populations have been stable between 1970 and 2012 (ECCC 2016a).

Golden-winged warbler is considered a priority species under the Bird Conservation Strategy with the objective of doubling current abundance (Environment Canada 2014). Golden-winged warbler was designated as Threatened by COSEWIC in 2006 and was listed under Schedule 1 of SARA as Threatened in 2007. The population objective for golden-winged warbler, as identified in the federal recovery strategy, is to maintain self-sustaining populations in the focal areas in Manitoba, Ontario and Quebec, while maintaining, at a minimum, the current abundance of approximately 35,000 pairs in Canada (ECCC 2016a).

Population data for this species are not available for the RSA; however, the RSA is located within one of the three focal areas in Manitoba (GL3) identified in the federal recovery strategy (ECCC 2016a). These focal areas are known to contain core populations that sustain the current breeding distribution and are important for expanding the population into adjacent areas (ECCC 2016a). Golden-winged warblers were not recorded in the RSA during acoustic monitoring surveys in 2018 and 2019 (Dillon 2019a,b; monitoring locations shown on Figure 6.6.4-2); however, there is possible breeding evidence for this species in the areas surrounding the two Manitoba Breeding Bird Atlas squares that overlap the RSA. No eBird sightings of golden-winged warbler have been reported in the RSA; however, there has been a recent sighting of a male approximately 11 km to the southeast, in August 2016 near Pinawa (eBird 2017).

The primary threat to golden-winged warbler populations is considered to be hybridization with blue-winged warblers (*Vermivora cyanoptera*; ECCC 2016a); however, the current range of blue-winged warbler does not approach the vicinity of the RSA (Gill et al. 2001). Further, a recent study found that only six genomic regions differ between golden-winged and blue-winged warblers (Toews et al. 2016). This suggests golden-winged and blue-winged warblers are the same species, and therefore hybridization may not be a threat to the sustainability of golden-winged warbler populations.

6.6.5.5 Bats

6.6.5.5.1 Habitat Availability

All bat species in Canada have four primary habitat requirements: overwintering sites (hibernacula), swarming sites, roosts and foraging areas. Maternity roost sites and, especially, hibernacula are considered to be the main limiting habitat features for little brown myotis and northern myotis within their ranges (COSEWIC 2013). Critical habitat for these SARA-listed bat species has only been "partially identified" for a portion of their over-all critical habitat requirements (i.e., hibernacula). It is acknowledged that protection of hibernacula alone is insufficient to meet the population and distribution objectives for the three endangered bat species (Environment Canada 2015a). Critical habitat requirements for maternity roosts and summering habitat for roosting and foraging have not yet been formally identified and are the focus of future research effort (Environment Canada 2015a).

Within the RSA, the potential for hibernacula in exposed bedrock that typically forms caves (i.e., karst topography with limestone, dolomite and gypsum-containing minerals) was coarsely assessed at an overview-level. Based on Figure 6.3.1-1, which describes regional geology in the RSA, the potential for bat hibernacula is low across the RSA, because these mineral types are not present. There have been no surveys to-date that would confirm the presence or absence of hibernacula or potential hibernacula features within the RSA; however, the potential for hibernacula to be present within the RSA is considered to be very low based on geological conditions. Although little brown myotis occasionally hibernate in anthropogenic structures (like houses), it is unlikely that this is occurring within the WR-1 building, as there are likely few gaps between the outer walls and below-grade floors that would permit entry, as there was significant shielding and barrier installation of the below-grade floors to limit the release of radioactivity during the time when the reactor was functional. The report on the results of acoustic monitoring conducted in 2015 also reported there have been no hibernacula identified within any buildings in the RSA to-date (Murrant 2016). As a final confirmation to ensure their absence, pre-demolition visual surveys will be conducted in all below-grade floors of the WR-1 building (Section 6.6.7). Foraging habitat requirements are varied between the two species representing this VC and not likely limiting in the local environment. As a result, the focus of this assessment is on potential maternity roost habitat.

Based on research conducted to-date on maternity roosting behaviour in natural habitats, older forests are generally preferred by bats, including the two species represented by this VC, likely because of higher snag availability (COSEWIC 2013). Snags contain cavities and loose bark required for sheltering roosting females and pups (Environment Canada 2015a). Little brown myotis and northern myotis show a preference for large-diameter (i.e., older) trees and little brown myotis females show evidence of philopatry in roost selection (the tendency to return to the same home area following hibernation; COSEWIC 2013; Environment Canada 2015a).

There is considerable variation in preferred roost tree species. Lacki et al. (2007) determined that little brown myotis most often roost in large trembling aspen, but also in white spruce and red spruce. Olson and Barclay (2013) found the majority of roosts located in trembling aspen or balsam poplar. In Alberta's boreal forest, females are known to locate maternity roosts in tall trees of the genus *Populus* (i.e., balsam poplar, trembling aspen and cottonwood) with early stages of decay, located in old forest stands with moderate canopy cover (Crampton and Barclay 1998). Poplar-leading deciduous and mixed forest stands are common within the RSA. However, preferred roost tree species may vary by region and availability in the forest community.

The available landcover and wetlands spatial data were used to determine a conservative, coarse-scale estimation of the availability of forests or swamp wetland types representing maternity roost habitat preferences for little brown myotis and northern myotis as follows:

- forest stands (all types); and
- treed wetlands (swamps).

A total of 3,091 ha and 0.2 ha of suitable natural maternity roost habitat for little brown myotis and northern myotis is estimated to occur in the RSA and LSA, respectively, in the Base Case, comprising 83% of total land cover in the RSA and 0.6% of total land cover in the LSA (Table 6.6.5-3).

Anthropogenic structures such as buildings, bridges and bat boxes are used for maternity roosts by little brown myotis and less commonly by northern myotis (Whitaker et al. 2006). For the purposes of this assessment, as part of a conservative approach, all mapped buildings in the RSA and LSA were considered potential suitable maternity roost habitat for little brown myotis. As of 2016, there were 128 buildings of various sizes in the RSA and 61 buildings in the LSA. A total of 4 ha and 3 ha of suitable anthropogenic maternity roost habitat for bats (primarily little brown myotis) is estimated to occur in the RSA and LSA, respectively, in the Base Case, comprising 0.1% of total land cover in the RSA and 11% of total land cover in the LSA (Table 6.6.5-3).

Table 6.6.5-3: Maternity Roosting Habitat Availability for Bats in the Base Case

Habitat Suitability	Regional Study Area		Local Study Area	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)
Suitable – Natural (both species)	3,091	83.3	<1	0.6
Suitable – Buildings (primarily little brown myotis)	4	0.1	3	11.0
Unsuitable	615	16.6	26	88.4
Total	**3,710**	**100.0**	**29**	**100.0**

In 2015, a single season of acoustic monitoring surveys were completed to determine the composition of the bat community at specific areas within the RSA and LSA (monitoring locations shown on Figure 6.6.4-2). The surveys focused on the area of the main campus, (i.e., LSA). The presence of both SARA-listed species, little brown myotis and northern myotis, was confirmed within the LSA. A summary memo from the 2015 acoustic monitoring bat surveys reported that the recordings of bats occurred at intervals spaced throughout the night, without an activity burst at sunset (Murrant 2016). The conclusion was made that this indicates bats are likely travelling to the campus area (i.e., built-up area) from farther away and not roosting within the LSA, because an initial burst of bat activity, typically observed when bats emerge *en masse* from their communal roosts at sunset, was not recorded. There is uncertainty in this conclusion, as it is possible that some locations within the LSA that have roosting bats were not within the detection range of the acoustic monitoring devices and the potential emergence of bats from some buildings or structures within the campus area was not captured. Daytime visual searches for roosting bats in the interior of the WR-1 building were conducted by CNL staff in 2021 on 4 dates (July 20, 21, 27 and 28) (McKinnon et al. 2022). A total of 18 person-hours of search effort was conducted on numerous below-ground floors of the building, including removal of suspended ceiling tiles to search above the tiles. An acoustic monitoring device (Wildlife Acoustic SM4BAT) was also installed within a crawl space and set to record from 19:48 to 04:45 between July 21 and 26. No visual confirmation of bat presence within the building (individuals or signs) was made, nor were any bats recorded by the acoustic monitoring device. There has been no physical evidence of roosting activity recorded to-date within the WR-1 Building or any buildings within the LSA (i.e., piles of bat feces/guano, or observations of bats in buildings) (Murrant 2016). Within the LSA, any building with suitable access for bat entry could potentially provide suitable maternity roosting habitat, and for the purposes of this assessment, all mapped buildings are considered potential anthropogenic roosting habitat (for little brown myotis) as part of the conservative approach.

The acoustic monitoring conducted to-date supports a conservative assumption that little brown myotis and northern myotis could be roosting within treed areas of the RSA. The nature of acoustic monitoring (which only detects individual bats moving past the detector while in flight) cannot identify the location of individual roosts in buildings or trees. Only visual roost emergence surveys can definitively confirm where bats are roosting, by observing bat emergence from the roost. Although it does not confirm individual roost locations, the use of passive acoustic detectors in habitats that contain candidate roosts can provide evidence of roosting activity within an area, as the peak in bat activity immediately following sunset indicates that bats are roosting in an area and are emerging to forage. Because the forest types present in the RSA are consistent with roosting habitat preferences and because SARA-listed bats have been recorded flying within the LSA, this assessment applies the precautionary assumption that the small treed area within the LSA and treed areas within the outer RSA could provide suitable natural habitat and likely contains maternity roosts for both bat species.

The RSA contains abundant areas of potential maternity roosting habitat for bats. The majority of the RSA has been undisturbed for the last 50+ years as a result of WL activities focused primarily within the main campus area. Fire suppression within the RSA has likely had a generally positive effect on the availability of maternity roost tree habitat for little brown myotis and northern myotis, because both of these species are more commonly found roosting in large diameter trees that are present in mature forest stands. In addition, suitable foraging habitat in the form of wetlands and riparian areas around the Winnipeg River is also abundant in close proximity to potential roosting habitats.

The clearing, building construction and maintenance of large turfgrass covered lawns within the LSA, and the presence of roads and associated infrastructure have likely reduced natural maternity roosting habitat availability within the LSA. However, as described above, these changes do not represent a complete reduction of potential roosting habitat availability for one of the two bat species. Little brown myotis are well adapted to human

disturbance and use buildings, bat houses and bridges for maternity roosts. Considering the natural and anthropogenic roosting habitat within the RSA, the availability of maternity roosting habitat is not likely a limiting factor for bats in the Base Case.

6.6.5.5.2 Habitat Distribution

In the Base Case, potential maternity roost habitat for little brown myotis and northern myotis is common and well-distributed across the RSA in the form of tree covered habitat (Figure 6.6.4-1). Required foraging habitat features (wetlands, open water features such as the sewage lagoons and east bank of the Winnipeg River) are also well distributed and commonly intersperse the potential maternity roosting habitat of the RSA. Throughout the RSA, linear features in the form of roads, the hydroelectric corridor and other gaps in forest cover create gaps and potential commuting corridors, if they are not too wide. Both species generally avoid large clearcuts in forested areas, as well as open areas (COSEWIC 2013; Environment Canada 2015a). Studies in Alberta found the center of clearcuts greater than 30 m from the forest edge were completely avoided by northern myotis and that little brown myotis traveled 2 to 2.5 times less in the center than through the forest edges or along retained stands of trees within the clearcut block (COSEWIC 2013).

The effects of edges and corridors around mature forest stands on little brown myotis and northern myotis are not well known and there are inter-specific differences among them. A number of studies suggest that some degree of forest fragmentation may be beneficial for little brown myotis (Broders and Forbes 2004; Broders et al. 2006; Ethier and Fahrig 2011; Jantzen and Fenton 2013; Segers and Broders 2014). Other studies have found that little brown myotis prefer closed and cluttered canopy areas and avoid edges (Kalcounis and Brigham 1995; Jung et al. 1999; Morris et al. 2010). The forest structure preferred by northern myotis is not well characterized; however, edge habitat around the outer limits of mature forest stands, riparian and cleared corridors (from roads and hydroelectric lines) represent potential foraging and commuting corridors (COSEWIC 2013). Consequently, not only are maternity roost and foraging habitats common in the RSA in the Base Case, they are also well connected.

Within the LSA, although potential maternity roosting habitat for little brown myotis in the form of buildings is dispersed throughout the area, with the much larger area of undisturbed forest surrounding the main campus, it does not appear to represent an area with a high likelihood of containing significant maternity roost numbers (Figure 6.6.4-2).

6.6.5.5.3 Survival and Reproduction

Little brown myotis and northern myotis occur in every province and territory in Canada (except Nunavut) and approximately 50% and 40%, respectively, of their global range is within Canada. These two bat species were listed as Endangered on Schedule 1 of SARA through an emergency listing order in 2014. The urgency of this listing was due to dramatic population declines caused by white-nose syndrome (WNS), which is a fungal disease caused by *Pseudogymnoascus destructans* that affects bats while hibernating.

White-nose syndrome causes physical damage (erosion of the skin, as well as damage to sweat glands, muscles, hair follicles and other tissue) and results in white-grey blotches on the surface of wings and ears and fuzzy white growth on the muzzle (i.e., the source of the name; Environment Canada 2015a). The physical damage causes bats to arouse from their state of torpor and expend energy that is typically reserved until spring emergence. The change in activity levels and physical damage combined are what eventually causes death (Environment Canada 2015a). Canada is currently divided into WNS-affected and non WNS-affected areas. The provinces of Ontario, Quebec, New Brunswick, Nova Scotia and PEI are considered WNS-affected and all other provinces and territories (including Manitoba) are currently non WNS-affected areas.

In general, the total population sizes of bats in Canada are not clearly known based on limitations in survey effort. However, prior to the introduction of WNS, little brown myotis was likely the most common bat species in Canada, with northern myotis also common. Populations of both species might have exceeded one million individuals (COSEWIC 2013). Since detection of WNS in 2010, the recorded population of myotis bats (which includes little brown and northern myotis) has been reduced by 94% in Nova Scotia, New Brunswick, Ontario and Quebec.

White-nose syndrome has been estimated to travel at an average rate of 200 to 400 km per year (COSEWIC 2013). It is anticipated that the entire Canadian population of little brown myotis will be affected by WNS within 11 to 22 years, or possibly sooner based on the recent confirmation of WNS in Washington State (USGS 2016). Based on modelling, little brown myotis is predicted to be functionally extirpated (i.e., less than 1% of existing population) in Canada and the United States by 2026 (COSEWIC 2013); however, this modeling did not consider higher rates of WNS survival in the north portion of the species' range than originally expected. The northern myotis population is expected to have similar declines based on the similarity of their life history characteristics (Environment Canada 2015a). Little brown myotis and northern myotis populations that overlap the RSA are currently within the non WNS-affected area of Canada. Consequently, these populations are not likely as susceptible to any additional pressures as those in WNS-affected areas to the east.

Beyond the devastating effects of WNS, other threats to little brown myotis and northern myotis have been recognized as habitat loss and degradation (at hibernacula, maternity roosts and foraging areas), disturbance or harm (through collision with or barotrauma from wind turbines, intentional harm from extermination, or unintentional harm from recreational or scientific disturbances and industrial disturbance), pollution and climate change (Environment Canada 2015a). Little brown myotis in particular are vulnerable to persecution and extermination efforts because of their tendency to roost in anthropogenic structures such as attics (Environment Canada 2015a). Extermination of large colonies can affect local populations, particularly in WNS-affected areas, but also potentially in non-affected areas, depending on local densities.

Regarding reproduction and life span, both bat species are relatively long-lived and have low reproductive rates, making their populations sensitive to increases in adult mortality and slow to recover when the population size is already small. Individuals of little brown myotis have been recorded to live to over 30 years of age (Fenton and Barclay 1980), although the average life span is thought to be shorter (COSEWIC 2013). The life span of northern myotis is at least 15 years (COSEWIC 2013).

Survivorship of both species is not well understood and there is uncertainty based on deficiencies in study design and analysis used in studies that have reported survival rates (COSEWIC 2013). Survival rates are lowest in the first year of life because juveniles often lack sufficient fat reserves needed for hibernation (COSEWIC 2013). Females of both species start breeding after their first year and continue breeding annually. Females give birth to one pup per year after 44 to 60 days of gestation. For little brown myotis, which are more widely studied, reproductive rates seem to decline with increasing latitude; a reproductive rate of greater than 96% was recorded in the eastern United States, with lower rates of 33% to 74% in the Yukon (COSEWIC 2013). In summary, because the RSA is within a non WNS-affected area, survival and reproduction of bat populations overlapping the RSA are not likely impaired at the Base Case, assuming WNS has not yet passed from Ontario into Manitoba.

6.6.5.6 Snapping Turtle

6.6.5.6.1 Habitat Availability

Snapping turtle are considered one of the most aquatic freshwater turtle species in Canada (i.e., they are primarily located in wetted habitats) and their preferred aquatic habitat consists of shallow, slow-flowing, permanent streams, lakes and ponds with soft mud substrate and dense aquatic vegetation (Canadian Herpetological Society 2020; COSEWIC 2008; ECCC 2016b). Based on records from established snapping turtle populations in Canada, natural habitat types typically include wetland habitats such as marshes, swamps, peat bogs; lentic habitats including ponds and lake edges and shallow bays, as well as lotic habitat, including river edges and slow-moving streams (ECCC 2016b). Overwintering habitat is also aquatic, as snapping turtle also typically hibernate in lentic or lotic habitat, beneath a thick layer of mud (ECCC 2016b).

Upland (terrestrial) habitat is also required by snapping turtle, for nesting and overland migration to/from nesting and aquatic habitats. Nesting habitat consists of exposed sand or gravel substrate adjacent to water and can be located on road shoulders (which are present within the RSA and LSA). Movement corridors to and from bodies of water are also required habitat components and this type of terrestrial habitat is particularly important if local aquatic habitat conditions become unfavourable and overland migration to areas with better conditions is undertaken (ECCC 2016b). Although terrestrial habitat is important, the focus of this spatial habitat assessment is on aquatic habitat, with particular focus on aquatic habitat near roadways. Road crossings of streams represent one of the largest threats to the species (road mortality during overland migration), and also a primary pathway of effects for this project. The chain link fencing surrounding the LSA greatly limits the potential for snapping turtle access and habitat use within the LSA.

The land cover and wetlands spatial data were used to determine a conservative, coarse-scale estimation of the availability of aquatic habitat for snapping turtle as follows:

- waterbodies; and
- marsh wetlands.

The highest quality potentially suitable aquatic habitats for snapping turtle in the RSA are wetlands and watercourses that are located 500 m and 2 km and 2.5 km southeast of the LSA, near Ara Mooradian Way and connected to the Winnipeg River. There is no suitable aquatic habitat within the LSA (Table 6.6.5-4).

Table 6.6.5-4: Aquatic Habitat Availability for Snapping Turtle in the Base Case

Habitat Suitability	Regional Study Area		Local Study Area	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)
Suitable	43	1.1	0	0.0
Unsuitable	3,667	98.9	29	100.0
Total	**3,710**	**100.0**	**29**	**100.0**

6.6.5.6.2 Habitat Distribution

Approximately 10% of the snapping turtle range is contained within Canada. Snapping turtle have been recorded in the Winnipeg River near the Project location (Canadian Herpetological Society 2020) and within the RSA, by the Manitoba Herps Atlas (Manitoba Herps Atlas 2016) and CNL staff (CNL 2022b). The highest likelihood areas of suitable habitat for snapping turtle in the RSA is limited to wetlands and streams that are connected to the Winnipeg River and the sewage lagoons north of the LSA (Figure 6.6.5-1). Potential natural aquatic habitat is located from 500 m to 2.5 km southeast of the LSA, but there is no suitable habitat within the LSA itself (Figure 6.6.5-2). The Winnipeg River shoreline is expected to provide higher quality habitat than wetlands in the RSA. Although there have been no habitat assessments or turtle nesting surveys completed in the RSA, there is potential for snapping turtle to use roads such as Ara Mooradian Way as travel corridors and possibly the gravel shoulders of the roads as nesting areas. Snapping turtle have been incidentally observed and recorded by staff on the WL site on site roads (CNL 2022b).

6.6.5.6.3 Survival and Reproduction

Snapping turtle populations are primarily limited by this species' late age of maturity, long lifespan, high adult survival and slow recruitment (COSEWIC 2008). Females in southern populations reach sexual maturity at 12 years of age, while individuals in more northern populations (e.g., in Manitoba) reach sexual maturity between 15 and 20 years of age (COSEWIC 2008). Lifespan in the wild is largely unknown but is has been suggested that individuals can live over 100 years (COSEWIC 2008). Females lay approximately 40 eggs in late May to June (COSEWIC 2008).

Snapping turtle populations are particularly vulnerable to increases in adult mortality and do not recover quickly from declines. It has been suggested that a 0.1% increase in annual adult mortality rate will cause a population to be halved in under 20 years (COSEWIC 2008). A primary cause of adult mortality is from traffic, especially on roads located through or adjacent to wetlands (COSEWIC 2008). Female turtles are most vulnerable to mortality from vehicle collisions during the reproductive season because females frequently cross roads in search of nesting sites and soft gravel road shoulders are attractive nesting sites (Aresco 2005; COSEWIC 2008). In populations with high mortality of females from road mortality, the sex ratio of the population can become highly skewed towards males. In an area of New York State with high road density, a population of snapping turtles was found to be made up of 95% males (Steen and Gibbs 2004). Other causes of adult mortality include fishing (swallowing hooks or being hooked by anglers), human persecution and legal and illegal hunting.

Eggs and juveniles are susceptible to nest predation (particularly in road rights-of-way and areas with high road densities; Browne 2003), contaminants (Bishop et al. 1998) and short, cool summers in the northern portion of this species range, which affect hatching success as embryo development is temperature dependent (COSEWIC 2008).

6.6.5.7 Traditional Knowledge

This section summarizes observations and concerns shared by Indigenous Nations in their Traditional Land Use and Occupancy Studies. The following are quotes relevant to the terrestrial environment.

From the Sagkeeng First Nation:

> *And the berries, of course, those are very important. And as far as I can remember, the wild berries were so important. And now they're so, so tiny. And so scarce and so tiny. I remember them being so huge and luscious. And I remember how important those were. That was part of our diet. And now, when you go out you can walk for miles and miles and miles and when you do find them, they're so puny and so – and they used to be so huge."* (Firelight Group Inc and Sagkeeng Anicinabe 2018)
>
> *I looked at the trees [in the Project Footprint] and I noticed how skinny they were. I says why are your trees so skinny, you know? ... But the trees, I found them really, really skinny. So maybe it's from the soil, you know?"* (Firelight Group Inc and Sagkeeng Anicinabe 2018)
>
> *You know, there was a lot of deer or whatever back there [Project Footprint]. There was lots back then. You could see them all the time. Here now you got to wait for them. You got to wait and wait. Back then these people just seen them all the time. It wasn't hard for them to go get a moose or a deer or something like that eat. Not like today. Everything is scared off and they're hiding somewhere."* (Firelight Group Inc and Sagkeeng Anicinabe 2018)
>
> *Well, even them [rabbits] are hard to come by now. There's not too many of them. Not like, I guess, you know in the 70s, there used to be lots of them and, now there's hardly any. Hardly see them now...Well, you know, they were supposed to die out every seven years, but, that's more than seven years now that, you know, it's hardly any now. It's, I guess, maybe the weather affecting them...The food that they eat. Hardly any. I know, in the 70s there, yeah, in the 70s, me and, my wife used to go out in the moonlight there and, shoot them. Yeah. But, you know, after that, you know, she couldn't kill any more. So, we stopped. We used to go out and, shoot 20, 25, like, you know in not even an hour, because, they'd be sitting in the moonlight, on the trails. But, now there's none."* (Firelight Group Inc and Sagkeeng Anicinabe 2018)

From Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation:

> *"Wild rice is dying out because of contamination. It used to be a good crop. I used to go to the Whiteshell every fall to pick wild rice."* (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019)
>
> *"Wild rice was good years ago, now there isn't much wild rice."* (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019)
>
> *"Rabbits are found with pus under their fur, foxes without fur on their tail, and deer are acting crazy because of contamination and disease."* (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019)
>
> *"There are clear signs of sickness in animals throughout our Traditional Territory. Moose have brain worms and rot in their meat, so they cannot be eaten. Disease is spread from deer and also because they are*

eating polluted roots from the river." (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019)

"There used to be muskrats, beaver, ducks - all types on wildlife in the river. Now you don't see it because the river is contaminated." (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019)

From the Manitoba Metis Federation:

Interviewer 1: "Is there anywhere of that you know of that is good mammal habitat near the site?"

Interviewee: "For deer? Oh yeah, all along the river pretty well, there's a lot of, there's some brush, good places for them to hide. And I know, you see them with their young a lot, in those places. Actually, right around the ACL here too, I know, I don't hunt there but I know there's- you aren't really supposed to, there is a lot of deer in that area."" (SVS 2019)

For further information on how CNL incorporated traditional knowledge into the EIS refer to Section 4.3 Influence of Traditional Knowledge in the Environmental Assessment and to Section 5.0 Traditional Land and Resources Use of the Indigenous Engagement Report (CNL 2022a).

6.6.6 Project Interactions and Mitigation

6.6.6.1 Methods

This section describes the process by which interactions between Project components and activities and the terrestrial environment were identified and evaluated. Potential effect pathways are identified, and mitigation developed to eliminate and/or reduce effects is presented. A pathways analysis is then used to focus the assessment on key interactions between the Project and the terrestrial environment by evaluating the different effect pathways to determine if, after incorporation of mitigation, there is still potential to cause residual effects. Where effects will be adequately mitigated and are not forwarded for further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are articulated. Primary pathways that may lead to residual effects after incorporation of mitigation are further characterized in the assessment. As such, this section helps to focus the remainder of the assessment on those interactions (effects pathways) likely to result in residual adverse effects.

The first part of the analysis was to identify the potential effects pathways for all phases of the Project. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. The next step in the analysis was the development of environmental design features and mitigation that could be incorporated into the Project to eliminate and/or reduce adverse effects on the terrestrial environment. Environmental design features included Project design elements, environmental best practices and management policies and procedures. Environmental design features and mitigation were developed through an iterative process between the Project's engineering and environmental teams, combined with input from Project-specific or regional engagement with other interested parties. The environmental design features and/or mitigation were selected considering their effectiveness for implementation and maintenance and their appropriateness within the context of the identified effect pathways.

After incorporation of mitigation, potential pathways were evaluated into the following categories using scientific knowledge, logic, experience with similar developments and the effectiveness of environmental design features and mitigation:

- **No linkage pathway –** pathway is removed by environmental design features or mitigation such that the Project would not be expected to result in a measurable environmental change relative to Base Case values and therefore would have no residual effects on the terrestrial environment.
- **Secondary pathway –** the pathway could result in a measurable minor environmental change but would have a negligible residual effect on the terrestrial environment relative to Base Case and/or guideline values and is not expected to contribute cumulatively to other Project effects or to the effects of other past, present or reasonably foreseeable developments to cause a significant effect.
- **Primary pathway –** the pathway is likely to result in an environmental change relative to the Base Case and/or guideline values that could contribute to residual effects on terrestrial environment.

Environmental design features and mitigation that have been or could be incorporated into the Project to eliminate and/or reduce adverse effects were considered. Potential pathways that were completely removed due to implementation of environmental design or mitigation were not assessed further. Pathways that were assessed to be secondary and demonstrated to have a negligible residual effect on terrestrial environment through simple qualitative or semi-quantitative evaluation of the pathway were also not advanced for further assessment. Primary pathways are carried forward for more detailed quantitative and/or qualitative effects analysis to characterize the residual effects of the Project.

6.6.6.2 Results

Potential interactions between the Project and terrestrial environment VCs are presented in Table 6.6.5-1. Mitigations identified to address and, if possible, remove potential interactions between the Project and terrestrial environment are also integrated into the pathway analysis presented in Table 6.6.5-1.

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Table 6.6.5-1: Pathways Analysis for Terrestrial Environment Valued Components

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
Construction of temporary supporting infrastructure during decommissioning (e.g., batch mixing plant or other similar equipment for preparation of grout)	Potential loss or alteration of wildlife habitat from demolition of the WR-1 Building and construction of temporary supporting infrastructure.	■ The Project is located in an already disturbed area. ■ Temporary supporting infrastructure will be located within the LSA (i.e., previously disturbed and developed area). ■ Erosion and sediment control practices (e.g., silt fences, runoff management) applicable to the region and already in place at the RSA will be used during decommissioning activities around disturbed areas, where appropriate. This will reduce the potential for effects on adjacent natural areas that provide suitable wildlife habitat.	No Linkage

Activities associated with in situ disposal (ISD) of WR-1 and demolition of above-ground structures of the WR-1 Building	■ Potential mortality or injury to wildlife (particularly snapping turtle) from movement of decommissioning-related heavy equipment and other vehicles on roads.
	■ Sensory disturbance from increased noise levels created by ISD of the WR-1 and demolition of above-ground structures of the WR-1 Building.
	■ Potential loss of nest/roost substrate for barn swallow and little brown myotis within WR-1 Building.
		■ Wildlife have the right of way.
		■ Employees and contractors are provided with standard safety training and environmental awareness training.
		■ Enforcement of existing CNL property speed limits on access roads (90 km/hr or 60 km/hr for vehicles transporting dangerous goods).
		■ CNL will:
		  ▪ Post turtle crossing warning signage at the existing watercourse crossings on Ara Mooradian Way approximately 300 m south of the LSA fenceline and at 2 km and 2.5 km south of the LSA fenceline, where snapping turtle are likely to cross.
		  ▪ Install reptile and amphibian fencing at these three potential crossing locations, or alternate locations to be determined by CNL biologists based on a combination of turtle observation data and assessment of suitable habitat adjacent to Ara Mooradian Way.
		  ▪ Implement routine annual wildlife road surveys using protocols for road surveys available from other Canadian jurisdictions for similar species (e.g., Survey Protocol for Blanding's Turtle in Ontario [MNRF 2015]), to be conducted when snapping turtles are likely to cross (i.e., terrestrial life history period from May 1 to September 30).
		  ▪ Based on results of routine wildlife road surveys, evaluate implementation of traffic calming measures during the season when snapping turtles are expected to cross the road (i.e., terrestrial life history period from May 1 to September 30). These may include options such as further reduction of posted speed limit, installation of speed bumps, or other measures.
		■ As per CNL's *Management of Land, Habitat and Wildlife* (CNL 2018a), dead or wounded animals on roads must be reported to the Environmental Protection department.
		■ Wildlife collisions with vehicles will be monitored, which provides feedback for adaptive management (and the potential need for more signage, extension of existing fencing, or other fencing to restrict wildlife access to road surfaces).
		■ Decommissioning activity will be primarily limited to daytime hours and noise will be short-term and sporadic. Decommissioning of the WR-1 Building will be completed in a controlled manner and no blasting will be required. The loudest decommissioning activity will be jack hammering to remove deeply embedded contaminants in concrete – this activity will be limited to the interior of the building envelope, which will serve to reduce the level of noise outside the building and in the surrounding RSA where there may be wildlife present.
		■ Pre-disturbance surveys by suitably trained and experienced biologists or environmental specialists will be conducted to confirm presence/absence of little brown myotis roosts and active barn swallow nests inside the WR-1 Building prior to removal of suitable nesting areas (assumed to be limited to above-grade building structures). Surveys to be conducted the year prior to initiation of decommissioning, during the appropriate season, over multiple visits, if necessary.
			Secondary

Table 6.6.5-1: Pathways Analysis for Terrestrial Environment Valued Components

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
Activities associated with in situ disposal (ISD) of WR-1 and demolition of above-ground structures of the WR-1 Building	■ Potential mortality or injury to wildlife (particularly snapping turtle) from movement of decommissioning-related heavy equipment and other vehicles on roads. ■ Sensory disturbance from increased noise levels created by ISD of WR-1 and demolition of above-ground structures of the WR-1 Building ■ Potential loss of nest/roost substrate for barn swallow and little brown myotis within WR-1 Building	■ As a precaution, pre-disturbance searches for hibernating little brown myotis will also be conducted during the winter prior to the initiation of decommissioning to confirm the absence of hibernating individuals inside the below-grade floors of the WR-1 Building, taking As Low As Reasonably Achievable (ALARA) into consideration. ■ If active bat maternity roosts or barn swallow nests are identified in any structure to be affected by decommissioning, initiate erection of species-appropriate barriers once individuals have left the structure and roosts/nests are no longer active.	Secondary
	Release of chemical and radiological contaminants during the closure phase.	■ As part of CNL's licence with the CNSC, environmental monitoring around the WL site is required and will continue for the Project. ■ Follow-up monitoring during the closure phase will be completed to verify effects predictions and to provide information for use in adaptive management to address potential unforeseen effects.	Secondary
	Air and dust emissions (including sulphur dioxide, nitrogen oxides and particulate matter) and subsequent deposition.	■ Implementation of CNL's *Environmental Protection* (CNL 2021) and *Management and Monitoring of Emissions* (CNL 2018b), which includes operational control monitoring, air verification monitoring and environmental monitoring. ■ Implementation of dust management techniques to control dust generated by the Project, consistent with the current Environmental Assessment Follow-up Program. ■ Use of contamination immobilization agents, containment, ventilation and HEPA filters to control generation of airborne emissions during decontamination or removal of contaminated systems or structures. ■ Use of dust suppression methods during building demolition or soil remediation activities to control airborne emissions and nuisance dust during building demolition or soil remediation. Methods may include: ▪ wetting techniques during demolition to limit mobility of dust; ▪ wind restrictions during demolition to stop work or apply wetting techniques; and ▪ hydro seeding during backfilling and landscaping to reduce soil erosion. ■ Road watering and chemical dust suppressant when necessary. Dust suppressant is already used annually at the site for select unpaved roads. ■ Removal of accumulations of particulates (e.g., dirt) on road as soon as possible. ■ On-site vehicles and equipment engines will meet Tier 3 emission standards, where possible, and be maintained in good working order. ■ Limit idling of vehicles on-site and speed on roads. ■ Use of tarps or 3-sided enclosures for raw material storage.	Secondary
Installation of concrete cap and engineered cover over the grouted WR-1 Building and final restoration	Potential introduction and spread of noxious weed species during decommissioning and reclamation.	■ Locally-appropriate grass seed mixtures that are certified weed-free will be applied to any cleared and reclaimed areas as soon as practical following decommissioning. ■ Upon completion of the installation of the concrete cap and engineered cover over the grouted WR-1 Building, turf grass will be established and maintained. Turf grass establishment methods will include selective herbicide application to remove weeds prior to grass seeding and watering of newly seeded areas until grass has established. Maintenance of the concrete cap and engineered cover during the institutional control period includes restricting weed establishment and preventing surface erosion and abrasion. ■ The former WR-1 Building location will be fenced around the perimeter with six foot-high chain link fence. This will serve to reduce access to ground-based wildlife species. The concrete cap and engineered cover will be maintained during the institutional control period to deter wildlife and avoid the disruption of roots to the Whiteshell Reactor Disposal Facility.	No Linkage
Post-closure Performance	Release of chemical and radiological contaminants in the long-term during the post-closure phase.	■ As part of CNL's licence with the CNSC, environmental monitoring around the WL site is required and will continue for the Project. ■ Follow-up monitoring during the post-closure phase will be completed to verify effects predictions and to provide information for use in adaptive management to address potential unforeseen effects.	Secondary

6.6.6.2.1 No Linkage Pathways

The following pathways were assessed as having no measurable environmental change and hence, no linkage to residual effects on VCs for the terrestrial environment.

- **Potential loss or alteration of wildlife habitat from demolition of the WR-1 Building and construction of temporary supporting infrastructure.**

The footprint of the WR-1 Building is approximately 0.07 ha; and it is located in an area that has been previously disturbed, where wildlife habitat value is considered to be negligible to low. In addition, temporary supporting infrastructure will be located within the LSA on previously disturbed and developed areas. Therefore, the Project is not expected to result in an incremental loss of wildlife habitat from current conditions at the WL site. Erosion and sediment control practices (e.g., silt fences, runoff management) applicable to the region and already in place at the RSA will be used during decommissioning activities around disturbed areas, where appropriate. This will reduce the potential for effects on adjacent natural areas that provide suitable wildlife habitat. Consequently, this interaction was determined to have no residual effect on the maintenance of self-sustaining and ecologically effective wildlife populations in the RSA.

- **Potential introduction and spread of noxious weed species during reclamation can affect vegetation community species composition.**

Reclamation of temporarily disturbed areas and the former WR-1 Building site has potential to introduce noxious weed species listed under the *Noxious Weeds Act* of Manitoba. There is also potential to introduce invasive plant species into new areas, which can disrupt adjacent natural vegetation communities and decrease habitat quality (Mack et al. 2000; Carlson and Shepherd 2007; Truscott et al. 2008). Weed species introduced into natural areas have the potential to affect plant community structure and species diversity directly through competition and indirectly through alterations to soil microorganisms, nutrients and soil moisture (Mack et al. 2000; Truscott et al. 2008).

The majority of weed species introductions arise from human transport (Mack et al. 2000; Reichard and White 2001) and roads also act as dispersal route and habitat for weed establishment (Parendes and Jones 2000). Ara Mooradian Way is the primary access route to the site and provides a means of ingress for noxious weed species through direct dispersion of plant propagules (seeds and/or vegetative parts) from vehicles and machinery, and indirectly through the formation of suitable sites for weeds, in the form of disturbed road edges. Many weed species are able to spread more easily in landscapes that have been fragmented, often become established along edge habitats, such as disturbed road edges associated with transportation corridors (Lafortezza et al. 2010).

Preventing weed species from entering an area is often more efficient and cost effective than dealing with their removal once established (Clark 2003; Polster 2003; Carlson and Shephard 2007). Locally-appropriate grass seed mixtures that are certified weed-free will be applied to any cleared and reclaimed areas as soon as practical following decommissioning. This will reduce the potential for the establishment and spread of invasive plant and weed species. Upon completion of the installation of the concrete cap and engineered cover, turf-grass will be established and maintained. Turf-grass establishment methods will include selective herbicide application to remove weeds prior to grass seeding and watering of newly seeded areas until grass has established. Maintenance of the concrete cap and engineered cover during the institutional control period includes restricting weed establishment and preventing surface erosion and abrasion.

The implementation of mitigation will reduce the potential for introduction of weed species during decommissioning activities. Some localized introduction of weed and invasive species may occur, but mitigation to address these identified in Table 6.6.5-1 would result in no measurable changes to the abundance and distribution of natural wildlife habitat relative to Base Case conditions. Therefore, this interaction was determined to have no residual effect on the maintenance of self-sustaining and ecologically effective wildlife populations in the RSA.

6.6.6.2.2 Secondary Pathways

The following pathways were assessed as potentially having a measurable minor environmental change, but negligible residual effect on the terrestrial environment relative to Base Case.

- **Sensory disturbance from increased noise levels created by ISD of WR-1 and demolition of above-ground structures of the WR-1 Building.**

Short-term sensory effects of noise from ISD of WR-1 and demolition of above-ground structures of the WR-1 Building has the potential to affect golden-winged warbler. Noise levels greater than 50 dB can negatively affect local birds, including golden-winged warbler, and may lead to temporary displacement if birds avoid otherwise suitable habitat in areas of the RSA adjacent to the LSA where decommissioning activities create noise levels greater than 50 dB. It should be noted that this displacement would only occur if noise at that level is propagated to the required distance to suitable habitat. If experienced at sufficient levels, noise can also potentially reduce reproductive success and survival by raising stress levels and interfering with communications (e.g., reducing ability to hear approaching predators or intraspecific vocalizations; Ortega 2012).

Short-term sensory effects of noise from decommissioning activities also have the potential to affect bat survival by altering their ability to effectively carry out echolocation (Mackay and Barclay 1989; Schaub et al. 2008; Siemers and Schaub 2011). Available research has not resulted in definition of measurable thresholds that may negatively affect bat activity (e.g., dB levels). The pathway of this potential effect is limited by the primary work period (during daylight hours, when bats are inactive), and because bats are highly mobile, they are also able to avoid areas with elevated noise. Noise could also result in adverse changes to the availability of potential bat maternity roosting habitat in the RSA area outside of the LSA, if the level of disturbance causes avoidance and abandonment of occupied maternity roosts. Detailed information on how bats respond to anthropogenic noise is limited and varies among species; however, it is known that female bats may abandon their maternity roosts and young if noise is at a sufficient level. Bats have been found to abandon roosts when they are directly disturbed by human activity, especially those causing loud and sudden noises (California Department of Transportation 2016).

The creation of noise likely represents more of a potential effect on habitat availability for both golden-winged warbler and bats and any wildlife species in proximity to the LSA, if the noise causes individuals to avoid previously occupied breeding or maternity roost habitat that is in or around areas with high noise levels. However, this potential effect is reduced by a number of factors. The closest potential natural bat maternity roosting habitat (forested land) is approximately 250 m away from the SSA and there is already anthropogenic activity ongoing within the LSA that bats would have become habituated to since the inception of WL in the 1960s. Similarly, for golden-winged warbler, there is mapped suitable habitat present in the area surrounding the LSA; however, the ongoing anthropogenic activity has likely habituated songbirds to ongoing noise levels and disturbance. In addition, the predicted level and nature of noise associated with decommissioning activities (with the loudest activity occurring inside the building), and the attenuation of noise that occurs with distance and tree cover. As a result, noise is expected to have a negligible effect on golden-winged warbler and bat survival and reproduction or habitat availability.

- **Potential mortality or injury to wildlife (particularly snapping turtle) from movement of decommissioning-related heavy equipment and other vehicles on roads.**

The ISD of WR-1 will have project-associated vehicular traffic, primarily along Ara Mooradian Way. This could result in increased injury and mortality to wildlife VCs, particularly snapping turtle. The risk of vehicle-wildlife collisions is not uniform with regards to species, as species with small size and slow speed (e.g., amphibians and turtles) have a higher mortality risk from crossing roads than larger and/or more mobile species (e.g., birds; Hels and Buchwald 2001; Fahrig and Rytwinksi 2009).

Traffic speed and volume are the primary factors that contribute to road-related wildlife mortality. Speed limits (90 km/hr or 60 km/hr for vehicles transporting dangerous goods) are clearly posted on the main access road (Ara Mooradian Way) and enforced to mitigate against potential wildlife mortalities during decommissioning, as well as all other WL site activity. In addition, CNL staff have standard safety training and are provided with environmental and wildlife awareness training. It is expected that this will serve to reduce the risk for vehicular collision with avian and bat VC species, as well as other large mammals that frequent the RSA such as deer.

CNL will also enact the following mitigation measures related to vehicle-wildlife interactions, particularly considering snapping turtle, in advance of the Project:

- Post turtle crossing warning signage at the existing watercourse crossings on Ara Mooradian Way (approximately 300 m south of the LSA fenceline and at 2 km and 2.5 km south of the LSA fenceline), which represent the three highest potential snapping turtle crossing locations (the closest two locations are shown on Figure 6.6.4-2).
- Install reptile and amphibian fencing at these three potential crossing locations, or alternate locations to be determined by CNL biologists based on a combination of turtle observation data and assessment of suitable habitat adjacent to Ara Mooradian Way. Fencing should be checked annually, in early May of each year, to confirm it is still functional for directing reptiles and amphibians through culverts versus the road surface. If required, maintenance or replacement should occur to maintain effectiveness.
- Implement routine annual wildlife road surveys using protocols for road surveys available from other Canadian jurisdictions for similar species (e.g., Survey Protocol for Blanding's Turtle in Ontario [MNRF 2015]), to be conducted when snapping turtles are likely to cross (i.e., terrestrial life history period from May 1 to September 30).
- Based on results of routine wildlife road surveys, evaluate implementation of traffic calming measures during the season when snapping turtles are expected to cross the road (i.e., terrestrial life history period from May 1 to September 30). These may include options such as further reduction of posted speed limit, installation of speed bumps, or other measures.

Suitable design and materials for fencing will reflect Best Management Practices available from other Canadian jurisdictions with similar species (e.g., Best Management Practices for Mitigating the Effects of Roads on Amphibian and Reptile Species at Risk in Ontario; MNRF 2016). The length of fencing required at each culvert crossing location will depend on the area of suitable habitat on both sides of the roadway and require on-site assessment by a biologist to determine what length is required to funnel turtles toward the culvert and keep them off the road. Fencing will require monitoring and maintenance to ensure it remains effective over the duration it is in place.

Considering the mitigation to be implemented in advance of the Project (i.e., speed limits and staff awareness training for wildlife, signage to alert drivers at turtle crossing locations, installation of fencing as access barriers and funnels at high potential crossing locations and enactment of wildlife patrolling) increases in vehicle traffic during decommissioning activities is expected to result in a minor increase in mortality risk to wildlife populations as compared to Base Case conditions. It should be noted that there have been no reported road mortalities of snapping turtles at the WL site to date, but there has been reported road mortality of painted turtles near the sewage lagoons (CNL 2022b). Overall, collisions with vehicles are expected to have negligible residual effect on wildlife populations (and snapping turtle in particular) and are not predicted to affect the maintenance of self-sustaining and ecologically effective wildlife populations that overlap the RSA. A follow-up monitoring program to address the uncertainty regarding the effectiveness of this mitigation for protecting snapping turtle populations is described in Section 6.6.7 Monitoring and Follow-up.

- **Potential loss of nest/roost substrate for barn swallow and little brown myotis within WR-1 Building.**

The MBCA prohibits the destruction of migratory bird nests during the breeding season and the SARA protects critical habitat of Endangered or Threatened species listed on Schedule 1, once it has been defined in a recovery strategy. Residences (nests) of SARA-listed species are immediately protected from damage or destruction, once the species is listed on Schedule 1. In the RSA (Zone C4), the migratory bird breeding season for all habitat types (forested, open and wetlands) extends from April 14 to August 27 (ECCC 2016c). The only VC bird species likely to nest in an area to be directly affected by decommissioning of the WR-1 Building is barn swallow. A nest survey was completed in the summer of 2015 and no barn swallow nesting activity was found on the outside of the WR-1 Building (CNL 2016c); however, CNL staff have reported barn swallow do nest in many other buildings within the LSA (CNL 2017). Barn swallows commonly reuse nests from previous years (Brown and Brown 2019). Because there has been no nesting activity on the WR-1 Building to-date, it is less likely that new nests will be established on, or in, the WR-1 Building before demolition. However, the potential remains for new nests to be created on the building exterior.

A detailed pre-disturbance survey for nesting barn swallow will be conducted in the summer preceding the initiation of decommissioning activities in the WR-1 Building. A suitably trained biologist or environmental specialist will conduct a minimum of two visual surveys during the appropriate nesting season and weather conditions to confirm the presence/absence of barn swallow nesting activity on all external structures of the WR-1 Building. If there are no barn swallow nests observed, no further exclusion methods will be required, if the building will be demolished before the start of the breeding season in the following year. If demolition activities are not initiated prior to the start of the breeding season, deterrents will be installed at any potential barn swallow nesting areas (e.g., overhanging rooflines). In keeping with guidance from ECCC, deterrents may only be installed outside of the barn swallow occupation period, which in Manitoba, is between May 1 and August 31 (Government of Canada 2019). This will serve to reduce the likelihood that new barn swallow nests will be created on the building exterior.

If barn swallow nesting activity (or nesting activity of any other species – including Peregrine falcon) is observed on the WR-1 Building, the locations of any nests will be recorded and nest activity monitored until the young have fledged. For barn swallow this can occur as late as September, as there can be two broods per season in Manitoba (COSEWIC 2011). If they are found nesting on the WR-1 Building, appropriate mitigation would then be put into place following consultation with and approval by ECCC, in accordance with habitat protection provisions and permitting requirements under SARA and/or MBCA. In order to avoid new nests from being built on the WR-1 Building the next year (when demolition is to commence), species-specific and appropriate deterrents may be installed the year before demolition activities commence but again, only outside of the barn swallow occupation period. In locations where there are active nests, this period is between May 1 or the date when adults are first

observed building or occupying a nest (whichever is earlier) and August 31 or the date when an adult is last observed on the nest (whichever is later) (Government of Canada 2022). This could include installation of netting to block the area used as nest substrate and any other similar areas where nests may be built (e.g., overhanging roofs) or to adjust the timing of activities.

Little brown myotis and northern myotis are SARA listed species. There are prohibitions against killing or harming individuals or destroying a residence, including actively used maternity roosting habitat. This risk is highest for little brown myotis, which are commonly known to roost in buildings, and much less so for northern myotis, as they are less frequently documented to roost in anthropogenic structures and typically only resort to them if natural tree roosting habitat is fragmented and less available (Environment Canada 2015a). Little brown myotis show a high degree of philopatry (tendency to return to the same home area each year) and site fidelity (individuals will tend to roost in the same sites and buildings once established; Environment Canada 2015a). They also are highly loyal to roost locations in anthropogenic structures (like buildings), with some sites used continually for 50 years or more (Environment Canada 2015a). This site fidelity behaviour would mean that because there has been no roost activity identified within the WR-1 Building to-date (surveys conducted in 2015 and 2021), there is lower likelihood that a new roost would be established in the building, prior to the initiation of decommissioning activity. Pre-disturbance surveys to confirm the absence of roosting bats will be conducted in the following phased approach.

Female bats form maternity roost colonies to give birth and raise their young; most young are born in late-June or early-July and are weaned at 26 days of age (COSEWIC 2013). Roosts are also used during the pre-maternity roosting period and swarming period. Therefore, the bat roosting period is assumed to be from May 1 to August 31. A survey for roosting bats will be conducted in the summer preceding the initiation of decommissioning activities in the WR-1 Building. Visual surveys for evidence of roosting bats and roost emergence surveys will be conducted, using hand-held acoustic bat monitoring detectors (to determine species identification), on all four sides of the building exterior. The objective of these surveys is to visualise and confirm bats exiting from any potential roosting locations within the building. This monitoring will be conducted in the summer – from June to July – during the expected period of highest bat activity in the RSA. Monitoring will be conducted for a minimum of two nights, during suitable conditions (i.e., not on nights with rainfall events or high winds). If there are no bats detected leaving the WR-1 Building, it can be concluded that bats are not likely roosting in the building and no further survey or exclusion effort is required.

If the visual roost emergence survey of the WR-1 Building determines there is active bat maternity roosting occurring in the building, any potential access point to the roost location will be blocked from the outside, once the maternity roosting period is completed (i.e., mid-August). Exclusion tubes (following Bat Conservation International designs; BCI 2014) will be installed at all observed and potential bat access points on the building envelope. These tubes will allow any remaining bats to exit the building, but will not permit re-entry. At the end of October, permanent exclusion materials can be installed on these above-ground, exterior portions of the building, as per the Bat Conservation International guidelines (BCI 2014), if necessary.

Pre-disturbance searches for hibernating little brown myotis will be conducted during the winter prior to the initiation of decommissioning to confirm the absence of hibernating individuals inside the below-grade floors of the WR-1 Building. Starting in November of the calendar year prior to decommissioning activities, searches will be conducted for hibernating bats. An appropriate survey method will be used, which may include the use of a laser thermometer or thermal imaging camera. The laser thermometer survey method is described as follows: a surveyor will use a laser thermometer to measure the ambient temperature of the walls and ceilings on each sub-surface floor of the WR-1 Building, along perimeter walls. If the temperature on the ceiling and/or walls on a particular floor is above 15°C (the suitable temperature for hibernacula described in the recovery strategy is 2°C to 10°C),

no further surveys will be performed, as the temperature on that floor is too high for hibernation. On any floor where there are ambient ceiling and/or wall temperatures between 2°C to 10°C, all available lights will be turned on and a suitably trained biologist or environmental specialist will use a high-powered spotlight to search all surfaces of the walls and ceiling for individual hibernating little brown myotis. Searches for guano (to be distinguished from mouse feces) will also be conducted. If there are no bats detected within the below-grade floors of the WR-1 Building, it can be concluded that bats are not hibernating in the building and no further survey or exclusion effort is required.

The guidance document for federal land managers regarding the emergency listing order for little brown myotis, northern myotis and tri-colored bat (Environment Canada 2015b) suggests if active bat roosts are found in a building on a federal site, managers should consider installation of alternate roosting habitat in the form of bat boxes. Offsetting the removal of unoccupied bat maternity roost substrate (buildings) is not required under SARA. Bat boxes can be highly effective at providing habitat for roosting little brown myotis and possibly northern myotis, both of which are currently listed as endangered across Canada due to the effects of WNS.

As a proactive approach and in consideration of all future decommissioning and building demolition activities that will occur on the WL site, barn swallow nesting structures with nest cup design examples (BSC 2017), were installed by CNL in 2018 to compensate for potential future loss of anthropogenic barn swallow nesting habitat. If bats are found to be roosting in the WR-1 building, or any other anthropogenic structures on the WL site, additional installation of bat boxes as compensatory habitat would be initiated. CNL has made a corporate commitment to sustainable development and responsible environmental stewardship at all of their sites, and installation of these compensatory habitat structures will demonstrate visible and measurable commitments to improving habitat availability for these species at risk that occur on the WL site (i.e., RSA). Installation of the habitat structures should occur the year preceding demolition of the building. This is in keeping with guidance that recommends replacement of roost/nest habitat to be lost prior to the removal of habitat, to allow for individuals to recognize and potentially colonize the new structures before old ones are removed (BSC 2017).

Overall, potential loss of nest/roost substrate for barn swallow and little brown myotis within the WR-1 Building are expected to have negligible residual effect on the maintenance of self-sustaining and ecologically effective wildlife populations that overlap the RSA. The follow-up monitoring program regarding the effectiveness of the bat boxes and barn swallow nesting structure, if required, is further described in Section 6.6.7 Monitoring and Follow-up.

- **Non-radiological air emissions and dust emissions (including sulphur dioxide, nitrogen oxides [NOx/NO_2] and particulate matter) and subsequent deposition.**

The Project will generate air and dust emissions such as carbon monoxide (CO), oxides of sulphur (SO_x includes sulphur dioxide [SO_2]), oxides of nitrogen (NO_x includes nitrogen dioxide NO_2), particulate matter ($PM_{2.5}$, PM_{10}) and suspended particulate matter (SPM). Air emissions, such as SO_x and NO_x, can result from the use of fossil fuels in generators, vehicles and machinery. The LSA is characterized as an anthropogenically altered landscape, with limited habitat quality in the form of native tree and shrub species. As described above, infrastructure and paved areas comprise 25% of the total area and the remaining 74% is primarily landscaped and maintained turfgrass lawn (Figure 6.6.4-2). A small proportion of the area contains broadleaf forest (less than 1%).

Examples of mitigation implemented to limit predicted residual effects from Project emissions to air quality and subsequently the terrestrial environment include:

- implementation of CNL's Environmental Protection Program (CNL 2021) and *Management and Monitoring of Emissions* (CNL 2018b), which includes operational control monitoring, air verification monitoring and environmental monitoring;
- use of dust suppression methods during building demolition or soil remediation activities to control airborne emissions and nuisance dust during building demolition or soil remediation. Methods may include:
  - wetting techniques during demolition to limit mobility of dust;
  - wind restrictions during demolition to stop work or apply wetting techniques; and
  - hydro seeding during backfilling and landscaping to reduce soil erosion.
- apply road watering and chemical dust suppressant when necessary (dust suppressant is already used annually at the site for select unpaved roads);
- removal of accumulations of particulates (e.g., dirt) on road as soon as possible; and
- use of tarps or 3-sided enclosures for raw material storage.

The predicted residual effects on air quality were estimated to increase because of the Project. Fugitive dust from roads is the largest contributor to suspended particulate matter emissions. Material handling from demolition is the largest contributor to PM_{10} emissions. Non-road equipment exhaust emissions are the largest contributors to $PM_{2.5}$ and NOx (as NO_2) emissions. Finally, the largest contributor to SO_2 and CO emissions is fuel combustion for emergency power generators. Predicted concentrations for the Application Case are below applicable air quality guidelines and/or standards (Section 6.2.1.77.2 Application Case Results).

Mitigation of fugitive dust emissions is provided in Table 6.2.1-10 (Pathways Analysis for the Air Quality Valued Component) and includes the use of contamination immobilization agents, containment, ventilation and High-efficiency Particulate Air (HEPA) filters to control generation of airborne emissions during decontamination or removal of contaminated systems or structures. In addition, use of dust suppression methods during building demolition or soil remediation activities will be implemented to control airborne emissions and nuisance dust during building demolition or soil remediation. Consequently, air emissions are predicted to be below applicable air quality guidelines and/or standards as discussed in Section 6.2.1.77.2 Application Case Results, and will not impact the surrounding terrestrial or aquatic environment

CNL recently demolished a number of other buildings at the WL site. The mitigation listed above was applied and successfully reduced SPM emissions which ultimately reduce subsequent deposition. It is expected that this same mitigation will also be effective during the demolition of the WR-1 building. Therefore, with the implementation of CNL's *Management and Monitoring of Emissions* (CNL 2018b), and through the implementation of the dust management techniques for the Project, air and dust emissions and subsequent deposition are expected to result in minor changes to soil quality relative to Base Case conditions. As such, this pathway is determined to result in a negligible residual effect on the maintenance of self-sustaining and ecologically effective wildlife populations in the RSA.

- **Release of chemical and radiological contaminants during the closure phase.**
- **Release of chemical and radiological contaminants in the long-term during the post-closure phase.**

An Environmental Risk Assessment was completed to evaluate the potential for adverse effects on terrestrial biota health associated with exposure to chemical and radiological contaminants from the Project (Section 6.7.2.7 Residual Effects Analysis) during the closure and post-closure phases.

For the closure phase, sources of the relevant chemical and radiological contaminants include release via atmospheric releases from the WR-1 Building during grouting and demolition (Section 6.7.2.7.1 Application Case - Closure Phase). Exposure pathways include the routes of contaminant dispersion from the source to the receptor location and the routes of contaminant transport through the food chain or other media to the receptor organism.

During the closure phase, there are predicted to be no exceedances of the 2.4 milligray per day (mGy/day) radiation benchmark for terrestrial biota on or near the WL site (Section 6.7.2.7.1). All predicted doses are well below this level. Therefore, it is unlikely that there would be significant adverse effects on terrestrial wildlife populations or communities as a result of chemical and radionuclide releases from closure activities (Section 6.7.2.7.1).

Following the completion of closure activities, the Project site and engineered cover will be graded to promote drainage from the site to the Winnipeg River. Run-off control for the concrete cap and engineered cover is designed to limit erosion and infiltration of water into the grouted structure. This is achieved by sloping the concrete cap and engineered cover surface to maintain a slope toward the edges and the collection of water by the existing surface water management systems at the WL site.

A grass seed mixture native to the area will be used to establish vegetative cover, restricting weed establishment and preventing erosion and abrasion. A six-foot-high chain link perimeter fence will be installed and maintained for perpetuity. The concrete cap and engineered cover will be actively maintained during the institutional control period to deter wildlife and avoid the disruption of roots to the WRDF. Consequently, the post-reclamation state of the SSA will be highly modified and unlikely to support a diverse community of terrestrial wildlife VCs. The expansive remaining portions of RSA will provide much higher wildlife habitat value. Avian species (i.e., birds and bat) that could potentially access the SSA will have much larger areas of natural habitat in which to forage and the addition of the relatively small turf grass covered mound on the landscape is unlikely to cause an increase in level of attraction.

For the post-closure phase, the relevant chemical and radiological contaminants may be released via leakage through the grouting to groundwater and subsequent migration of groundwater to surface water at the Winnipeg River. The assessment of ecological health (Section 6.7.2.7.2 Application Case – Post-closure Phase) used groundwater release rates and dispersion modelling to estimate radionuclide concentrations in surface water, to calculate dose rates to terrestrial biota.

During post-closure, the incremental change in radionuclide levels in the Winnipeg River resulting from the transport of radionuclides from the WRDF to the Winnipeg River via groundwater is predicted to be not practically distinguishable from background levels (see Section 6.4.2.7.2 Application Case Results). Similar to the closure phase, there are predicted to be no exceedances of the 2.4 mGy/day radiation benchmark for terrestrial biota on or near the WL site (Section 6.7.2.7.2) during the post-closure phase. All predicted doses are well below this level. There are also no exceedances of the HQs identified for exposure of the terrestrial receptors to cadmium, lead, HB-40 and xylene. Therefore, no significant adverse effects on terrestrial populations or communities as a result of these chemical releases are predicted.

6.6.6.2.3 Primary Pathways

No primary pathways were identified between the Project and the terrestrial environment. As such, a residual effects analysis and determination of significance has not been completed for the terrestrial environment assessment.

6.6.7 Monitoring and Follow-up

The conceptual outline for monitoring and follow-up programs recommended to confirm the predictions made in the terrestrial environment assessment during the closure phase are presented in Table 6.6.7-1. Although no residual effects to terrestrial VCs are predicted, these conceptual monitoring and follow-up programs are provided as proactive mitigation by CNL and includes consideration of all future decommissioning and building demolition activities that will occur on the WL site.

CNL will implement an Environmental Assessment Follow-up Program for the Project as identified for other environmental components to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. This monitoring will be integrated with that for the existing Environmental Assessment Follow-up Program for the WL site, where practical.

As part of CNL's licence (NRTEDL-W5-8.00/2024), environmental monitoring of the WL site is required. It is anticipated that for closure, the monitoring at the WL site and surrounding area will continue to proceed in accordance with CNL's existing Environmental Monitoring Program. This includes sampling and analysis of ambient air, surface water and groundwater, including the Winnipeg River, sediment, vegetation, garden produce, game animals and fish. This current follow-up monitoring program includes collection of vegetation within the vicinity of the WL site and garden crop samples upstream and downstream of the WL site.

Connected to the assessment of effects to the terrestrial environment, monitoring is also identified in the assessment of ecological health described in Section 6.7.2.10 Monitoring and Follow-up. Follow-up monitoring during the post-closure phase to confirm surface water quality as the primary pathway will serve to verify the accuracy of predicted environmental effects on the potential ecological receptors in the terrestrial environment undertaken in this assessment. It is noted that data generated by the monitoring program will be evaluated on an ongoing basis within an adaptive management framework. Additional information on the Environmental Assessment Follow-up Program for the Project can be found in Section 11.0 Summary of Monitoring and Follow-up Programs.

CNL will continue to proactively seek, engage, and support meaningful discussion on issues and opportunities related to the Project, including the monitoring and follow-up program, with Indigenous peoples and communities of interest. CNL has also had discussions with Indigenous Groups on how future monitoring on the WL site could incorporate Indigenous interests, such as locations where the community fishes or harvests in proximity to the WL site, as well as discussion on participation and/or oversight by Indigenous peoples. CNL is also providing the opportunity and funding for an MMF environmental monitor to observe CNL's environmental monitoring program in action, including collection of water, soil and plant samples for analysis. CNL will continually evaluate both the process and the outcome of the ongoing engagement and communication activities, to address and manage issues as they arise.

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Table 6.6.7-1: Monitoring and Follow-up Programs for the Terrestrial Environment

Valued Component	Project Phase, Potential Effect and Conceptual Monitoring Program	Monitoring Program Objective	Suggested Duration	Implementing Program
Barn swallow	**Potential Source(s) of Effects:** ■ Closure and Post-Closure: If barn swallow are confirmed to be using the WR-1 Building as habitat through pre-disturbance surveys, there will be incremental contribution of the Project and all future decommissioning activities to the loss of potential nesting habitat in the RSA. There is predicted to be negligible effects on barn swallow, if determined to be nesting in the WR-1 Building, through the implementation of habitat compensation. **Proposed Monitoring:** ■ Barn swallow nest structures were installed in 2018 at the WL site proactively in consideration of potential loss of barn swallow nesting habitat from future decommissioning activities. ■ Effectiveness monitoring of compensatory barn swallow nest structures will be conducted to determine if the compensatory nest habitat is being used. ■ This compensation model and follow-up monitoring would be consistent with what has been designed by the Ontario Ministry of Natural Resources and Forestry. Barn swallows are designated as "Threatened" on the Ontario *Endangered Species Act*'s Species at Risk in Ontario list. An equivalent protocol has not been developed for Manitoba (barn swallow are not currently designated on the provincial ESEA). Barn swallow are designated as "Threatened" under the federal *Species at Risk Act*. **Trigger for Further Action:** ■ If effectiveness monitoring shows that the barn swallow nest structure is not being used, it would be relocated to other suitable habitat on the site.	■ Offset the incremental contribution of the Project and all future decommissioning activity to the loss of potential nesting habitat in the RSA using compensatory nesting habitat ■ Determine number of individuals using compensatory nesting habitat on an annual basis	Annually for three years following installation.	■ Integrated into CNL's Environmental Protection Program. ■ A Biodiversity Plan will be developed and included in the Environmental Assessment Follow-up Program for the WL site.
Bats	**Potential Source(s) of Effects:** ■ Closure and Post-Closure: If bats are confirmed to be using the WR-1 Building as habitat through pre-disturbance surveys, incremental contribution of the Project and all future decommissioning activity to the loss of potential anthropogenic maternity roosting habitat in the RSA. There is predicted to be negligible effects on bats, if determined to be roosting in the WR-1 Building, through the implementation of habitat compensation. **Proposed Monitoring:** ■ In consultation with CNL biologists on other CNL sites to be decommissioned in the future, and in consideration of future losses of anthropogenic structures that may provide roosting habitat at the WL site, offsetting in the form of bat boxes may be required if bats are confirmed to be using the WR-1 Building as habitat. ■ Criteria for appropriate siting, if required, may include: accessibility of box locations for installation and future monitoring of utilization/effectiveness, avoidance of areas with radiological contamination in surface water features and appropriate distance to anthropogenic disturbances to avoid sensory effects (i.e., noise). Immature forested areas adjacent to larger waterbodies (i.e., Winnipeg River) and wetlands are high priority locations, because these forest types do not currently provide high quality tree roosting habitat and would be most benefited by installation of bat roost boxes to expand the spatial coverage of potential roosting habitat within the RSA. Final site selection would be at the discretion of CNL biologists. ■ Effectiveness monitoring may be conducted to determine if boxes are being used for three years post-installation. **Trigger for Further Action:** ■ If effectiveness monitoring shows that the bat boxes are not being used by the target species, they would be relocated to other suitable habitat on the site.	■ Offset the incremental contribution of the Project and all future decommissioning activity to the loss of potential anthropogenic maternity roosting habitat across the RSA. ■ Install bat boxes and determine number of individuals and species using bat boxes on an annual basis.	Bat boxes should remain in place throughout the Closure Phase at minimum. Monitoring should take place annually for three years post-installation.	■ Integrated into CNL's Environmental Protection Program. ■ A Biodiversity Plan will be developed and included in the Environmental Assessment Follow-up Program for the WL site.

Table 6.6.7-1: Monitoring and Follow-up Programs for the Terrestrial Environment

Valued Component	Project Phase, Potential Effect and Conceptual Monitoring Program	Monitoring Program Objective	Suggested Duration	Implementing Program
Snapping turtle	**Potential Source(s) of Effects:** ■ Closure: Minor increase in mortality risk on snapping turtle as a result of vehicle collisions, and negligible residual effect, if mitigation is implemented. ■ CNL will implement a follow-up monitoring program to address the uncertainty regarding the effectiveness of proposed mitigation for protecting snapping turtle populations. **Proposed Monitoring:** ■ Implementation of routine annual wildlife road surveys using protocols for road surveys available from other Canadian jurisdictions for similar species (e.g., Survey Protocol for Blanding's Turtle in Ontario [MNRF 2015]), to be conducted when snapping turtles are likely to cross (i.e., terrestrial life history period from May 1 to September 30). ■ Any road mortality or injury of snapping turtle (or other reptile species) will be reported and data will be compiled in a database that can be used to inform adaptive management for the site. **Trigger for Further Action:** ■ If, after mitigation and operational measures are shown to be ineffective and any mortality or injury of snapping turtle occurs, further mitigation will be considered in an adaptive management framework. This mitigation may take the form of: surveys of high-risk road crossing locations to determine if they are being used by turtles for crossing, potential upgrade of existing crossing culverts to enhance snapping turtle passage, consideration of the potential need to re-design or lengthen the existing amphibian and reptile fencing at the three most likely turtle crossings on Ara Mooradian Way, or consideration of the need to add fencing on any other roads where injuries or mortality of snapping turtle is recorded. ■ Based on results of routine wildlife road surveys, evaluate implementation of traffic calming measures during the season when snapping turtles are expected to cross the road (i.e., terrestrial life history period from May 1 to September 30). These may include options such as further reduction of posted speed limit, installation of speed bumps, or other measures.	Track turtle observations during routine wildlife road surveys and use information for adaptive management.	Ongoing reporting and monitoring should take place annually over the active decommissioning period (until the start of institutional control).	■ Integrated into CNL's Environmental Protection Program. ■ A Biodiversity Plan will be developed and included in the Environmental Assessment Follow-up Program for the WL site. ■ Continuation of WL staff reporting of incidental wildlife observations.

6.6.8 Conclusions

Valued components refer to environmental features that may be affected by a project. The VCs have been identified to be of concern by the proponent, scientists, government agencies, Indigenous people, or the public (The Agency 2018). Indigenous Traditional Knowledge and Land Use Studies (Firelight Research and SFN 2018, BRFN, BON, and HWFN 2019, and SVS 2019) and Indigenous engagement with Sagkeeng First Nation, the Manitoba Métis Federation, Brokenhead Ojibway Nation, Black River First Nation, Hollow Water First Nation, and Wabaseemoong Independent Nations identified additional VCs for consideration in the terrestrial effects assessment. CNL explained that all SARA-listed wildlife species with the potential to occur within the WL site (or with confirmed occurrence records) were considered as potential VCs at the species level. Species that were well represented by the broader groups of species were not explicitly included, as the selected VCs provides inferences about effects on other groups of species with similar life history traits and habitat requirements. Species with a very low likelihood of occurrence in the LSA, for which habitat was not present in the RSA, or for which effects of the Project were unlikely, were excluded as VCs. Other species identified by the Indigenous Nations (e.g., deer, moose, and furbearers) were included in the assessment of ecological health effects in Section 6.7.2.

The VCs assessed for the terrestrial environment included barn swallow, golden-winged warbler, bats and snapping turtle. The assessment endpoint for the terrestrial environment is the maintenance of self-sustaining and ecologically effective populations. Habitat availability, habitat distribution and survival and reproduction were selected as the measurement indicators for the terrestrial environment VCs.

During closure, the Project will generate air and dust emissions from demolition activities. With Implementation of CNL's *Management and Monitoring of Emissions*, there is predicted to be negligible effects on the terrestrial environment from the Project as a result of air and dust emissions. Sensory disturbance, road mortality, and loss of nest/roost substrate also have the potential to affect terrestrial valued components during closure. Surveys to confirm whether nesting and/or roosting activity is occurring in the WR-1 Building will be conducted during the appropriate season the year prior to the initiation of decommissioning activities. If evidence of nesting or roosting activity is found, appropriate mitigation in the form of deterrents will be implemented under consultation with ECCC and in accordance with habitat protection provisions and the required permitting process under Species at Risk Act and potentially the Migratory Bird Conservation Act. The objective of the selected mitigation will be to prevent birds and bats from accessing the building during the period when it will be demolished. The potential for road mortality of snapping turtle will be addressed through adaptive management and ongoing monitoring and documentation of road mortalities. If road mortality of snapping turtle occurs, additional mitigation will be enacted, as required. Following implementation of mitigation and monitoring in an adaptive management framework, there is predicted to be negligible effects on the terrestrial environment during the closure phase as a result of the Project. As such, closure activities are predicted to have a negligible effect on the maintenance of self-sustaining and ecologically effective wildlife populations, including species at risk.

Surveys during the appropriate season, to be undertaken the year prior to initiation of decommissioning activities, will confirm whether nesting and/or roosting activity is occurring in the WR-1 Building. If evidence of nesting or roosting activity is found, appropriate mitigation in the form of deterrents will be implemented, under consultation with ECCC and in accordance with habitat protection provisions and the required permitting process under SARA and potentially MBCA. The potential for road mortality of snapping turtle will be addressed through adaptive management and ongoing monitoring and documentation of road mortalities. If road mortality of snapping turtle occurs, additional mitigation will be enacted, as required.

The objective of the selected mitigation will be to prevent birds and bats from accessing the building during the period when it will be demolished. Compensatory habitat features (i.e., bat boxes) may be installed or adjusted depending on the outcome of the above surveys and to demonstrate CNL's commitment to environmental stewardship. Barn swallow nesting structures have already been installed in consideration of potential future losses of anthropogenic nesting habitat associated with site-wide decommissioning. The potential for road mortality of snapping turtles will be addressed through adaptive management and ongoing monitoring and documentation of road mortalities. If road mortality of snapping turtle occurs, additional mitigation will be enacted, as required. Following implementation of mitigation and monitoring in an adaptive management framework, there is predicted to be negligible effects on the terrestrial environment as a result of the Project.

During the post-closure phase, there are predicted to be no exceedances of the 2.4 mGy/d radiation benchmark for terrestrial biota on or near the WL site. All predicted doses are well below these levels. Therefore, based on the assessment completed in Section 6.7.2.7.2, it is unlikely there would be significant adverse effects on terrestrial populations or communities as a result of radionuclide releases from closure activities or in the long-term during the post-closure phase. There are also no exceedances of the HQs identified for exposure of the terrestrial receptors to cadmium, lead, HB-40 and xylene. Therefore, no significant adverse effects on terrestrial populations or communities as a result of these chemical releases are predicted. Because the Environmental Risk Assessment found the predicted doses would be far below any effect level, no significant effects are predicted for the VCs identified by Indigenous peoples.

Overall, the assessment of potential pathways of effects determined there are no primary pathways that would lead to residual effects on terrestrial VCs. Although no residual effects on terrestrial VCs are predicted, monitoring programs are described as possible proactive mitigation by CNL and includes consideration of all future decommissioning and building demolition activities that will occur on the WL site. In addition, CNL will implement an Environmental Assessment Follow-up Program for WR-1 as outlined for other environmental components to verify the accuracy of indirect environmental effects and determine the effectiveness of mitigation that has been, or is to be, implemented.

CNL will continue to proactively seek, engage, and support meaningful discussion on issues and opportunities related to the Project, including the monitoring and follow-up program, with Indigenous peoples and communities of interest. CNL has also had discussions with Indigenous peoples on how future monitoring on the WL site could incorporate Indigenous interests, such as locations where the community fishes or harvests in proximity to the WL site, as well as discussion on participation and/or oversight by Indigenous peoples. CNL will provide Indigenous Nations and stakeholders with the opportunity to participate in the implementation and review of mitigation measures.

6.7 Human and Ecological Health

This section of the Environmental Impact Statement (EIS) for the Canadian Nuclear Laboratories (CNL) In Situ Decommissioning of WR-1 at the Whiteshell Laboratories Site (the Project) summarizes the results of the Environmental Risk Assessment (ERA) completed for the Project (EcoMetrix 2021). The purpose of the ERA is to evaluate effects to physical human health (Section 6.7.1 Human Health) and ecological health (Section 6.7.2 Ecological Health) from changes in ambient levels of radioactivity and non-radiological substances. The assessment considers potential effects on human and ecological health during the closure phase and the post-closure phase, which includes a Normal Evolution Scenario. The Normal Evolution Scenario represents a reasonable extrapolation of present-day site features and receptor lifestyles, and it includes the expected evolution of Whiteshell Reactor 1 (WR-1) after closure and degradation of engineered controls. Disruptive Events are identified in the Decommissioning Safety Assessment Report (DSAR) (Golder 2021) for the Project and represent the occurrence of very unlikely events that could lead to higher risk conditions. Disruptive Events are summarized in this section as they apply to physical human and ecological health. CNL acknowledges that human health is more than just physical health. Assessments of other aspects contributing to overall human well-being, while similar to physical health, are not assessed here, but are assessed in Sections 6.8 Land and Resource Use and 6.9 Socio-economic Environment.

6.7.1 Human Health

6.7.1.1 Scope of the Assessment

The scope of the assessment focuses on summarizing the potential health effects to humans from Project activities. The general approach to in situ disposal (ISD) involves permanently encasing with grout the below-grade WR-1 systems. ISD is a permanent, passive decommissioning end state. The decommissioning activities proposed as part of the Project include:

- preparation for ISD;
- grouting of below-grade structures and systems;
- removal of above-grade WR-1 Building;
- installation of a concrete cap and engineered cover over the WRDF;
- final site restoration;
- preparation of institutional control; and
- institutional control.

The above-grade structures will be demolished and removed. Some above-grade structures (e.g., part of the Primary Heat Transport [PHT] system that is above-ground) will be dismantled and placed within the WR-1 Building prior to ISD. A concrete cap and engineered cover will then be constructed over the below-grade structure (refer to Section 3.5 for more detail) and the Project site will be regraded and reclaimed. The end state of the Project (i.e., after the WR-1 Building is demolished, grouted and covered with a concrete cap and engineered cover) is referred to as the Whiteshell Reactor Disposal Facility (WRDF). Environmental monitoring will be completed to confirm that the WRDF is functioning as intended in the long-term (see Section 11 Monitoring and Follow-up for details).

The human health environment assessment follows the overall environmental assessment approach and methods described in Section 6.1 Environmental Assessment Approach. The assessment is completed in the following steps:

- **Step 1 – Identify Valued Components (VCs) and define the spatial boundaries, temporal boundaries and assessment cases** (refer to Section 6.7.1.3 Valued Components and Section 6.7.1.4 Assessment Boundaries) for the human health assessment. The VCs, assessment endpoints and measurement indicators used to assess Project related changes to human health, the spatial and temporal boundaries at which the assessment occurred, and the assessment cases considered are described.
- **Step 2 – Describe the existing conditions** (refer to Section 6.7.1.5 Description of the Existing Environment). Existing conditions in the local and regional areas are described, including the combined effects of previous and existing developments (Base Case). The existing environment represents the historical and current environmental pressures that have shaped the observed patterns in the environment (i.e., natural variation).
- **Step 3 – Evaluate Project interactions and mitigation** (refer to Section 6.7.1.6 Project Interactions and Mitigation). Project components and/or activities with the potential to affect human health are identified and mitigation options to limit or avoid effects are presented. A pathways analysis is then used to assess key interactions between the Project and human health. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. Where effects are adequately mitigated and are not forwarded to further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are articulated. Primary pathways that may lead to residual effects to human health after incorporating mitigation are carried forward to Step 4; residual effects characterization.
- **Step 4 – Present the methods and results of the residual effects analysis** (refer to Section 6.7.1.7 Residual Effects Analysis). This section outlines the methods used to predict and characterize residual effects to human health from primary effect pathways. The analysis results are presented, including the characterization of: (i) residual incremental effects of the Project and the effects of the Project in combination with past and present developments on human health (Application Case); and (ii) residual effects of the Project in combination with past and present developments, as well as other reasonably foreseeable developments (Reasonably Foreseeable Development Case). A key outcome of this section is the predicted effects to human health that are passed on to other VCs for inclusion in their assessment.
- **Step 5 – Describe the level of certainty and management of uncertainty** (refer to Section 6.7.1.8 Prediction Confidence and Uncertainty). Evaluate the available literature, data and models used for the assessment and describe the level of certainty that can be placed on predicted residual effects. This section will also identify how the uncertainty has been managed so that the effects are not underestimated.

- **Step 6 – Classify and determine the significance of the predicted residual effects** (refer to Section 6.7.1.9 Residual Effects Classification and Determination of Significance). Residual effects predicted from primary pathways are classified using a common set of criteria: direction, magnitude, geographic extent, duration, reversibility, frequency and likelihood. A determination of the significance of the predicted residual effects of the Project on human health is made. Relative to other sections, the human health assessment uses a slightly different approach to the classification of residual effects and evaluation of significance, because several of the criteria (e.g., geographical extent, duration, frequency, and reversibility) are already incorporated into the risk estimates and, therefore, are not independent variables.
- **Step 7 – Identify monitoring and follow-up** (refer to Section 6.7.1.10 Monitoring and Follow-up) required to confirm effect predictions and address uncertainty.
- **Step 8 – Present a consolidated summary of conclusions and outcomes of the assessment** (refer to Section 6.7.1.11 Conclusions) of residual effects on human health.

6.7.1.2 Indigenous Engagement Feedback – Key Interests and Concerns

Interests and concerns raised by Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations during engagement related to the human health risk assessment are summarized in Table 6.7.1-1. These concerns were gathered through direct engagement and through the analysis of the array of studies provided to CNL. Other general concerns and questions raised during Indigenous engagement activities are documented in Section 4 Indigenous Engagement. Specific interests and concerns from each Indigenous Nation are consolidated in Section 4 Appendices.

Table 6.7.1-1: Summary of Issues Raised During Engagement Activities Related to the Human Health Risk Assessment

Interest and Concern	Inclusion Status	Additional information and Rationale
Effects on Harvesters ■ Consuming fish and wildlife ■ Consuming plants ■ Reduced (or continuation of existing low) faith in country foods impacting on country food harvesting rates and consumption rates	Already included in the environmental assessment Weekay and Moose were added to the diet of a Harvester in the Human Health Assessment	Effects on harvesters from the consumption of fish, plants, and wildlife are assessed in Section 6.7.1.7 Residual Effects Analysis. Other effects on overall well-being are assessed in Section 6.8 Land and Resource Use and Section 6.9 Socio-economic Environment
Health of the Environment ■ Long-term effects of the Project on the quality of air and water quality groundwater	Already included in the environmental assessment	Effects on the Project on air and water quality and subsequent human health effects are assessed in Section 6.7.1.7 Residual Effects Analysis.

Table 6.7.1-1: Summary of Issues Raised During Engagement Activities Related to the Human Health Risk Assessment

Interest and Concern	Inclusion Status	Additional information and Rationale
Monitoring ■ Current monitoring practices ■ Future monitoring practices including the need for Indigenous-led community environmental monitoring program(s), including country foods monitoring and country foods risk communication	Already included in the environmental assessment	Information on the current monitoring program at the WL site is described in Section 6.7.1.5 Description of the Environment. Information on the monitoring program for the Project is available in Section 6.7.1.10 Monitoring and Follow-up. Indigenous participation on the development of the Environmental assessment Follow Up Program is described in Section 11.4.
Accidents and Malfunctions ■ Failure of the grout and ISD barriers	Already included in the environmental assessment	The effects of a failure of the ISD system are examined as a disruptive event in Section 6.7.1.7.2.1 (WRDF Barrier Failure)

6.7.1.3 Valued Components

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018) through studies, submissions and direct engagement. The HHRA focused on public health and the health of on-site workers not involved in performing closure activities. Consistent with CSA N288.6-12, Nuclear Energy Workers were not assessed because their potential doses are controlled through CNL's Radiation Protection Program. The assessment for public health considered locations where people are known to be present. During post-closure, there is no exposure pathway for workers (i.e., surveillance and monitoring personnel during period of institutional control) as airborne emissions will be limited by the Project and workers will not be exposed to liquid emissions. Valued components and rationale for their selection for the HHRA are provided in Table 6.7.1-2.

Table 6.7.1-2: Valued Components for the Human Health Risk Assessment

Valued Component	Rationale for Selection
Public Health	Potential exposure to airborne and waterborne radiological and non-radiological emissions ■ Farms A and F includes year-round occupants, with livestock, located near the east bank of the Winnipeg River. Farm F being north-northeast of the WL site and Farm A being north of the WL site. ■ Harvesters represent Indigenous or traditional users of the area who may be exposed through harvesting of country foods. ■ In the long-term, during post-institutional control, there is the potential that a farm may inhibit the site.
Worker Health	On-site workers not involved in performing closure activities may be potentially exposed to both radiological and non-radiological hazards (e.g., asbestos).

Assessment endpoints are qualitative expressions used to assess the significance of residual effects on VCs and represent the key properties of the VC that should be protected for future human generations (i.e., incorporates sustainability). The assessment endpoint is the protection of human health. Measurement endpoints represent properties of the environment, that when changed, could result in or contribute to an effect on an assessment endpoint. The measurement endpoints for the HHRA are outlined in Table 6.7.1-3. The human health section draws on many other assessments within the EIS (e.g., air quality).

Table 6.7.1-3: Assessment Endpoints and Measurement Indicators for the Human Health Risk Assessment

Valued Component	Assessment Endpoints	Measurement Indicators
Public Health	Protection of human health	■ Changes to air quality. ■ Changes to surface water quality. ■ Changes to groundwater quality.
Worker Health		

Contaminants of potential concern for measurement indicators are further defined in Section 6.7.1.7.1 and 6.7.1.7.2.

a) Health of on-site workers not involved in performing closure activities.

6.7.1.4 Assessment Boundaries

6.7.1.4.1 Spatial Boundaries

In order to assess the potential effects of the Project on human health, an appropriate spatial boundary was defined, with consideration given to locations where people could be affected by Project activities directly or where they could be indirectly affected by interacting with aquatic and terrestrial resources affected by Project activities (Figure 6.7.1-1).

- **Site Study Area (SSA):** is the WR-1 Building and represents the Project footprint (i.e., where project activities will be undertaken; 0.07 ha).
- **Local Study Area (LSA):** is defined as the area within which there is potential for measurable changes to measurement indicators resulting from the proposed Project activities. The LSA was adapted from the surface water Regional Study Area (RSA) and is designed to include receptors from both the HHRA and Ecological Risk Assessment (EcoRA). Therefore, the southern boundary of the LSA extends from the west shore of the Winnipeg River to the east fence on the property line about 400 m north of Provincial Highway 211. The eastern boundary of the LSA follows the fence on the property line to the north property line. The northern boundary follows the north fence on the property line about 1.6 km and then turns north for about 400 m before turning west and extending to the west side of the Winnipeg River. This is to include the closest existing farm (Farm A) downstream on the east bank because this is the most conservative potential water user. The western boundary follows the west bank of the Winnipeg River for about 1.5 km and then turns west for 370 m, north for 1.4 km and then turns east for 630 m to the west side of the Winnipeg River. This is to include the closest farm (Farm F) and harvester that could be affected by air emissions from the Project. The LSA has an approximate size of 4,174 ha.
- **Regional Study Area:** is defined as the area within which the potential effects of the Project may interact with the effects of other existing or reasonably foreseeable projects. The RSA is the same as the air quality study area and is defined as a 12 km by 12 km rectangle surrounding the LSA (approximately 14,400 ha).

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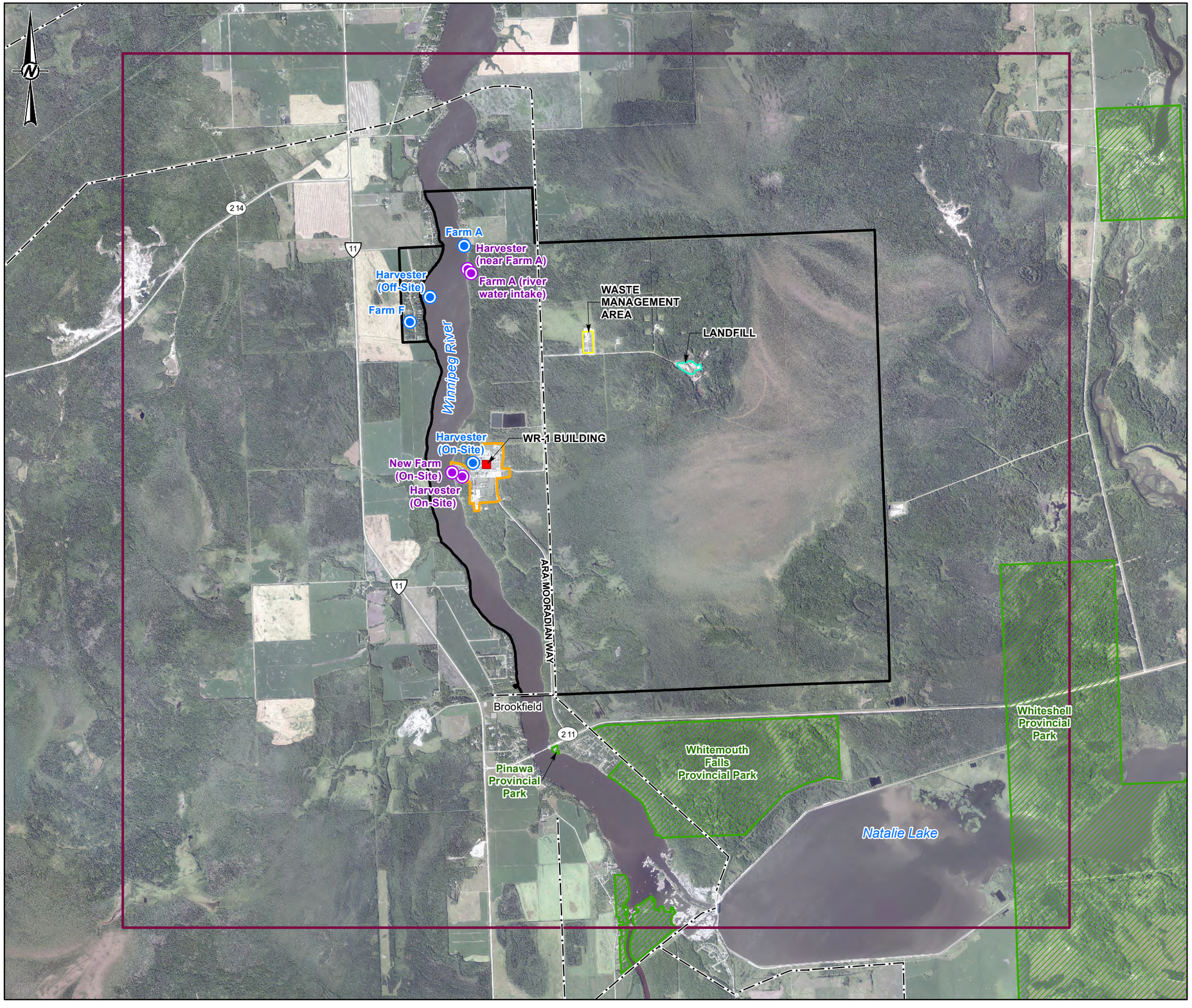

LEGEND

- WR-1 BUILDING (SITE STUDY AREA)
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- WHITESHELL LABORATORIES MAIN CAMPUS
- WASTE MANAGEMENT AREA
- LANDFILL
- LOCATION OF HUMAN RECEPTORS FOR CLOSURE PERIOD
- LOCATION OF HUMAN RECEPTORS FOR POST-CLOSURE PERIOD

BASE FEATURES

- CITY/TOWN
- TRANSMISSION LINE
- PROVINCIAL PARK

0 1 2 3

1:55,000 Kilometers

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY (LSA) PROVIDED BY CNL (2016-11-22)
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT

CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT

EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE

SPATIAL BOUNDARIES FOR THE HUMAN HEALTH AND ECOLOGICAL HEALTH ASSESSMENTS

CONSULTANT

wsp GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/PR/RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0015	2	**6.7.1-1**

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6.7.1.4.2 Temporal Boundaries

The temporal boundaries of the assessment are the timeframe during which Project activities are actively occurring, and the duration of predicted residual effects. The duration of an effect is defined as the amount of time between the start and end of a Project activity or stressor (which is related to the Project phases) plus the time required for the residual effect to be reversed. In some cases, a residual effect may be irreversible within the temporal boundaries of the Project if the effect is predicted to last so far into the future that the duration cannot be predicted with any level of certainty (e.g., residual effect lasts for thousands of years). The following phases were identified for the Project:

- **Closure Phase:** Preparation and implementation of in situ disposal, which includes preparation for in situ disposal, grouting of below-grade structures and systems, removal of above-grade WR-1 structures and systems, installation of the concrete cap and engineered cover, and environmental controls and final site restoration. These activities last from 2022 to 2027.
- **Post-closure Phase:** The post-closure phase has two discrete periods: institutional control and post-institutional control. Institutional control is estimated to last 100 years during which long-term monitoring and maintenance activities will continue to demonstrate WRDF performance is in compliance with the safety case assumptions and performance modelling. The 100 year timeframe is not related to the design life of the WRDF barriers. The 100-year active monitoring period was selected to ensure that sufficient opportunity is provided to verify the WRDF is performing as expected. Additionally, beyond 100 years, there is less confidence that institutional controls, like access restrictions, can be relied upon. Although the duration of institutional control is at least 100 years, it is recognized that it will continue until the CNSC, or the appropriate authority at the time, agrees it is no longer needed.

  Post-institutional control occurs after year 2127 and continues indefinitely. The post-closure phase will continue indefinitely; however, the timeframe defined for assessment of potential effects as part of the normal evolution of the Project is 10,000 years. This time period encompasses the phase in which peak effects (i.e., doses) are anticipated.

6.7.1.4.3 Assessment Cases

The assessment cases considered for human health include the Base Case, the Application Case and the Reasonably Foreseeable Development (RFD) Case.

- **Base Case:** represents existing conditions and characterizes combined effects from previous and existing developments and activities. The Base Case reflects the effects of existing disturbances, such as forestry, hydro-electric dams, transportation, agricultural, mining and residential and recreational development. Current effects from the existing WL facilities and operations, for example, are considered part of the Base Case. In addition, effects from the decommissioning and reclamation activities already completed at the WL site are also considered as part of the Base Case. The base case is represented in the assessment by baseline air quality (Section 6.2.1.5 Description of the Environment) and surface water quality (Section 6.4.2.5 Description of the Environment) and used in the assessment as required by the relevant human health guideline for each contaminant of potential concern (COPC).
- **Application Case**: represents the effects of the Base Case combined with predicted effects from the Project. The Application Case includes post-closure activities, and therefore, the associated effects during the post-closure phase of the Project represent the bounding case.

- **RFD Case**: represents the predictions of the cumulative effects of the Application Case, plus projects that are currently under application review or that have officially entered a regulatory application process and which overlap with the human health RSA. Effects from the future decommissioning and reclamation activities to be completed at the WL site, as described in the Comprehensive Study Report (AECL 2001), are considered as part of the RFD Case. There are no other foreseeable developments in the human health environment RSA that are expected to overlap with residual effects on human health (Table 6.7.1-4). The Comprehensive Study Report (AECL 2001) indicated that no public health threats were predicted from the decommissioning and reclamation activities for the WL site. Releases are well within regulatory limits for the protection of human health and regular monitoring provides that any aberrations are detected immediately (AECL 2001). Current effects from the existing WL facilities and operations are considered part of the Base Case (i.e., existing conditions). Consequently, cumulative effects of the Base Case and the potential effects from the Project are evaluated in the Application Case, and an RFD Case is not applicable to the human health assessment and is not further discussed.

Table 6.7.1-4: Reasonably Foreseeable Developments Considered in the Human Health Assessment

Type of Project	Location	Description	Timeframe	Overlap with Valued Components
Infrastructure Decommissioning	WL	Decommissioning of remaining infrastructure on the WL site (includes ISD of the low-level waste trenches).	2016 to 2027	Yes – however, effects are evaluated as part of the Application Case
Environmental Remediation	WL	Remediation of affected lands, with the exception of the low-level waste trenches.	2016 to 2027	Yes – however, effects are evaluated as part of the Application Case

6.7.1.5 Description of the Environment

Background radiation dose from natural and anthropogenic sources and historical radiation dose from WL operations are used to establish a baseline characterization of radiation dose for the HHRA prior to the Project. Section 6.9.5.2.6 Community Well-being outlines the factors that contribute to the communities' overall sense of well-being, including their relationship to the WL site.

6.7.1.5.1 Background Sources of Radiation and Radioactivity

This section describes the background radiation (i.e., ambient radioactivity) that is present in the environment due to natural and anthropogenic sources independent of WL operations, including air, soil, food, water, aquatic sediments and plant or animal tissue. The background radiation dose varies greatly, both spatially and temporally. The main natural sources of radiation are cosmic rays; naturally occurring radionuclides in air, water and food; and naturally occurring radionuclides in the soil, rocks and building materials used in homes (CNSC 2013).

Cosmic radiation penetrates the Earth's atmosphere and gives an external radiation dose at the earth's surface. Naturally occurring radionuclides such as uranium, potassium and thorium are present in soils, rocks and building materials. These naturally occurring radionuclides also contribute to the background gamma radiation dose.

Naturally occurring radionuclides are also in plants, animals and water from surrounding soils and rocks. Humans ingest these foodstuffs and receive an internal radiation dose. Radon gas, a product of the decay of uranium in soil, is inhaled and also contributes to the internal radiation dose. The average annual background radiation doses in Canada are shown on Figure 6.7.1-2; the total average annual dose is about 1.8 millisieverts (mSv), worldwide the average is 2.4 mSv (CNSC 2013). The average dose reported for Winnipeg is 4.1 mSv/a (CNSC 2013).

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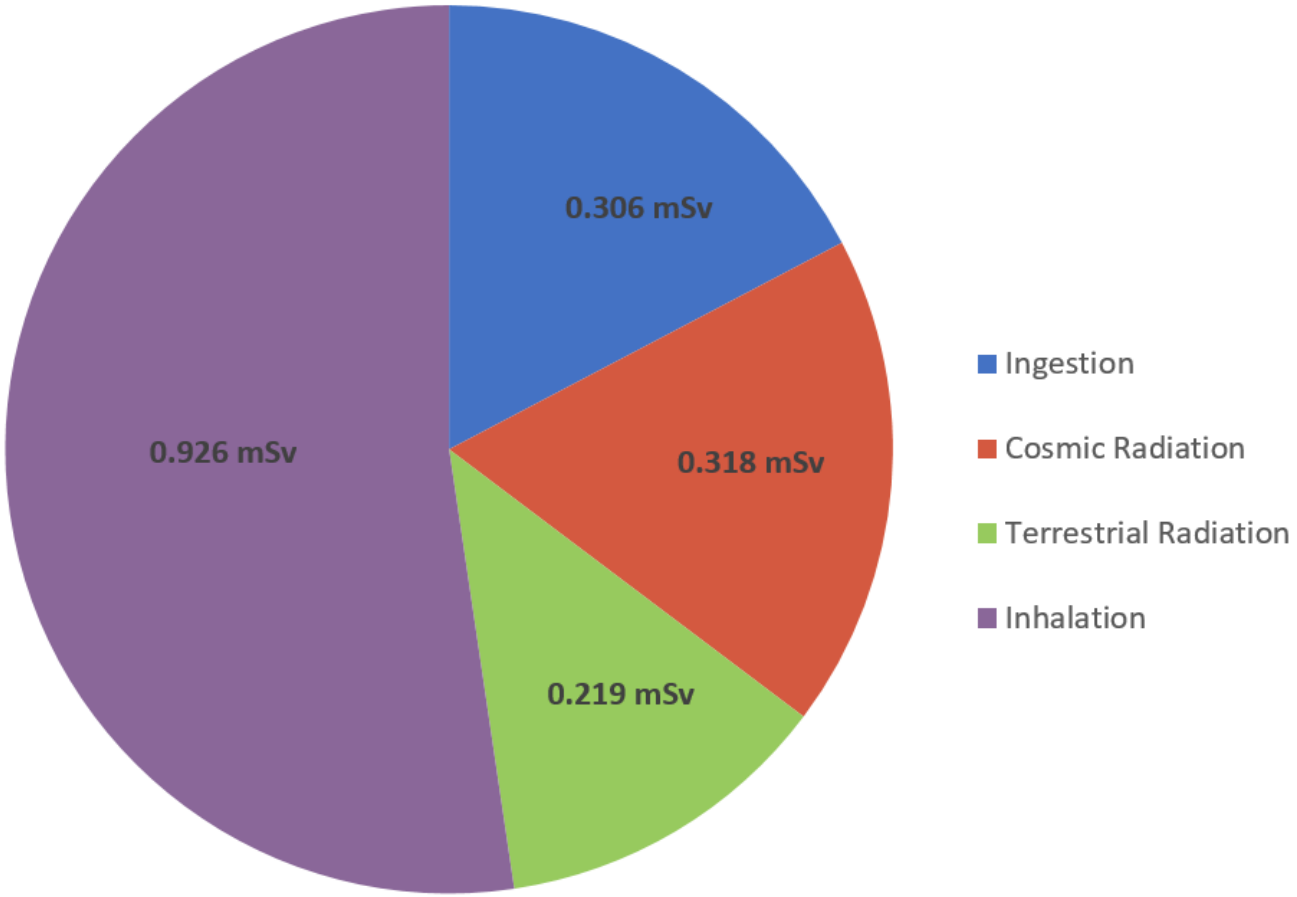

REFERENCE(S)

CNSC (CANADIAN NUCLEAR SAFETY COMMISSION). 2013. NATURAL BACKGROUND RADIATION. UPDATED NOVEMBER 19, 2014. ACCESSED JULY 2019. AVAILABLE AT HTTP://NUCLEARSAFETY.GC.CA/ENG/RESOURCES/FACT-SHEETS/NATURAL-BACKGROUND-

CLIENT
CANADIAN NUCLEAR LABORATORIES

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	PR
PREPARED	SO/RRD
REVIEWED	KL
APPROVED	MM

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
AVERAGE BACKGROUND RADIATION DOSES IN CANADA (MSV/Y)

PROJECT NO.	CONTROL	REV.	FIGURE
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6.7.1.5.2 Radiation Dose from Whiteshell Operations

Canadian Nuclear Laboratories reports the results of the Environmental Monitoring Program for the WL site each year to the Canadian Nuclear Safety Commission (CNSC). The Environmental Monitoring Program data are collected to verify that radiation doses to members of the public as a result of the operations of the WL site remain As Low As Reasonably Achievable (ALARA). The calculated radiation dose to members of the public from WL operations is shown in Table 6.7.1-5, and represents the baseline radiation dose from WL prior to the Project.

The 2019, dose assessment showed the radiation dose to the public from WL operations was 2.3×10^{-6} mSv/a for airborne effluent and 8.7×10^{-5} mSv/a for liquid effluent (CNL 2020a). The 2019 total adult dose of 8.9×10^{-5} mSv/a represents 0.009% of the effective dose limit of 1 mSv/a for members of the public. The 5-year average adult dose from 2015 to 2019 was 2.8×10^{-6} mSv/a for airborne effluent and 5.8×10^{-5} mSv/a for liquid effluent. The 5-year average total adult dose of 6.0×10^{-5} mSv/a represents 0.006% of the effective dose limit. The dose to members of the public is predominantly from liquid effluents.

Table 6.7.1-5: Total Dose to Critical Groups outside the Whiteshell Laboratories Boundary Based on Environmental Monitoring Results – 2015 to 2019

Year	Airborne Effluent Pathway – Adult Dose (mSv/a)	Liquid Effluent Pathway – Adult Dose (mSv/a)
2019	2.3×10^{-6}	8.7×10^{-5}
2018	1.6×10^{-6}	3.6×10^{-5}
2017	2.0×10^{-6}	4.8×10^{-5}
2016	2.0×10^{-6}	7.5×10^{-5}
2015	6.0×10^{-6}	1.1×10^{-4}
5-year Average (2015 – 2019)	**2.8×10^{-6}**	**5.8×10^{-5}**

Source: CNL 2020a, Table 1.
mSv/a = millisieverts per year.

In 2019, the estimated adult dose due to fish ingestion was 6.9×10^{-6} mSv/a for adults (CNL 2020a). This was equivalent to about 0.0007% of the annual regulatory limit of 1 mSv/a for members of the public. Table 6.7.1-6 shows the dose estimates for 2014 to 2019 along with the five-year average (2014 to 2018). The 2019 dose was lower than the previous five years and lower than the five-year average.

Table 6.7.1-6: Estimated Adult Dose from WL Effluents due to Fish Ingestion – 2014 to 2019

Dose (mSv/a)						
2014	**2015**	**2016**	**2017**	**2018**	**Five-Year Average**	**2019**
4.8×10^{-5}	4.2×10^{-5}	6.7×10^{-5}	4.8×10^{-5}	1.4×10^{-5}	4.4×10^{-5}	6.9×10^{-6}

Source: CNL 2020a, Table 37

6.7.1.6 Project Interactions and Mitigation

6.7.1.6.1 Methods

This section describes the process by which interactions between Project components and activities and human health were identified and evaluated. Potential effect pathways are identified and mitigation options to eliminate and/or reduce effects are presented. A pathways analysis is then used to focus on key interactions between the Project and the environment. Where effects will be adequately mitigated and are not forwarded for further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the assessment is concluded at this stage and the reasons are articulated. Primary pathways that may lead to residual effects after incorporation of mitigation are further characterized in Section 6.7.1.7 Residual Effects Analysis. As such, this section helps to focus the remainder of the assessment on those interactions (effects pathways) likely to result in residual adverse effects.

The first part of the analysis was to identify the potential effects pathways for all phases of the Project. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. The next step in the analysis was the development of environmental design features and mitigation practices that could be incorporated into the Project to eliminate and/or reduce adverse effects to human health. Environmental design features included Project design elements, environmental best practices and management policies and procedures. Environmental design features and mitigation were developed through an iterative process between the Project's engineering and environmental teams, combined with input from Project specific or regional engagement with other interested parties. The design features and/or mitigation activities were selected considering their effectiveness for implementation and maintenance and their appropriateness within the context of the identified effect pathways.

After incorporation of mitigation, potential pathways were evaluated into the following categories using scientific knowledge, logic, experience with similar developments and the effectiveness of environmental design features and mitigation:

- **No linkage pathway –** pathway is removed by environmental design features or mitigation such that the Project would not be expected to result in a measurable environmental change relative to Base Case values and therefore would have no residual effects to human health.
- **Secondary pathway –** the pathway could result in a measurable minor environmental change, but would have a negligible residual effect on human health relative to Base Case and/or guideline values and is not expected to contribute cumulatively to other Project effects or to the effects of other past, present or reasonably foreseeable developments to cause a significant effect.
- **Primary pathway –** the pathway is likely to result in an environmental change relative to the Base Case and/or guideline values that could contribute to residual effects to human health.

Environmental design features and mitigation that have been or could be incorporated into the Project to eliminate and/or reduce adverse effects were considered. Potential pathways that were completely removed due to implementation of environmental design or mitigation were not assessed further. Pathways that were assessed to be secondary and demonstrated to have a negligible residual effect to human health through simple qualitative or semi-quantitative evaluation of the pathway were also not advanced for further assessment. Primary pathways were carried forward for more detailed quantitative and/or qualitative effects analysis to characterize the residual effects of the Project.

6.7.1.6.2 Results

Pathways through which the Project may interact with the human health environment are summarized in Table 6.7.1-7.

Table 6.7.1-7: Pathways Analysis for the Human Health Valued Components

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
General Project activities during the closure phase	Closure activities will alter concentrations of non--radiological indicator compounds (e.g., particulate matter and carbon dioxide), which could affect human health, including: ■ use vehicles and equipment that combust fuel and emit indicator compounds; ■ material handling, for grouting and demolition; ■ vehicles travelling on paved roads; ■ operation of batch mixing plant for grout production.	■ Implementation of CNL's *Environmental Protection* (CNL 2021b) and *Management and Monitoring of Emissions* (CNL 2018a), which includes operational control monitoring, air verification monitoring and environmental monitoring. ■ Implementation of CNL's Occupational Safety and Health Program, including work permit system and Personnel Protection Equipment and Clothing. ■ Use of contamination immobilization agents, containment, ventilation and HEPA filters to control generation of airborne emissions during decontamination or removal of contaminated systems or structures. ■ Use of dust suppression methods during building demolition or soil remediation activities to control airborne emissions and nuisance dust during building demolition or soil remediation. Methods may include: ▪ wetting techniques during demolition to limit mobility of dust; ▪ wind restrictions during demolition to stop work or apply wetting techniques; and ▪ hydro seeding during backfilling and landscaping to reduce soil erosion. ■ Road watering and chemical dust suppressant when necessary. Dust suppressant is already used annually at the site for select unpaved roads. ■ All vehicles will pass through a vehicle monitoring station. ■ Removal of accumulations of particulates (e.g., dirt) on road as soon as possible. ■ On-site vehicles and equipment engines will meet Tier 3 emission standards, where possible, and be maintained in good working order. ■ Limit idling of vehicles on-site and speed on roads. ■ Use of enclosure for batch mixing plant and raw material handling.	Secondary

Table 6.7.1-7: Pathways Analysis for the Human Health Valued Components

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
	Closure activities will result in the atmospheric release of radiological and non-radiological compounds from the WR-1 Building	■ Implementation of CNL's Radiation Protection Program and Procedure, which includes Radiation Safety Zones, detailed work planning to limit doses to As Low As Reasonably Achievable (ALARA), dose monitoring and contamination control procedures (e.g., stabilizing and immobilizing agents). ■ Implementation of CNL's Occupational Safety and Health Program, including work permit system and training requirements. ■ Implementation of CNL's *Environmental Protection* (CNL 2021b) and *Management and Monitoring of Emissions* (CNL 2018a), which includes operational control monitoring, air verification monitoring and environmental monitoring.	Primary
Long-term performance during the post--closure phase	Release of solutes into the groundwater as the grout and reactor components gradually deteriorate over time may cause changes in groundwater quality which could migrate towards the Winnipeg River	■ Encapsulation of the reactor by a multi-component Whiteshell Reactor Disposal Facility (WRDF) (i.e., geosphere, concrete foundation, grout and facility systems and components) to mitigate groundwater flow into the ISD waste. ■ Installation of a concrete cap and engineered cover system to mitigate moisture infiltration into the WRDF and hence limit release of solutes into the groundwater. ■ Environmental monitoring will be completed throughout the post-closure phase for the Project to confirm that the cover and grout is functioning as intended, and to confirm modelling predictions.	Primary
Long-term performance during the post--closure phase	Release of chemical and radiological contaminants in the long-term during the post-closure phase from the previous activities completed at the WL site.	■ As part of CNL's Licence No. NRTEDL-W5-8.00/2024 with the Canadian Nuclear Safety Commission, environmental monitoring around the WL site will continue for the Project. ■ Follow-up monitoring during the post-closure phase will continue to verify effect predictions and to provide information for use in adaptive management to address potential unforeseen effects.	Secondary

6.7.1.6.2.1 No Linkage Pathway

There are no pathways identified as having no linkages to effects to the human health VCs.

6.7.1.6.2.2 Secondary Pathways

In some cases, a Project source of effect and an interaction with an assessment endpoint exists but mitigation is expected to cause minor changes to human health relative to the existing Base Case and/or guidelines. The following pathway is expected to result in negligible effects on the human health VCs and will not be evaluated further in the EIS.

- **Closure activities will alter concentrations of non-radiological indicator compounds (e.g., particulate matter and carbon dioxide), which could affect human health.**

Closure activities will result in the release of Criteria Air Contaminants (CACs) and fugitive dust emissions. Sources of dust deposition and air emissions include stack emissions, fuel use, aggregate material handling, on-site batch mixing plant and road dust. Environmental design features and mitigation have been incorporated into the Project to reduce potential adverse effects from dust deposition and air emissions. CNL's *Environmental Protection* (CNL 2021b) and *Management and Monitoring of Emissions* (CNL 2018a) include operational control monitoring, air verification monitoring and implementation of dust management techniques.

The release of CACs (particulate matter, nitrogen oxides, sulphur dioxide and carbon monoxide) and fugitive dust were assessed as part of the air quality VC in Section 6.2 Air Quality. Predicted concentrations for the Application Case (Section 6.2.1.7 Residual Effects Analysis) are below applicable air quality guidelines and/or standards. Therefore, the release of CACs and fugitive dust are expected to result in negligible effects to human health.

- **Release of chemical and radiological contaminants in the long-term during the post-closure phase from the previous activities completed at the WL site.**

The Comprehensive Study Report (CSR) indicated no residual effects on public health are expected as a result of the closure of the WL site. The assessment considered potential effects on the Winnipeg River and management of releases to ensure no residual effect. No decrease in water quality is expected and effluent emissions to the Winnipeg River are expected to decline to virtually zero following decommissioning. Re-suspension of contaminated sediments is also not expected to lead to a decrease in water quality (see Section 7.0 of AECL 2001).

The CSR (AECL 2001) also examined the potential for effects via groundwater quality from the low-level waste that may be managed in situ in the Waste Management Area (WMA), and their potential to affect the Winnipeg River and human health (see also Section 6.4.2.6.2.2 Project Interactions and Mitigation [surface water quality assessment]). The assessment considered three general exposure pathways: upward migration (with potential contamination of soils and vegetation), near-surface later migration (with potential contamination to local discharge in perimeter and roadside ditches) and downward migration and contamination of the sand and gravel aquifer and subsequently the river). Only the near-surface lateral migration scenario was considered in further detail. With respect to downward migration and release to the river it was determined that the general hydrology of the site limits or eliminates this pathway.

Water concentrations in the ditch were predicted and compared to established guidelines for several of the contaminants in the WMA. Radionuclide modelling in the CSR (Appendix C of AECL 2001) indicated that three radionuclides have the potential to exit the WMA through migration over a 200-year period, namely tritium, technetium-99 and carbon-14. Only technetium-99 is potentially present in nonzero concentrations in the ditch adjacent to the WMA in as early as 20 years. The carbon-14 and tritium will be released to the atmosphere, and when this is modelled there is no release of these radionuclides to the perimeter ditch. The preliminary exposure assessment for radiological contamination of the ditch, when these losses were conservatively ignored, resulted in a dose of 0.16 mSv/a at the predicted peak concentration of technetium-99 (Appendix C of AECL 2001).

With respect to non-radiological contaminants, some exceedances of applicable standards were predicted. Further refinement of the modelling and potential need for selective remediation to remove the hazard was recommended (AECL 2001). Organic contaminants were also considered; it was concluded that the remaining concentrations of the solvents and dichlorodiphenyltrichloroethane (DDT) are very small and unlikely to present a residual hazard.

The work at the WMA is subject to approval pending a final safety analysis be performed to confirm these conclusions. That analysis has not been finalized at this time, however both the Project and the WMA are subject to the same regulatory requirements, which require that no member of the public receive a dose greater than 1 mSv/a. *REGDOC 2.11.1, Waste Management, Volume III: Assessing the Long-Term Safety of Radioactive Waste Management* (CNSC 2018), Section 6.2.1, specifies a 1 mSv/a limit, and also specifies that a lower dose rate target should be set to account for emissions from other sources. Therefore, a value of 0.3 mSv/a dose limit to public has been established for the WL site. The Project specified a 0.25 mSv/a target dose rate limit for the public and results of the assessment for the normal evolution indicates that the Project is well below this target.

Consequently, there are negligible effects between the Project and previous activities at the WL site (i.e., effects from the WMA) and changes to surface water quality in the Winnipeg River.

As part of CNL's Licence No. NRTEDL-W5-8.00/2024 with the CNSC, environmental monitoring around the WL site will continue for the Project. Follow-up monitoring during the post-closure phase will continue to verify effect predictions and to provide information for use in adaptive management to address potential unforeseen effects. Consequently, changes to surface water quality from the closure of the WL site, are predicted to be negligible.

6.7.1.6.2.3 Primary Pathways

The following primary pathways were identified between the Project and human health and therefore, were carried forward to the residual effects analysis for their potential to affect human health:

- **Closure activities will result in the atmospheric release of radiological and non-radiological compounds from the WR-1 Building.**
- **Release of solutes into the groundwater as the grout and reactor components gradually deteriorate over time may cause changes in groundwater quality; which could migrate towards the Winnipeg River.**

6.7.1.7 Residual Effects Analysis

An ERA (EcoMetrix 2021) was completed for the Project to assess potential adverse effects on human health during the closure and post-closure phases of the Project. A summary of the methods and results of this assessment during the closure and post-closure phases of the Project is provided in Section 6.7.1.7.1 Application Case – Closure Phase and Section 6.7.1.7.2 Application Case – Post--closure Phase, respectively.

6.7.1.7.1 Application Case - Closure Phase

6.7.1.7.1.1 Methods

This section summarizes the methods used to assess the residual effects on human health, during the closure phase, for the Project activities and pathways identified as primary in Table 6.7.1-7. Policies, guidelines and standards considered in the analysis, as well as the model used to predict residual effects are described.

Receptor Selection and Characterization

The receptors for the HHRA were selected to be appropriate for assessment of both radiological and non--radiological stressors on human health. Off-site members of the public will potentially be exposed to low levels of airborne contaminants from decommissioning of the WR-1 Building. The most-affected off-site members of the public are defined as the “critical group” which include:

- Farm A and F (year-round occupants, with livestock); and
- Harvesters (separate receptor, represented by single receptor in the derivation of derived release limits [DRL] for the WL site [CNL 2018b]).

Radiological dose to workers at WR-1 may result from external exposure to radiation emitted from WR-1 during closure.

On-site workers performing ISD activities will be Nuclear Energy Workers. Doses to these workers will be monitored and managed as part of CNL’s Radiation Protection Program and Occupational Safety and Health Program in place under the WL Decommissioning Licence (NRTEDL-W5-8.00/2024). The application of the Radiation Protection Program provides that exposures will be kept ALARA and below the effective dose limit of 100 mSv over 5 years, and below 50 mSv in any single year, with human factors taken into account. An assessment of the radiological hazards and risks to workers performing closures activities, exposure mitigating measures and monitoring of worker doses is addressed in Section 7.1 of the DSAR (Golder 2021) for the Project. Therefore, this worker group has not been considered as a receptor for the HHRA in the EIS, consistent with Section 1.6 of *CSA N288.6-12: Environmental Risk Assessments at Class I Nuclear Facilities and Uranium Mines and Mills* (CSA Group 2012).

Other on-site workers (also classified as Nuclear Energy Workers the same as above, and subject to the same protections) not involved in performing closure activities were identified as a receptor for potential radiological exposures from environmental emissions during in situ decommissioning activities. Doses for other workers on-site, not directly involved in decommissioning activities, are assessed in Section 4.0 in the ERA (EcoMetrix 2021) for the Project and are summarized in Table 6.7.1-10 below. Decommissioning work will be conducted in accordance with requirements of the CNL Occupational Safety and Health Program Manual and CNL Work Permit System. The foundation of the safeguards against industrial hazards is qualified staffing and the implementation of proven and approved procedures through a system that requires continual improvement.

Farms A and F are the highest likely exposure group (i.e., critical groups) and are shown on Figure 6.7.1-1. Farms A and F are both livestock farms with the same characteristics as each other except for the location. Farm F being north-northeast of the WL site and Farm A being north of the WL site. Doses presented for Farm F are considered bounding for Farm A, as modelling during closure indicated that doses to residents at Farm F would be higher than at Farm A (EcoMetrix 2021); therefore, radiological doses are presented only for Farm F. For radiological parameters and consistent with *CSA N288.1-14: Guidelines for Calculating Derived Release Limits for Radioactive Material in Airborne and Liquid Effluents for Normal Operation of Nuclear Facilities* (CSA Group 2014) and CANDU Owners Group (COG) DRL Guidance Document (COG 2013) an adult, 10-year-old child, 1-year-old infant and 3-month-old infant were the age groups assessed for Farm F. The 1-year-old infant was evaluated to represent an infant that drinks cows' milk and an infant that drinks formula. The 3-month-old infant was evaluated to represent an infant that drinks breast milk (nursing) and an infant that drinks formula. Members of Farms A and F are considered to:

- reside at the farm 100% of the time;
- obtain the majority of their fruit and vegetables from their on-site garden;
- supply all of their own milk, poultry and eggs from their farm;
- supply some of their beef and pork from their farm;
- acquire honey from another local farm;
- obtain game (deer) (i.e., meat requirement) from hunting on their own property; and
- use a backyard swimming pool filled with well water 3 months out of the year.

Harvesters represent Indigenous or traditional users of the area who may be exposed through harvesting of country foods. The age groups evaluated for the Harvester included adult, 10-year-old child, and 1-year old infant, since Harvesters would likely bring back harvested food to feed their families. Harvesters are considered to:

- spend part of their time on-site, part near Farm F and part at an unexposed location;
- obtain deer and hare from hunting and trapping; and
- harvest plants including berries, weekay, and cedar.

CNL conducted an Indigenous food intake survey to understand the types and quantities of local food consumed. This survey was completed by members of the Sagkeeng First Nation. CNL also partnered with the Manitoba Métis Federation to conduct Harvester food intake surveys with Manitoba Métis Citizens that harvest in the area of the WL site. Additional Traditional knowledge on harvested foods was shared by Sagkeeng First Nation in a Traditional Knowledge Study, by the Manitoba Métis Federation in a Traditional Knowledge, Land Use and Occupancy Study, by Broken Head Ojibway, Black River and Hollow Water First Nations through their Traditional Use Study and by Wabaseemoong First Nation through their Traditional Use Study. The information collected through the surveys and the studies was used to validate the assumptions made for wild game, fish and plant ingestion rates for the subsistent Harvester receptors. The survey results have also been incorporated into the Harvester's diet. The intake rates from the Manitoba Métis Federation survey were lower than the intake rates identified by the Sagkeeng First Nation. Therefore, the Harvester receptor in the model uses the intake rates from the Sagkeeng First Nation Indigenous food intake survey, and is considered to be a conservative reflection of potential health effects to a Harvester.

Recreational users such as swimmers, anglers and boaters that occasionally carry out recreational activities along the Winnipeg River at locations close to the WL site, as compared to the most critical group locations (Farm A and Farm F), are not directly considered for the assessment because exposures to these individuals are anticipated to be well encompassed by those to the critical group.

Contaminants of Potential Concern

As part of normal operation, nuclear facilities release, in a controlled manner, small quantities of radioactive substances into the atmosphere and geosphere. These releases are regulated by the CNSC. Doses received by members of the public from routine releases at nuclear facilities are too low to be measured directly; therefore, a quantity known as a DRL is established for the site. Operating DRLs for the WL site were established in accordance with CSA N288.1-14 (CSA Group 2014). The DRLs have been calculated for 30 radionuclides that have been found or may reasonably expected to be present in airborne and liquid effluent streams at the WL site (CNL 2021b). As noted in the ERA (EcoMetrix 2021), the radionuclides that are considered for the closure period are primarily those that have been identified in the DRL Report (CNL 2021b) and the source term characterization report (CNL 2020b). These radionuclides have been found in WL's airborne effluent or are reasonably expected to be found in the airborne effluent during closure activities.

For the closure phase, the relevant COPCs are expected to be released via airborne effluents from the WR-1 Building as reactor systems are dismantled, transported off-site or encapsulated within the WRDF. No Project releases to the surface water environment are anticipated during the closure period. It has been assumed that the WR-1 Building stack will be dismantled during the closure phase, after grouting has been completed; therefore, airborne effluents are assumed to occur at ground level. Airborne emission estimates have been provided for demolition activities prior to grouting (referred to as demolition) and during grouting activities (refer to Section 6.2.1, Tables 6.2.1-11 and 6.2.1-12) as emissions are anticipated to be elevated during grouting (6 months). For both stages (demolition and grouting) airborne emission estimates have been provided for the average scenario or anticipated activities and activity level, as well as for the potential maximum scenario or accelerated activities and/or activity level.

Soil around the WR-1 building will be remediated if radioactivity is encountered that exceeds soil clean-up criteria established for the site end-state and land use (CNL 2019). As indicated in Section 6.3.1.6.2 Results [geology assessment], soil surrounding the foundation is not expected to exceed clean-up criteria; however, if soil contamination is encountered, it would be removed and segregated using standard excavation equipment and practices. As indicated in Table 6.2.1-10, dust suppression methods (e.g., water misting, use of applicable immobilization agent onto the soil surface) would be applied during excavation as required to suppress dust levels to meet environmental dust limit. Therefore, the release of radiological and non-radiological contaminants related to soil remediation was not anticipated to result in a residual effect.

Selection of Radiological COPCs

The radionuclides that are considered in the HHRA for the closure phase have been found in WL's airborne effluent or are reasonably expected to be found in the airborne effluent. All radionuclides identified through the source-term characterization process were carried forward quantitatively in the HHRA and did not undergo a formal screening assessment.

During closure, operational controls and procedures to prevent or limit the release of airborne effluents will be in effect (e.g., during demolition the above-grade building will be in place, the waste collection system and proven emergency response plans and personnel will all be operational and adequate ventilation and infiltration will be established). As well, decontamination and the use of stabilizing and immobilizing agents prior to dismantling the

WR-1 Building, will be used to control the release of airborne radionuclides. Release of radionuclides to the atmosphere during closure are not anticipated to be above the levels observed during the operation phase of the facility. During demolition of above-grade structures, radionuclides may be released from the Primary Heat Transport (PHT) system, and some existing surface contamination may become airborne (Table 6.7.1-8). During grouting, radionuclides may be released from the reactor core and biological shield (Table 6.7.1-9). During grouting it was conservatively assumed that the entire inventory of radionuclides is made available for release with dust particulate. In reality, much of the inventory will be fixed on surfaces of WR-1 structures. Tritium may also be released, for example, when disruptive activities are executed on the helium and heavy water system.

Table 6.7.1-8: Potential Radionuclide Release during the Closure Phase

Reactor Core	Biological Shield	Primary Heat Transport System
■ Carbon-14 ■ Iron-55 ■ Cobalt-60 ■ Nickel-59 ■ Nickel-63 ■ Niobium-94 ■ Silver-108m ■ Tritium	■ Chlorine-36 ■ Calcium-41 ■ Nickel-63 ■ Carbon-14 ■ Cobalt-60 ■ Europium-152	■ Strontium-90 ■ Caesium-137 ■ Europium-154 ■ Europium-155 ■ Technetium-99 ■ Iodine-129 ■ Uranium-235 ■ Uranium-238 ■ Neptunium-237 ■ Neptunium-239 ■ Plutonium-238 ■ Plutonium-239 ■ Plutonium-240 ■ Plutonium-241 ■ Americium-241 ■ Americium-243 ■ Curium-244 ■ Silver-108m ■ Cobalt-60

Note: The list of radionuclides potentially released during the closure phase was generally consistent with those identified in CNL's Derived Release Limits (2021a), with the exception of calcium-41, chlorine-36, europium-155, nickel-59, and neptunium-239 which were identified in the WR-1 Reactor Radiological Characterization Summary and Radionuclide Inventory Estimates Report (CNL 2020b)

Selection of Non-Radiological COPCs

Non-radiological airborne COPCs have been identified as potentially being released during the closure phase from the WL site. These include:

- asbestos (friable [contains more than 1% asbestos by weight or area and can be crumbled by the human hand] and non-friable [material that contains more than 1% asbestos and cannot be crumbled under hand pressure] asbestos containing materials);
- organic coolant (HB-40 used as reactor coolant, also known as OS-84, primarily hydrogenated terphenyl) in the PHT system;
- lead based paint and lead shielding;
- polychlorinated biphenyls (PCBs) in fluorescent light fixture ballasts;
- small quantities of mercury in thermostats and switches; and

- mould.

With the exception of HB-40, the identified hazardous substances are routinely addressed in construction projects. HB-40 consists mainly of hydrogenated terphenyl (74% to 87%), with smaller fractions of partially hydrogenated terphenyls and terphenyl. Since HB-40 is an oil, or a tar if irradiated, its release to air with dust should be limited.

The non-radiological COPCs listed above were compared against applicable air quality criteria as part of the ERA (EcoMetrix 2021). The predicted air concentrations for all non-radiological COPCs evaluated are below their relevant ambient air quality criteria. Therefore, exposure concentrations and dose for non-radiological COPCs were not completed as part of the ERA (EcoMetrix 2021).

Exposure Pathways

During the closure phase, releases to surface water are not expected, because any release from the grouted WRDF would occur after closure, and contaminant transport via groundwater to surface water would take additional time. Pathways relevant to exposure to airborne effluents are presented for the human receptors in Table 6.7.1-9 illustrated on Figure 6.7.1-3 and Figure 6.7.1-4. During the closure phase, human receptors on Farm A and F could potentially be exposed via air (inhalation, immersion), soil (incidental ingestion, groundshine), well water (ingestion, bathing), and ingestion of home-grown vegetables, fruits and livestock, and ingestion from locally hunted deer. Exposure pathways for on-site workers include inhalation of air on-site as well as immersion, and soil external contact and incidental ingestion pathways for outdoor workers. Non-radiological pathways are not applicable as no non-radionuclides were identified as COPCs for the closure phase.

CNL conducted an Indigenous food intake survey completed by members of the Sagkeeng First Nation to understand the types and quantities of local food consumed (CNL 2018c). The results indicate that survey participants consume animals such as wild game (e.g., moose, deer, rabbit and hare), waterfowl (e.g., duck and geese), fish, fruits and berries and medicinal plants (e.g., weekay and cedar). During the closure period, the focus is on terrestrial pathways, since only atmospheric releases are expected. Based on these considerations terrestrial animals including hare and deer, terrestrial plants including berries and medicinal plants including cedar and weekay are included in the assessment for the harvester. Other considerations for the harvester are considered in the post closure period where aquatic pathways are more applicable. It was noted from engagement with Indigenous peoples that Sagkeeng First Nation members in the Whiteshell area harvest wild rice and medicinal plants; however, wild rice does not grow in close proximity to WR-1.

CNL also partnered with the Manitoba Métis Federation to conduct Harvester food intake surveys with Red River Métis Citizens that harvest in the area of the WL site (SVS 2019). The information provided supported the VCs selected for the EIS and was used to validate the assumptions made for wild game, fish and plant ingestion rates for subsistent receptors. The intake rates from the Manitoba Métis Federation survey were lower than the intake rates identified by the Sagkeeng First Nation. Therefore, the Harvester receptor in the model uses the intake rates from the Sagkeeng First Nation Indigenous food intake survey. In addition, some diet components were not included in the model, such as moose. Diet components that exist in the Whiteshell area were considered for the ERA (EcoMetrix 2021), and it has been reported that moose populations are extremely low in the study area considered in the ERA (EcoMetrix 2021). Therefore, moose was excluded from the model in the closure phase but was added to the post closure phase model. This was done because moose is a very important VC to Indigenous people and in the future, moose may become more abundant in the area.

Atmospheric deposition to the Winnipeg River is considered negligible. This is consistent with the COG DRL guidance (COG 2013) which shows (assuming a modest flow rate for a lake of 0.1 m/s and an assumed water depth of 10 m) that the transfer of radionuclides from the atmosphere to large bodies of water (including lakes and rivers) is considered negligible. Rivers have larger flow rates than lakes; therefore, the conclusion for lakes that the atmospheric deposition pathway is negligible is applicable to rivers as well.

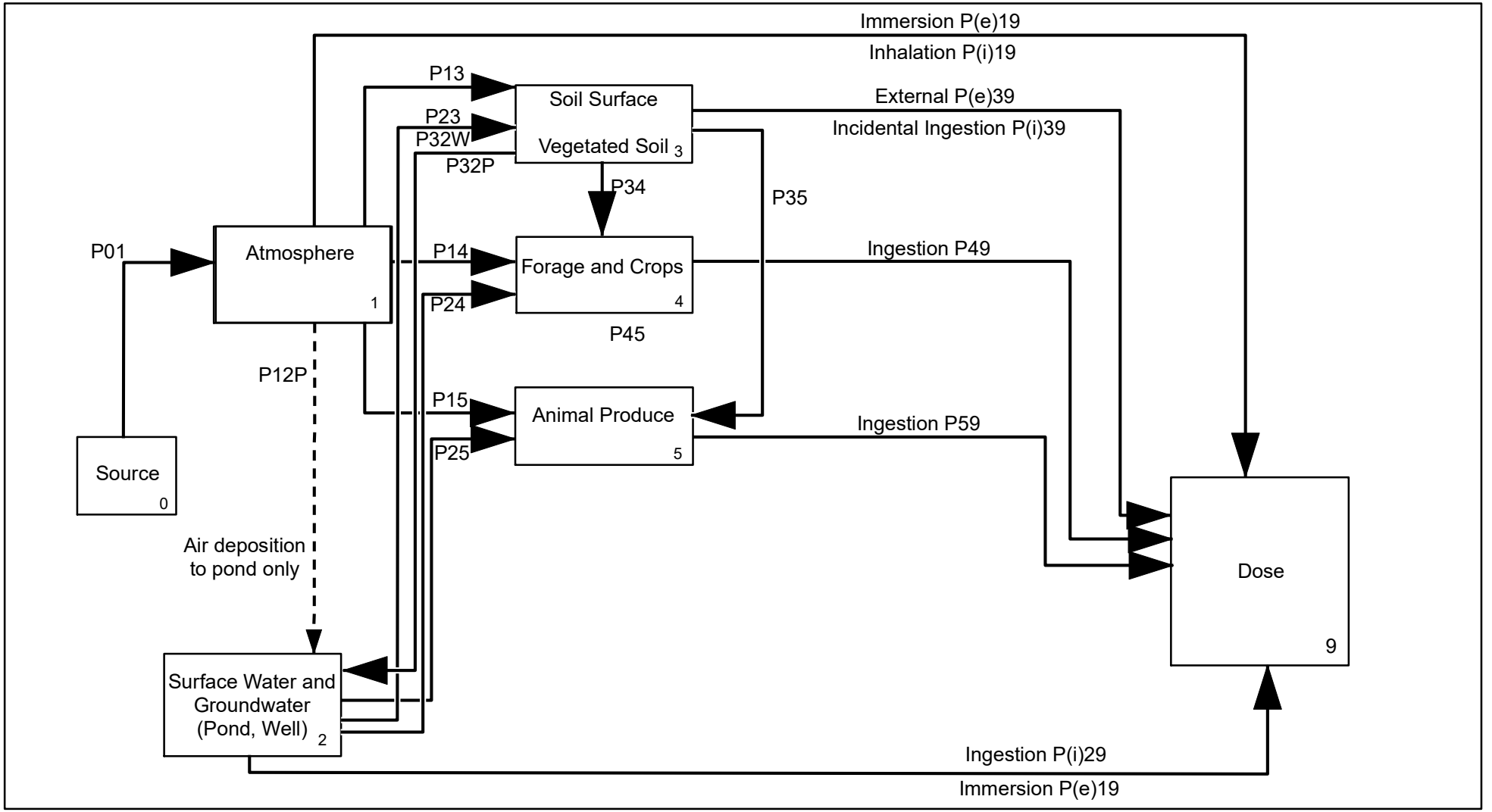
In CSA N288.1-14 (CSA Group 2014) the release of radionuclides from surface soil to the atmosphere is considered negligible because transfer is predominately from the atmosphere to soil. This pathway was not included during closure for this reason.

Table 6.7.1-9: Exposure Pathways for Receptors for Exposure to COPCs during Closure

Receptor	Exposure Pathway	Environmental Media
Farm F	Inhalation	■ Air
	Ingestion	■ Water (well water) ■ Soil (incidental) ■ Terrestrial plants (homegrown) ■ Terrestrial animals (beef, pork, poultry, eggs, milk, game, honey)
	External	■ Air ■ Water (well water) ■ Soil
Harvester	Inhalation	■ Air
	Ingestion	■ Terrestrial animals (hare, deer) ■ Terrestrial plants (berries, weekay, cedar)
	External	■ Air ■ Soil
On-Site WL Worker	Inhalation	■ Air
	Ingestion	■ Soil (incidental)
	External	■ Air ■ Soil

Note: Soil is considered to be clay as defined in the Hydrogeology Study Report (Dillon 2018).

PATH: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0015_EIS_Sec_6.7\20145046-0015-HL-0003_Figure 6_7_1-3_Conceptual Model for Human Receptors during the closure phase for Farm AF.mxd PRINTED ON: 2022-12-06 AT: 9:30:18 PM



REFERENCE(S)

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WSP GOLDER

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PREPARED	RRD
REVIEWED	KL
APPROVED	MM

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
CONCEPTUAL MODEL FOR HUMAN RECEPTORS DURING THE CLOSURE PHASE FOR FARM A/F

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0015	4	**6.7.1-3**

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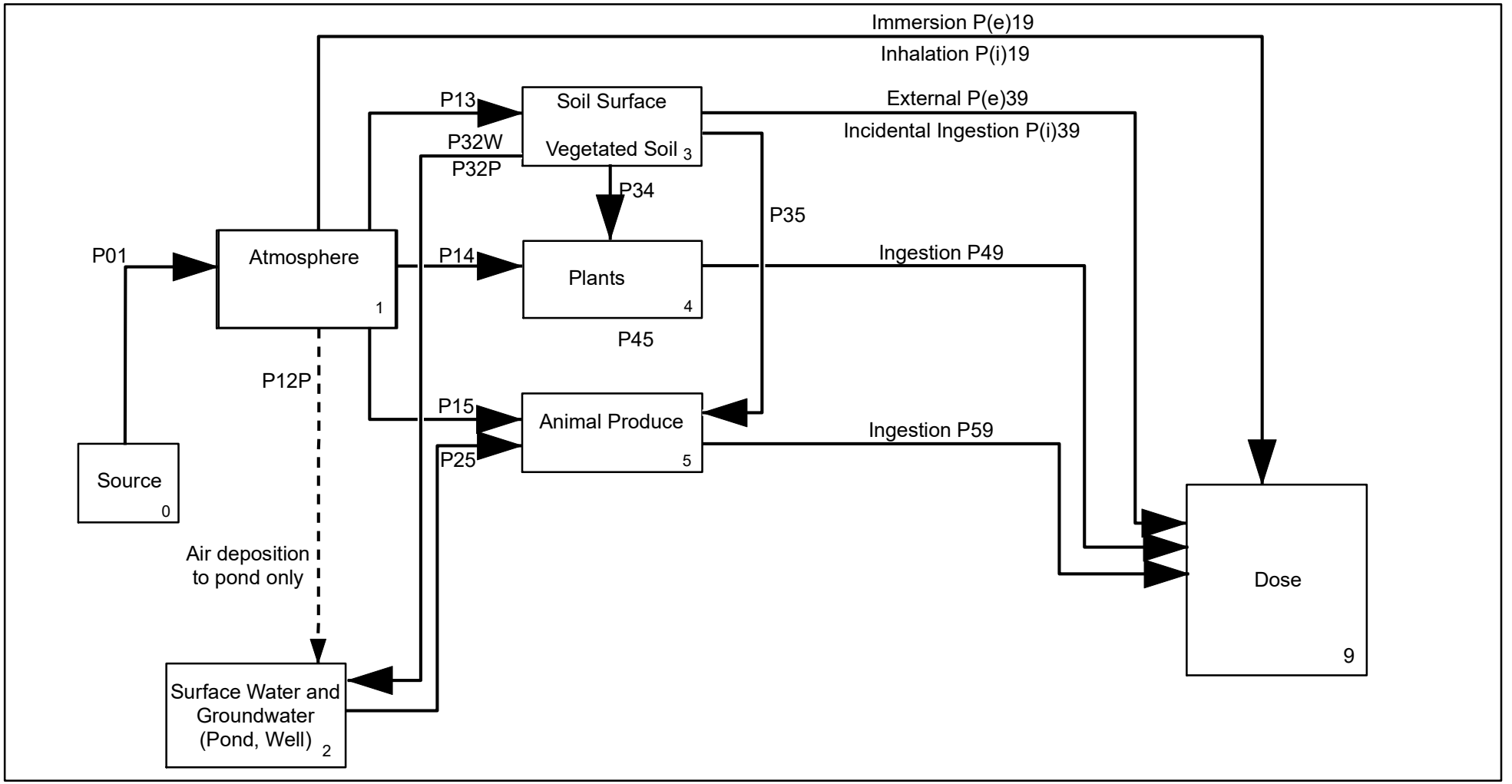
PATH: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0015_EIS_Sec_6.7\20145046-0015-HL-0004_Figure 6_7_1-4 Conceptual Model for Human Receptors during the closure phase harvester.mxd PRINTED ON: 2022-12-06 AT: 9:30:20 PM



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CONSULTANT
WSP GOLDER

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DESIGNED	PR
PREPARED	RRD
REVIEWED	KL
APPROVED	MM

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
CONCEPTUAL MODEL FOR HUMAN RECEPTORS DURING THE CLOSURE PHASE HARVESTER

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0015	4	**6.7.1-4**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A
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Model Software

An environmental transport and pathways model was used to evaluate the effects of contaminants on the local environment including human and ecological receptors. The software used for the exposure pathways analysis and for the calculation of radiological doses was IMPACT™ Version 5.5.1, which is consistent with the equations outlined in CSA N288.1-14 (CSA Group 2014) and the methods outlined in CSA N288.6-12 (CSA Group 2012). The Tool Qualification Report for IMPACT describes the verification and validation activities performed on IMPACT. A more detailed description of the model is provided in the ERA (EcoMetrix 2021).

6.7.1.7.1.2 Results

The public dose limit for radiation protection is 1 mSv/a, as described in the *Radiation Protection Regulations* (SOR/2000-203) under the *Nuclear Safety and Control Act*. This limit is defined as an incremental dose, and is set at a fraction of natural background dose. For the Project, an established dose constraint to the public from all nuclides and all pathways for the long-term expected evolution of 0.25 mSv/a is applied for the Project (CNL 2016).

For radionuclides, the total doses were compared to the public dose limit of 1 mSv/a and the dose constraint for the Project of 0.25 mSv/a. A summary of the total dose for each receptor and age group is provided in Table 6.7.1-10 along with a comparison to the public dose limit and dose constraint. The calculated radiological doses are all below these limits, for all human receptors in the candidate critical groups. Since the dose estimates are a small fraction of the public dose limit, no discernable health effects are anticipated due to exposure to radioactive releases from Project activities. Individual dose results for each radionuclide is provided in the ERA completed for the Project, in Tables 4-9 through 4-24 (EcoMetrix 2021).

Table 6.7.1-10: Summary of Total Dose during the Closure Phase Human Health Valued Components

Age Group / Exposure Scenario	Dose (mSv/a)	Percent of Dose Constraint	Percent of Public Dose Limit
Demolition			
Adult Harvester			
Demolition - Maximum	3.50×10^{-3}	1.40%	0.35%
Demolition - Average	9.19×10^{-4}	0.37%	0.09%
Child Harvester			
Demolition - Maximum	1.52×10^{-3}	0.61%	0.15%
Demolition - Average	4.00×10^{-4}	0.16%	0.04%
Infant Harvester			
Demolition - Maximum	6.66×10^{-4}	0.27%	0.07%
Demolition - Average	1.75×10^{-4}	0.07%	0.02%
Adult Farm F Resident			
Demolition - Maximum	3.46×10^{-3}	1.39%	0.35%
Demolition - Average	9.11×10^{-4}	0.36%	0.09%
Demolition			
Child (10-years old) Farm F Resident			
Demolition - Maximum	3.38×10^{-3}	1.35%	0.34%
Demolition - Average	8.89×10^{-4}	0.36%	0.09%

Table 6.7.1-10: Summary of Total Dose during the Closure Phase Human Health Valued Components

Age Group / Exposure Scenario	Dose (mSv/a)	Percent of Dose Constraint	Percent of Public Dose Limit
Infant (1-year old) Farm F Resident Cow's Milk			
Demolition - Maximum	2.61×10^{-3}	1.04%	0.26%
Demolition - Average	6.86×10^{-4}	0.27%	0.07%
Infant (1-year old) Farm F Resident Formula Fed			
Demolition - Maximum	1.17×10^{-3}	0.47%	0.12%
Demolition - Average	3.07×10^{-4}	0.12%	0.03%
3-month Old Farm F Resident Nursing			
Demolition - Maximum	1.23×10^{-3}	0.49%	0.12%
Demolition - Average	3.23×10^{-4}	0.13%	0.03%
3-month Old Farm F Resident Formula Fed			
Demolition - Maximum	3.96×10^{-4}	0.16%	0.04%
Demolition - Average	1.04×10^{-4}	0.04%	0.01%
Demolition			
On-Site Worker			
Demolition - Maximum	6.04×10^{-3}	2.42%	0.60%
Demolition - Average	1.59×10^{-3}	0.64%	0.16%
Grouting			
Adult Harvester			
Grouting - Maximum	1.58×10^{-5}	<0.01%	<0.01%
Grouting – Average	8.82×10^{-6}	<0.01%	<0.01%
Child Harvester			
Grouting - Maximum	1.69×10^{-5}	<0.01%	<0.01%
Grouting – Average	9.40×10^{-6}	<0.01%	<0.01%
Infant Harvester			
Grouting - Maximum	1.85×10^{-5}	<0.01%	<0.01%
Grouting – Average	1.04×10^{-6}	<0.01%	<0.01%
Adult Farm F Resident			
Grouting - Maximum	1.01×10^{-4}	0.04%	0.01%
Grouting – Average	5.69×10^{-5}	0.02%	<0.01%
Child (10-years old) Farm F Resident			
Grouting - Maximum	1.21×10^{-4}	0.05%	0.01%
Grouting – Average	6.79×10^{-5}	0.03%	<0.01%
Infant (1-year old) Farm F Resident Cow's Milk			
Grouting - Maximum	1.59×10^{-4}	0.06%	0.02%
Grouting – Average	8.88×10^{-5}	0.04%	<0.01%

Table 6.7.1-10: Summary of Total Dose during the Closure Phase Human Health Valued Components

Age Group / Exposure Scenario	Dose (mSv/a)	Percent of Dose Constraint	Percent of Public Dose Limit
Infant (1-year old) Farm F Resident Formula Fed			
Grouting - Maximum	1.23×10^{-4}	0.05%	0.01%
Grouting – Average	6.72×10^{-5}	0.03%	<0.01%
Grouting			
3-month Old Farm F Resident Nursing			
Grouting - Maximum	1.09×10^{-4}	0.04%	0.01%
Grouting – Average	6.30×10^{-5}	0.03%	<0.01%
3-month Old Farm F Resident Formula Fed			
Grouting - Maximum	8.91×10^{-5}	0.04%	<0.01%
Grouting – Average	4.89×10^{-5}	0.02%	<0.01%
Grouting			
On-Site Worker			
Grouting - Maximum	1.80×10^{-4}	0.07%	0.02%
Grouting – Average	9.76×10^{-5}	0.04%	0.01%

Note:

A dose of 0.0025 millisieverts per year (mSv/a) is equivalent to 1% of the dose constraint and a dose of 0.01 mSv/a is equivalent to 1% of the public dose limit.

Non-radiological COPCs are identified through the completion of a formal screening process. For the closure phase, all predicted air concentrations for non-radiological COPCs were below their relevant ambient air quality criteria (Section 4.1.2.2 of the ERA [EcoMetrix 2021] therefore, no non-radiological COPCs were identified for the closure phase and no health effects are anticipated as a result of airborne effluent from the Project.

6.7.1.7.2 Application Case – Post-closure Phase

This section describes the specific methods used to assess the residual effects on human health, during the post-closure phase (see Table 6.7.1-5). Policies, guidelines and standards considered in the analysis, as well as the model used to predict residual effects, are described.

6.7.1.7.2.1 Methods

Scenarios

The Normal Evolution Scenario is a description of the most likely, expected, evolution of the WRDF and its surrounding environment. The Normal Evolution Scenario accounts for the expected degradation of the engineered barriers over the post--closure phase. It starts immediately following the closure phase, to capture the entire post-closure phase (i.e., institutional control and post--institutional control periods). It is assumed that the WRDF will degrade over time due to mechanical stresses and chemical reactions.

Disruptive event scenarios are variants on the Normal Evolution Scenario, designed to address uncertainties that have arisen during the definition of scenarios and conceptual models. Each is described with scenario specific assumptions. Bounding scenarios are then identified to represent “worst case” with consequences greater than the other events considered. The following disruptive event scenarios were assessed in the safety assessment:

- **Unsealed Borehole:** This scenario considers the consequence of an enhanced permeability pathway for contaminated groundwater to affect downgradient receptors (i.e., the Winnipeg River).
- **Well in Plume:** To confirm the long-term safety of future generation, the assumptions was made that after institutional control a human receptor (On-site Farm) would obtain drinking water from a well, established half-way between the WRDF and the Winnipeg River.
- **Localized Failure of the WRDF:** This scenario represents a localized failure that results in an enhanced hydraulic connection through the WRDF containment barrier and an associated elevated exposure of human and non-human receptors near the WL site to contaminated groundwater.
- **WRDF Barrier Failure:** This scenario considers that failure of the WRDF concrete foundation resulting in an open fracture. It considers that the grouting fabrication and/or installation is inappropriate, or that the long-term performance deteriorates rapidly due to unforeseen or underestimated physical, chemical and/or biological processes.
- **Human Intrusion:** The specific human activity considered for the Human Intrusion Scenario is exploratory drilling. Exposure to (1) drill crew at the wellhead, (2) residents near to the site, (3) core transportation personnel and (4) laboratory technicians were all considered possible. Sources of exposure include gas released from the borehole, the drill core itself and contaminated groundwater.
- **Glaciation:** Considers an eventual glacial advance causing a full excision and surface distribution of the WRDF radionuclide inventory and exposure of humans resettling in the area following glacial retreat, approximately 140,000 years from closure.
- **Seismicity:** Considers the potential effects from a seismic event during the 10,000 year assessment timeframe. This disruptive event is encompassed by the WRDF Barrier Failure event as a potential outcome of a larger than design basis earthquake.
- **Liquefaction:** Considers the potential for liquefaction of soils surrounding the WRDF.

Three of the Disruptive Events described above were considered Bounding Scenarios and were identified as “worst case” with consequences greater than the other events considered. These were:

- Human Intrusion: an exploration borehole drilled into the WRDF and exposure of wastes;
- WRDF Barrier Failure: a substantial failure of the WRDF foundation; and
- Well in Plume: an on-site resident drinking groundwater from a well capturing the plume from the WRDF.

In addition to Normal Evolution Scenario and disruptive event scenarios, the safety assessment also considers other types of scenarios, including Defence in Depth Cases and Sensitivity Analysis Cases.

- Defence in Depth Cases are aimed at building confidence in the performance of the WRDF after closure. These cases examine the extent to which the Project depends on key engineered barriers and what would

happen if those barriers were not present. This group of scenarios therefore involves hypothetical combinations to analyze the barriers in the system. Each scenario involves a change in one or more parameters related to a particular barrier; by comparing the results to those of the Normal Evolution Scenario, the influence of the barrier is tested. The Defence in Depth Cases developed for the Project are described in the DSAR (Golder 2021).

- Sensitivity Analysis Cases are used to directly examine the effect of important uncertainties in the models and data used to represent the system. As many modelling aspects can in practice be expressed through parameter values, sensitivity cases focus on using alternative parameter value choices. The alternative parameter values that are assigned need not represent specific bounds on uncertainty (as in some cases these cannot easily be established); in other words, the alternative parameters need not necessarily be the "highest" or "lowest" possible values. Rather, they are used to test the effect of uncertainty; for example, if parameter x is increased by a factor of 10, by what factor does the dose increase? The Sensitivity Analysis Cases developed for the Project are described in the DSAR (Golder 2021).

These cases serve to illustrate the importance of facility design features, address uncertainty in model parameters and provide perspective on the limits of safety performance. These scenarios are not relevant for the EIS effects assessment and are therefore not discussed further in this report. In general, the EIS only restates necessary information from the ERA. Further information on scenarios, receptors, calculations and results in general, is available in the DSAR (Golder 2021).

Receptor Selection and Characterization

Normal Evolution Scenario

The receptors for the HHRA were selected to be appropriate for both radiological and non--radiological stressors on human health. Consistent with the closure scenario and CSA N288.6-12 (CSA Group 2012), Nuclear Energy Workers are not addressed for the radiological assessment because their radiation exposure is monitored, and their doses are controlled through CNL's Radiation Protection Program. On-site workers are not assessed during post-closure for non-radiological exposures since there is no aquatic pathway to on-site workers.

An On-site Farm was considered reasonable for the normal evolution scenario after the end of institutional control. The WRDF will be under institutional control for at least 100 years of post-closure, which will physically restrict residential use of the site, including any farming activities. To account for the possibility of a farm closer to the WRDF, an On-site Farm receptor drinking river water has been included after institutional control.

For evaluation of disruptive event scenarios, the On-site Farm receptor drinks groundwater. Other disruptive event scenarios include a WRDF barrier failure and a human intrusion via an exploration borehole. In the exploration borehole scenario receptors include a driller that handles the core and nearby residents that spend time near the borehole (EcoMetrix 2021). These on-site receptors are considered bounding for any other potential land users (e.g., industrial personnel) or farms established closer to the site than the existing farms.

Human receptors evaluated for both the radiological and non-radiological assessment for the post-closure scenario include:

- Farm A (year-round occupants, with livestock) (located near the east bank of the Winnipeg River);
- On-site Farm (located on the WRDF site after institutional control); and

- Harvesters.

Farm A is the most exposed critical group for releases to the Winnipeg River because liquid releases from the site travel downstream along the east bank according to the DRL report (CNL 2021b). Therefore, radiological doses presented for Farm A are considered bounding for Farm F. For radiological parameters and consistent with N288.1-14 (CSA Group 2014) and COG DRL Guidance Document (COG 2013) an adult, 10-year-old child, 1-year-old infant and 3-month-old infant were the age groups assessed for Farm A. The 1-year-old infant was evaluated to represent an infant that drinks cows' milk and an infant that drinks formula. The 3-month-old infant was evaluated to represent an infant that drinks breast milk (nursing) and an infant that drinks formula. For non--radiological dose calculations an adult and toddler were assessed, consistent with Health Canada Preliminary Quantitative Risk Assessment guidance (Health Canada 2010), as recommended by Clause 6.3.5 of CSA N288.6-12 (CSA Group 2012). Members of Farm A and the new On-site Farm are considered to:

- reside at the farm 100% of the time;
- obtain the majority of their fruit and vegetables from their on-site garden;
- supply all of their own milk, poultry and eggs from their farm;
- supply some of their beef and pork from their farm;
- obtain game (i.e., meat requirement) from hunting on their own property
- obtain fish from the Winnipeg River; and
- swim and drink water from the Winnipeg River.

The new On-site Farm receptor has the same characteristics as Farm A; however, residents obtain water for drinking, irrigation and bathing from the Winnipeg River directly downstream of the WRDF groundwater seep into the river. The farm does not have a well in normal evolution because the well capacity would not meet all the water needs of the residential family, which would therefore be more likely to use the adjacent Winnipeg River. One disruptive event scenario includes the On-site Farm using well water as drinking water *only,* since the well capacity could not meet other water needs.

Harvesters represent Indigenous and traditional users of the area who may be exposed through harvesting of country foods. The age groups evaluated for the Harvester included adult, 10-year-old child, and 1-year old infant, since Harvesters would likely bring back harvested food to feed their families. Harvesters are considered to:

- spend part of their time on-site, part near Farm A and part at an unexposed location.
- obtain moose and waterfowl from hunting;
- obtain fish from the Winnipeg River; and
- harvest plants including weekay.

CNL conducted an Indigenous food intake survey (CNL 2018b) completed by members of the Sagkeeng First Nation to understand the types and quantities of local food consumed. CNL also partnered with the Manitoba Métis Federation (SVS 2019) to conduct Harvester food intake surveys with Red River Métis Citizens that harvest in the area of the WL site. The survey results have been incorporated into the Harvester's diet. Additional Traditional knowledge on harvested foods was shared by Sagkeeng First Nation in a Traditional Knowledge Study, by the

Manitoba Métis Federation in a Traditional Knowledge, Land Use and Occupancy Study, by Broken Head Ojibway, Black River and Hollow Water First Nations through their Traditional Use Study and by Wabaseemoong First Nation through their Traditional Use Study. Human receptors during the post-closure- phase are shown on Figure 6.7.1-1. For radiological parameters an adult, 10-year-old child and 1-year-old infant were the age groups assessed for the Harvester. For non-radiological dose calculations an adult and toddler were assessed for the Harvester.

For each receptor, the exposure factors (e.g., intake rates, occupancy and shielding factors, etc.) are generally those used in N288.1-14 (CSA 2014) or other federal guidelines. For example, water ingestion rates for receptors are from Guidelines for Canadian Drinking Water Quality (Health Canada 2010), and are given as 0.6, 0.8 and 1.5 L/day for Toddlers, Child and Adults respectively. Detailed information on other receptor behaviours such as food ingestion rates and occupancy factors are documented in the Environmental Risk Assessment Tables 5-7 and 5-8 (EcoMetrix 2021).

Disruptive Scenarios

The receptors used for the Disruptive Scenarios were similar to those used in the Normal Evolution Scenario with a few variations as described below:

- Human Intrusion (Exploration Borehole): In this disruptive event scenario it was assumed that an exploration borehole was drilled through the concrete cap and engineered cover, grout, cement, and WRDF from ground surface to bedrock. The material encountered would be brought to surface, handled by the driller and dumped on the ground. Once the driller had left, trespassers would spend time at the drill location.
- WRDF Barrier Failure: For this disruptive scenario, an open fracture was modeled in the foundation of WRDF. Everything is the same as in the normal evolution scenario, except that groundwater loadings to surface water are based on an open fracture.
- Well in Plume: This disruptive scenario is the same as the normal evolution scenario, except that the On-site Farm has a well in the groundwater plume from WRDF and uses it for drinking water. Water for other purposes, including bathing and irrigation of garden crops is taken from the Winnipeg River near the site.

Contaminants of Potential Concern

For the post-closure phase, no atmospheric releases are expected as the grouting will be completed, and the above-grade building and components will have been removed. Atmospheric releases that occurred during closure that are dispersed and subsequently deposited on the ground or transported to a groundwater well near the WL site are not considered during the post-closure phase. The soil (internal and external) pathways and drinking water pathway (from a farm well) have small contributions to total dose during the closure phase and would have minimal impact on the total dose for the post-closure phase. Therefore, the phases were assessed separately to understand the effects of each phase of the Project separately.

A concrete cap and engineered cover will have been installed on top of the buried material. The site will also be under institutional control for 100 years. The main potential release mechanism during post-closure is via leakage through the WRDF to groundwater and subsequent migration of groundwater to surface water at the Winnipeg River.

Selection of Radiological COPCs

The radionuclides that were considered in the HHRA for the post-closure phase included those that have been historically found in WL's liquid effluent, are reasonably expected to be found in the WRDF and have the potential to migrate from groundwater to surface water during the post-closure phase (EcoMetrix 2021),or have been measured in the river bottom sediment. Radionuclides are considered of public and regulatory interest and therefore all radionuclides identified were carried forward quantitatively in the HHRA. The radionuclides included for the post-closure scenario were:

- Actinium-225
- Actinium-227
- Americium-241;
- Americium-243;
- Silver-108m;
- Bismuth-210
- Carbon-14;
- Calcium-41;
- Chlorine-36;
- Curium-244;
- Cobalt-60;
- Caesium-137;
- Europium-152;
- Europium-154;
- Europium-155;
- Iron-55;
- Gadolinium-55
- Iodine-129;
- Niobium-94;
- Nickel-59;
- Nickel-63;
- Neptunium-237;
- Neptunium-237;
- Protactinium-231;
- Protactinium-233;
- Lead-210;
- Polonium-210;
- Plutonium-238;
- Plutonium-239;
- Plutonium-240;
- Plutonium-241;
- Radium-223:
- Radium-224;
- Radium-225;
- Radium-226;
- Radium-228;
- Strontium-90;
- Technetium-99;
- Thorium-227;
- Thorium-228;
- Thorium-229;
- Thorium-230;
- Thorium-231;
- Thorium-232;
- Thorium-234;
- Uranium-233;
- Uranium-234;
- Uranium-235;
- Uranium-236;
- Uranium-237;
- Uranium-238;
- Yttrium-90.
-

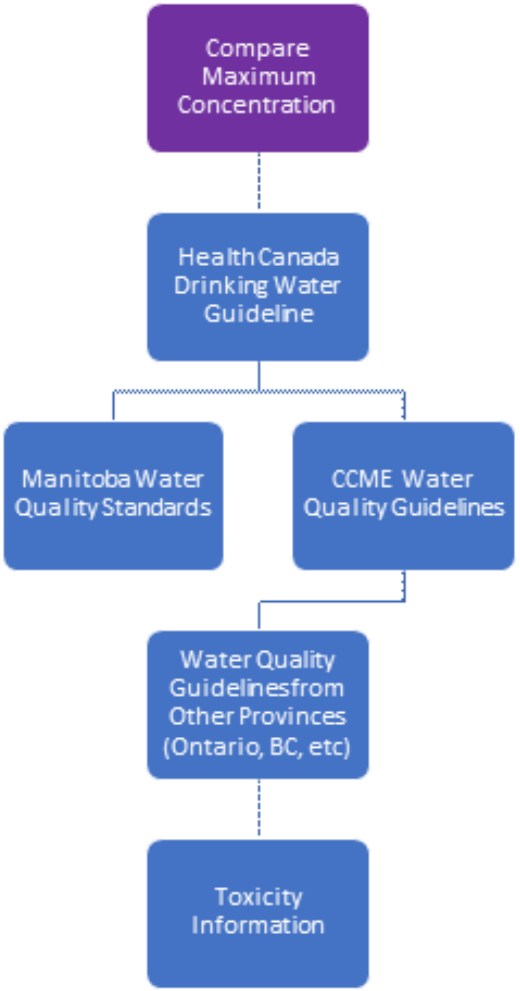
Selection of Non-Radiological COPCs

CNL has determined that a select number of non-radiological waterborne COPCs may potentially be released from the WL site during the post-closure phase (CNL 2017). These include:

- Boron;
- Cadmium;
- Chromium;
- HB-40;
- Mercury;
- Palladium;
- Potassium hydroxide; and
- Xylene.

Non-radiological parameters that may exceed the benchmarks as shown on Figure 6.7.1-5 were carried forward as non-radiological COPCs in this assessment. Based on the screening process, cadmium and lead were carried forward for further quantitative assessment in the HHRA for the post-closure phase.

PATH: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0015_EIS_Sec_6.7\20145046-0015-HL-0005_Figure 6_7_1-5 Selection Process for Human Health Screening of Non-Radiological COPCs.mxd PRINTED ON: 2022-12-06 AT: 9:30:22 PM



REFERENCE(S)

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CANADIAN NUCLEAR LABORATORIES

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WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	PR
PREPARED	RRD
REVIEWED	NDR
APPROVED	MM

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
SELECTION PROCESS FOR HUMAN HEALTH SCREENING OF NON-RADIOLOGICAL COPCS

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0015	4	**6.7.1-5**

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Exposure Pathways

Normal Evolution Scenario

The post-closure phase is not expected to result in airborne effluent, as the grouting will have been completed, the above-grade building will have been completely decommissioned and a concrete cap and engineered soil cover will have been installed over the WRDF. During the post-closure phase groundwater releases to surface water may occur. Aquatic dispersion will carry contaminants to downstream locations on the Winnipeg River. Waterborne contaminants can partition to sediment. River water and sediment will be the primary exposure media. River water will also be used for irrigation.

Pathways relevant to exposure to releases to surface water are presented for the human receptors in Table 6.7.1-11 and illustrated on Figure 6.7.1-6 and Figure 6.7.1-7. For non-radiological COPCs only the ingestion pathway has been considered, since the dermal pathway is considered negligible for inorganics (i.e., cadmium and lead). During post-closure, human receptors on Farm A and the On-site Farm could potentially be exposed via use of water from the Winnipeg River for drinking, bathing, livestock watering and irrigation (lawns and gardens) and by ingestion of home-grown vegetables, fruit and livestock. Ingestion of terrestrial plants and animals is included for the On-site and Farm A receptors since the Winnipeg River is used for irrigation of these plants and as drinking water for the animals. Residents from these farms are also assumed to fish in the Winnipeg River.

As described in Section 6.7.1.7.1.1, CNL conducted an Indigenous food intake survey completed by members of the Sagkeeng First Nation to understand the types and quantities of local food consumed (CNL 2018b). The results indicate that survey participants consume animals such as wild game (e.g., moose, deer, rabbit and hare), waterfowl (e.g., duck and geese), fish, fruits and berries and medicinal plants (e.g., weekay and cedar). During the post-closure phase, the focus is on aquatic pathways, since groundwater releases to surface water will occur. Since the focus is on aquatic pathways, moose has been included instead of deer (which was assessed during the closure phase), since a portion of the moose's diet is from ingestion of aquatic plants. Weekay is a wetland plant and could grow along the shore of the Winnipeg River or in shallow areas. It is unlikely that weekay would be exposed to direct groundwater, but could potentially be exposed to river water. Based on these considerations, exposure via consumption of food harvested from the site (e.g., plants, fish, waterfowl, and moose) would be the important pathways for exposure of the harvester to contaminants released from WRDF to the river.

Harvesters will ingest country foods such as weekay, fish and waterfowl, as well as moose that drink from the Winnipeg River. During post-closure, aquatic release (groundwater flow to the Winnipeg River) is the relevant pathway; therefore, terrestrial pathways are not evaluated for the harvester in post-closure.

CNL also partnered with the Manitoba Métis Federation to conduct Harvester food intake surveys with Red River Métis Citizens that harvest in the area of the WL site (SVS 2019). The information provided supported the VCs selected for the EIS and was used to validate the assumptions made for wild game, fish and plant ingestion rates for subsistent receptors. The intake rates from the Manitoba Métis Federation survey were lower than the intake rates identified by the Sagkeeng First Nation. Therefore, the Harvester receptor in the model uses the intake rates from the Sagkeeng First Nation Indigenous food intake survey.

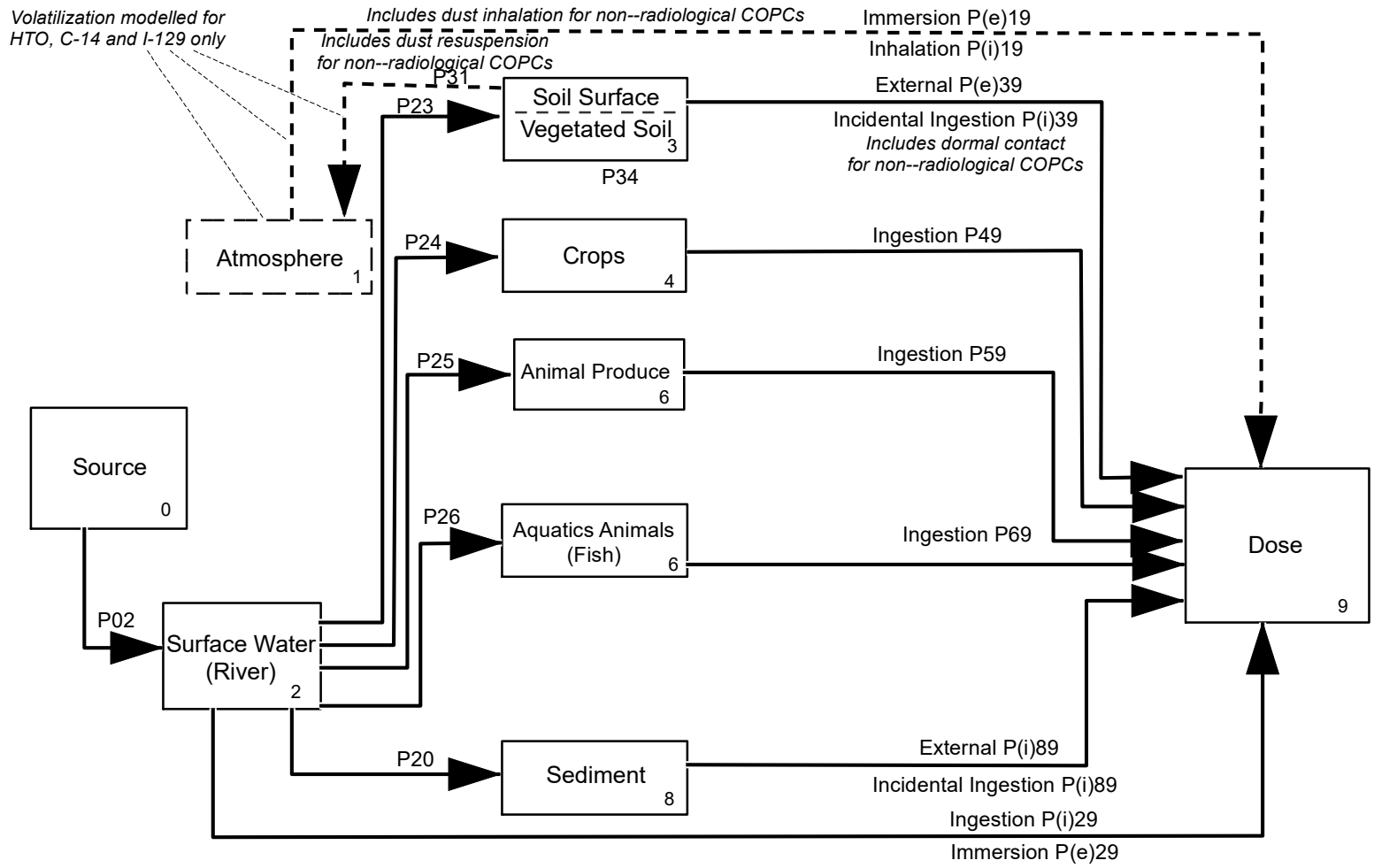
There is no direct release to air; however, for volatile radionuclides (tritium oxide, carbon-14, iodine-129), receptors will be exposed via the air pathway (inhalation and immersion) through volatilization from irrigated soil.

Table 6.7.1-11: Exposure Pathways for Receptors for Potential Exposure to Radiological and Non-Radiological COPCs during Post--closure (Normal Evolution Scenario)

Receptor	Exposure Pathway	Environmental Media
Farm A and On-site Farm	Inhalation	■ Air
	Ingestion	■ Water (Winnipeg River) ■ Soil/Sediment (incidental) ■ Terrestrial plants (homegrown) ■ Aquatic animals (fish) ■ Terrestrial animals (beef, pork, poultry, eggs, milk, game, honey)
	External	■ Air ■ Water (Winnipeg River) ■ Soil/Sediment
Harvester	Inhalation	■ Air
	Ingestion	■ Riparian plants (weekay) ■ Aquatic animals (fish) ■ Terrestrial animals (waterfowl, moose)
	External	■ Air ■ Soil/Sediment

Note: Soil is considered to be clay as defined in the Hydrogeology Study Report (Dillon 2018).

PATH: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0015_EIS_Sec_6.7\20145046-0015-HL-0006_Figure 6_7_1-6 Conceptual Model for Human Receptors during the Post-closure Phase for Farm A and On-site Farm.mxd PRINTED ON: 2022-12-06 AT: 9:30:23 PM



REFERENCE(S)

CLIENT
CANADIAN NUCLEAR LABORATORIES

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	PR
PREPARED	RRD
REVIEWED	KL
APPROVED	MM

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
CONCEPTUAL MODEL FOR HUMAN RECEPTORS DURING THE POST-CLOSURE PHASE FOR FARM A AND ON-SITE FARM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0015	4	**6.7.1-6**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A
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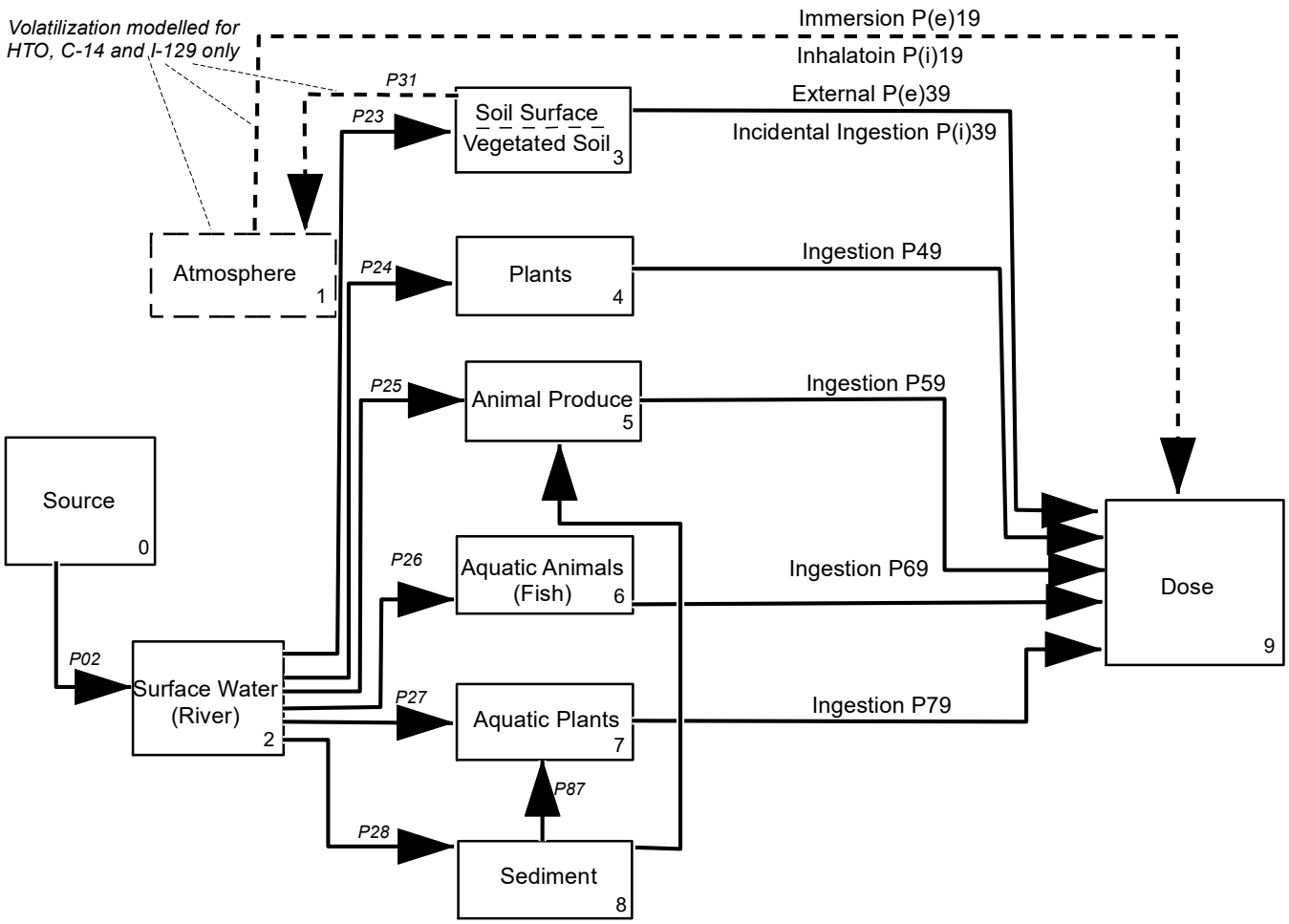
PATH: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0015_EIS_Sec_6.7\20145046-0015-HL-0007_Figure 6_7_1-7 Conceptual Model for Human Receptors during the Post-closure Phase for Harvester.mxd PRINTED ON: 2022-12-06 AT: 9:30:25 PM



Note: Animal produce exposure to sediments is for waterfowl only.

REFERENCE(S)

CLIENT
CANADIAN NUCLEAR LABORATORIES

CONSULTANT
WSP GOLDER

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
CONCEPTUAL MODEL FOR HUMAN RECEPTORS DURING THE POST-CLOSURE PHASE FOR HARVESTER

MM-YYYY	DECEMBER 2022
DESIGNED	PR
PREPARED	RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0015	4	**6.7.1-7**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A
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Disruptive Scenarios

As described above for the Normal Evolution Scenario, the post-closure phase is not expected to result in airborne effluent, but groundwater releases to surface water may occur. Aquatic dispersion will carry contaminants to downstream locations on the Winnipeg River. Waterborne contaminants can partition to sediment. River water and sediment will be the primary exposure media. River water will also be used for irrigation. Pathways relevant to exposure to groundwater releases to surface water for the Disruptive Scenarios are presented for the human receptors in Table 6.7.1-12.

Table 6.7.1-12: Exposure Pathways for Receptors for Potential Exposure to Radiological and Non-Radiological COPCs during Post-closure- (Disruptive Scenarios)

	Receptor	Exposure Pathway	Environmental Media
Inadvertent Human Intrusion (Exploration Borehole)	On-site Worker (Driller) - 1 hr	Inhalation	■ Air
		Dermal Contact	■ Soil
		Groundshine	
	Trespasser - exposed 1 hr daily	Inhalation	■ Air
		Dermal Contact	■ Soil
		Groundshine	
WRDF Barrier Failure	On-site Farm – full time residency	Inhalation	■ Air
		Ingestion	■ Water (Winnipeg River)
			■ Soil (incidental)
			■ Terrestrial Plants (homegrown)
			■ Terrestrial Animals and Animal Products
	Farm F and Farm A - full time residency	Inhalation	■ Air
		Ingestion	■ Water (well water)
			■ Soil (incidental)
			■ Terrestrial Plants (homegrown)
			■ Terrestrial Animals and Animal Products
	Harvester - 2 hr/wk on-site, downwind, and upwind from Project activities	Inhalation	■ Air
		Ingestion	■ Terrestrial Animals (waterfowl, moose)
		External	■ Air
			■ Soil

Table 6.7.1-12: Exposure Pathways for Receptors for Potential Exposure to Radiological and Non-Radiological COPCs during Post-closure- (Disruptive Scenarios)

	Receptor	Exposure Pathway	Environmental Media
Unplanned Human Habitation (Well in Plume)	On-site Farm – full time residency	Inhalation	■ Air
		Ingestion	■ Water (well water)
			■ Soil (incidental)
			■ Terrestrial Plants (homegrown)
			■ Terrestrial Animals and Animal Products
			■ Soil
		Dermal	■ Soil

Model Software

An environmental transport and pathways model was used to evaluate the effects of contaminants on the local environment including human and ecological receptors. The software used for the exposure pathways analysis and for the calculation of radiological doses was IMPACT Version 5.5.1, which is consistent with the equations outlined in CSA N288.1-14 (CSA Group 2014) and the methods outlined in CSA N288.6-12 (CSA Group 2012). The Tool Qualification Report for IMPACT describes the verification and validation activities performed on IMPACT. A more detailed description of the model is provided in the ERA (EcoMetrix 2021).

6.7.1.7.2.2 Results

Normal Evolution Scenario

The public dose limit for radiation protection is 1 mSv/a, as described in the *Radiation Protection Regulations* (SOR/2000-203) under the *Nuclear Safety and Control Act*. This limit is defined as an incremental dose, and is set at a fraction of natural background dose. A dose constraint of 0.25 mSv/a was established for the public from all nuclides and all pathways for the Project (CNL 2016). The total radiation dose to human receptors during the post-closure phase are below the CNSC public dose limit of 1 mSv/a, as well as the dose constraint of 0.25 mSv/a. Since the dose estimates are a small fraction of the public dose limit, no discernable health effects are anticipated due to exposure of potential critical groups to radioactive releases from the WL site during post--closure.

The maximum dose was conservatively assessed at a single point in time, corresponding to the peak loading rate from groundwater to the Winnipeg River for each radionuclide. The total dose is presented in Table 6.7.1-13. However, to assess the total radiation dose for each identified human receptor over the groundwater modelling timeframe, a more realistic representation of predicted dose rate to human receptors over the post-closure phase from the Normal Evolution scenario is presented in Figure 6.7.1-8. The dose increases steadily with time, generally peaking around 1,000 years (due to contribution from carbon-14) after closure and is greatly reduced as time progresses. The exception is the 3-month old formula-fed infant where the dose peaks at the beginning of modelling and then again after 100,000 years. This is because the dose from tritium peaks towards the beginning of the modelling timeframe, and the dose from polonium-210 peaks after 100,000 years.

Table 6.7.1-13: Summary of Total Dose during the Post-closure Phase Human Health Valued Components

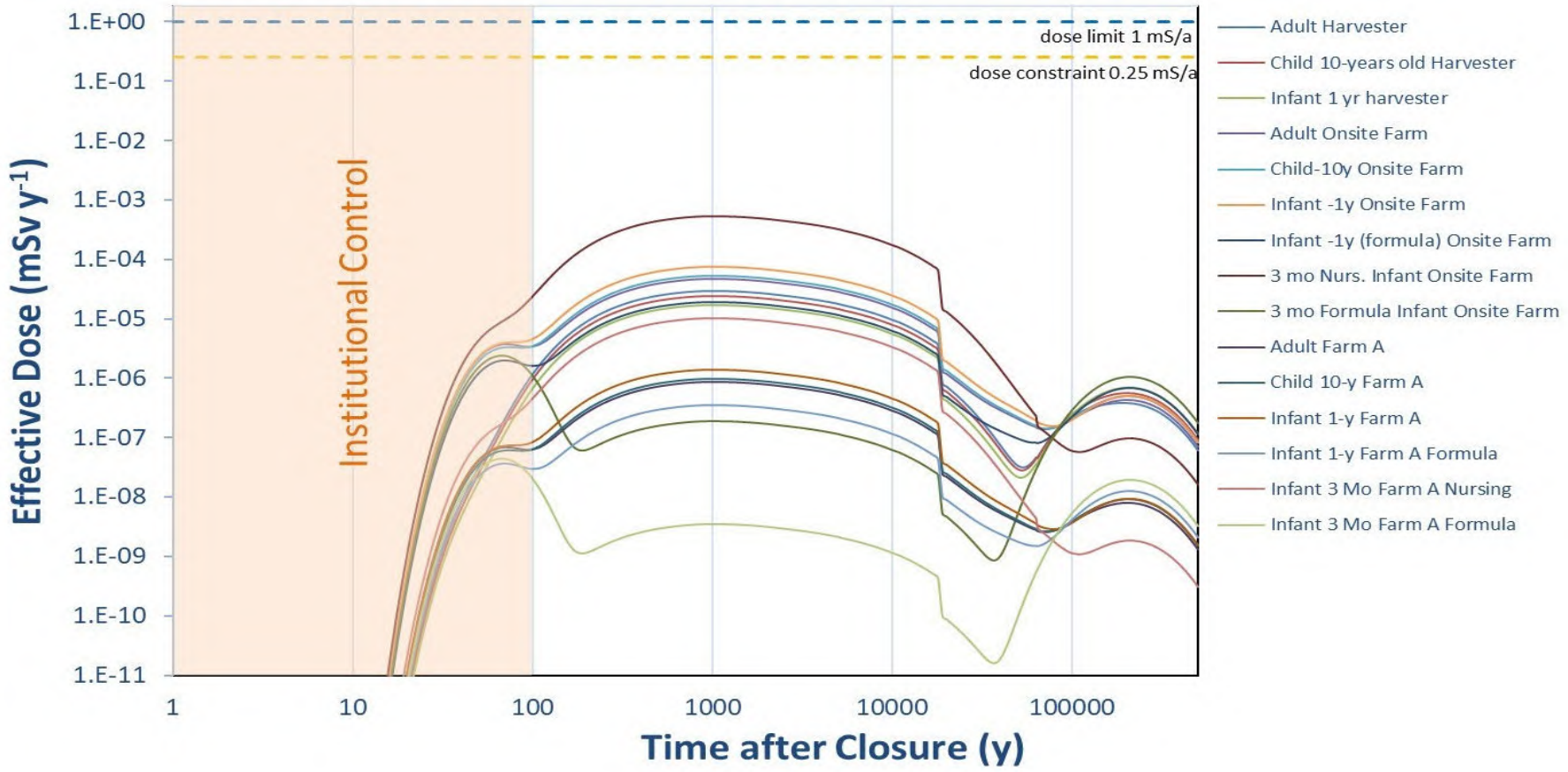
Age Group	Dose (mSv/a)								
	On-site Farm			Farm A			Harvester		
	Dose	Percent of Dose Constraint	Percent of Public Dose Limit	Dose	Percent of Dose Constraint	Percent of Public Dose Limit	Dose	Percent of Dose Constraint	Percent of Public Dose Limit
Adult	3.24×10^{-3}	1.30%	0.32%	3.35×10^{-4}	0.13%	0.03%	4.75×10^{-5}	0.02%	<0.01%
Child	3.25×10^{-3}	1.30%	0.33%	3.36×10^{-4}	0.13%	0.03%	3.05×10^{-5}	<0.01%	<0.01%
Infant (cow's milk)	4.23×10^{-3}	1.69%	0.42%	4.37×10^{-4}	0.17%	0.04%	2.00×10^{-5}	<0.01%	<0.01%
Infant (formula)	4.18×10^{-3}	1.67%	0.42%	4.36×10^{-4}	0.17%	0.04%	N/A	N/A	N/A
3 month old (nursing)	5.48×10^{-4}	0.22%	0.05%	1.04×10^{-5}	<0.01%	<0.01%	N/A	N/A	N/A
3 month old (formula)	3.65×10^{-6}	<0.01%	<0.01%	6.85×10^{-8}	<0.01%	<0.01%	N/A	N/A	N/A

Note:
A dose of 0.0025 mSv/a is equivalent to 1% of the dose constraint.
mSv/a = millisieverts per year; N/A = not available; <= less than.

As presented in Figure 6.7.1-9, the main contributors to total dose for the 3 month old nursing infant include tritium, carbon-14, neptunium-237, and polonium-210. The dose contribution from tritium is greatest at the beginning of modelling, then is dominated by carbon-14, until later in the modelling period where the main contributors to total dose are from neptunium-237 and polonium-210.

PATH: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0015_EIS_Sec_6.7\20145046-0015-HL-0008_Figure 6_7_1-8 Dose Rate to Human Receptors from Normal Evolution Scenarios.mxd PRINTED ON: 2022-12-06 AT: 9:30:27 PM

Total Dose to Exposed Groups for Normal Evolution Scenario



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CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	PR
PREPARED	RRD
REVIEWED	KL
APPROVED	MM

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
DOSE RATE TO HUMAN RECEPTORS FROM NORMAL EVOLUTION SCENARIOS

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0015	4	**6.7.1-8**

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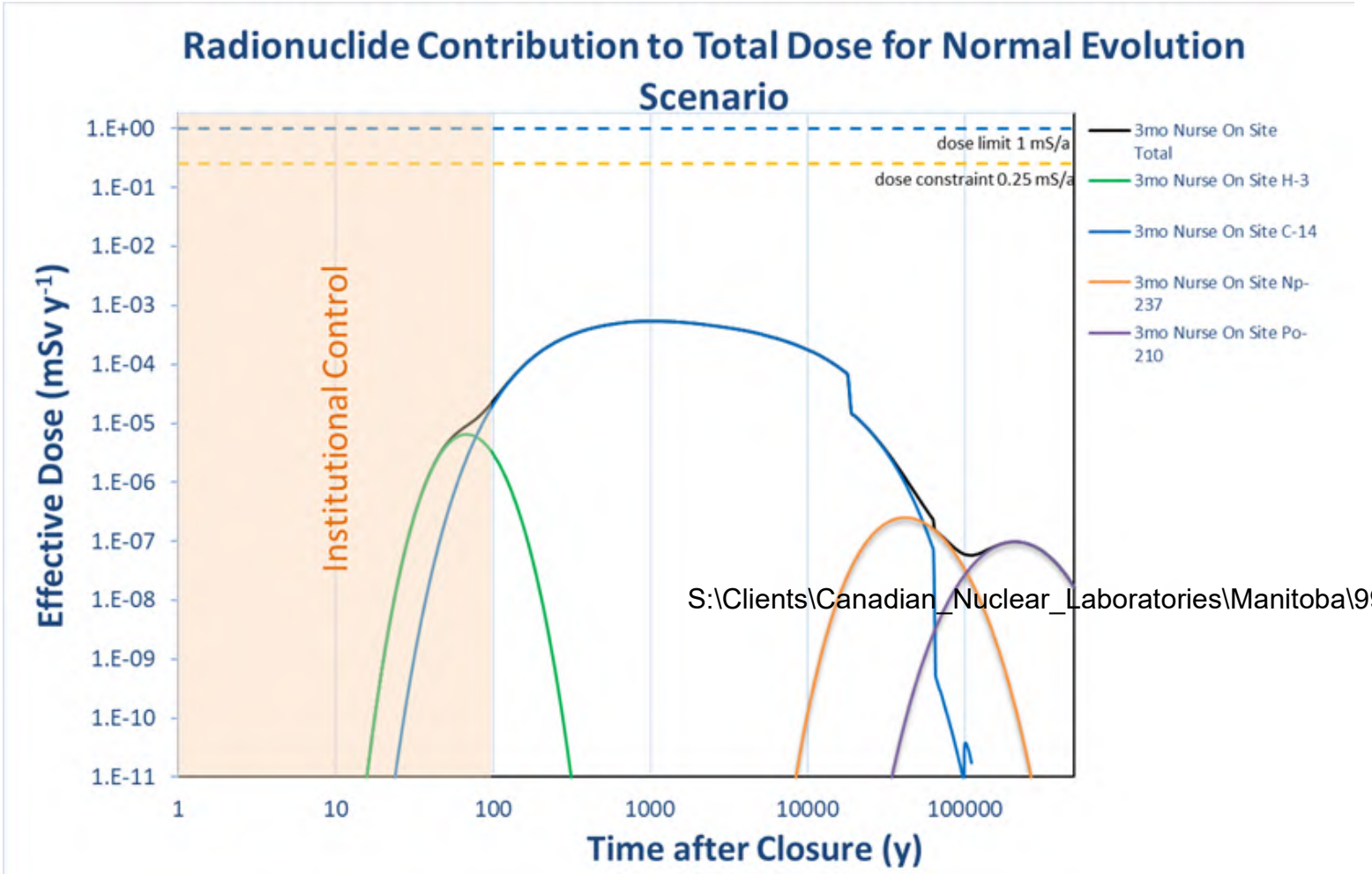
PATH: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0015_EIS_Sec_6.7\20145046-0015-HL-0012_Figure 6_7_1-9 Estimated ContributionRadionuclidesTotalDose.mxd PRINTED ON: 2022-12-06 AT: 9:30:32 PM



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REVIEWED	KL
APPROVED	MM

PROJECT
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TITLE
ESTIMATED CONTRIBUTION OF RADIONUCLIDES TO TOTAL DOSE OF 3 MONTH OLD NURSING INFANT OVER THE POST-CLOSURE PHASE DOSE

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0015	4	**6.7.1-9**

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The dominant pathway for both the On Site Farm as well as for Farm A is from Cs-137 through external exposure to sediment for the adult and 10-year old child, from the existing background concentration of Cs-137 in sediment, and is not associated with the source term from the WRDF. Based on the source-term concentrations expected to be released to groundwater during post-closure of the WRDF, the dominant contributor to the total dose for most of the human receptors is carbon-14 through ingestion of terrestrial animals. The exception is for the 3-month-old drinking formula, which has tritium as the dominant contributor to dose. The total dose is based on maximum mass loadings for each radionuclide. For carbon-14, the time of maximum mass loadings to the Winnipeg River occurs at year 1,006.

The doses and HQs to human receptors that could be exposed to the non-radiological COPCs (i.e., cadmium and lead) in surface water during post-closure were calculated based on total concentration (existing background plus Project contribution) as well as Project contribution only (Table 6.7.1-14, Table 6.7.1-15, and Table 6.7.1-16).

Risk was quantified for the human receptor based on the calculation of a hazard quotient (HQ) by dividing the estimated exposure by a toxicity reference value (TRV) that is known to be protective. To account for uncertainty in pathways beyond Project activities it was determined that to be protective a benchmark HQ value of 0.2 per medium (e.g. water, soil, food, air) would be used for the assessment. This is consistent with the approach taken by Health Canada (2010) in their guidance on human health quantitative risk assessment.

The HQs for the Harvester are below the acceptable risk level of 0.2 for cadmium and lead for all pathways and age groups. The HQs for the On-Site Farm and Farm A are below the acceptable risk level of 0.2 for cadmium and lead for all pathways, except for lead from drinking water from the Winnipeg River – based on existing background concentrations of lead in the Winnipeg River. When only Project exposures are considered, the HQs for all receptors and all pathways are below the acceptable risk level of 0.2 for cadmium and lead. The Project contribution to the lead HQ for drinking water is 0.002%. This indicates that the Project contribution to the total HQ is negligible and any exceedance is from existing background concentrations of lead in the Winnipeg River.

Table 6.7.1-14: Summary of Post-closure Hazard Quotients for Harvester Receptors under Normal Evolution Scenario

Pathway (unitless)	Adult (Existing Background + Project)		Toddler (Existing Background + Project)	
	Cadmium	Lead	Cadmium	Lead
Ingestion of Fish	1.40×10^{-4}	3.50×10^{-3}	1.46×10^{-4}	3.67×10^{-3}
Ingestion of Wild Waterfowl	6.09×10^{-4}	6.10×10^{-3}	3.93×10^{-4}	3.93×10^{-3}
Ingestion of Moose	1.45×10^{-2}	1.42×10^{-2}	9.35×10^{-3}	9.15×10^{-3}
Ingestion of Weekay	2.94×10^{-3}	1.09×10^{-1}	4.14×10^{-3}	5.82×10^{-2}
Total	1.82×10^{-2}	1.33×10^{-1}	1.40×10^{-2}	7.49×10^{-2}
Pathway (unitless)	**Adult (Project Only)**		**Toddler (Project Only)**	
	Cadmium	**Lead**	**Cadmium**	**Lead**
Ingestion of Fish	2.95×10^{-8}	3.87×10^{-8}	3.09×10^{-8}	4.06×10^{-8}
Ingestion of Wild Waterfowl	1.29×10^{-7}	6.74×10^{-8}	8.30×10^{-8}	4.35×10^{-8}
Ingestion of Moose	3.06×10^{-6}	1.57×10^{-7}	1.98×10^{-6}	1.01×10^{-7}
Ingestion of Weekay	6.22×10^{-7}	4.57×10^{-7}	8.75×10^{-7}	6.43×10^{-7}
Total	3.84×10^{-6}	7.20×10^{-7}	2.97×10^{-6}	8.28×10^{-7}

Table 6.7.1-15: Summary of Post-closure Hazard Quotients for Farm A Receptors under Normal Evolution Scenario

Pathway (unitless)	Adult (Existing Background + Project)		Toddler (Existing Background + Project)	
	Cadmium	Lead	Cadmium	Lead
River Water Ingestion	7.72×10^{-2}	**1.09×10^{1}**	1.32×10^{-1}	**1.86×10^{1}**
Soil Ingestion	1.22×10^{-6}	8.13×10^{-5}	2.10×10^{-5}	1.39×10^{-3}
Soil Dermal Contact	6.98×10^{-8}	4.64×10^{-5}	1.36×10^{-7}	9.04×10^{-5}
Dust Inhalation	7.72×10^{-7}	5.13×10^{-5}	1.65×10^{-6}	1.10×10^{-4}
Ingestion of Plants	2.36×10^{-6}	4.64×10^{-5}	2.48×10^{-6}	4.89×10^{-5}
Ingestion of Fish	1.12×10^{-4}	2.80×10^{-3}	1.17×10^{-4}	2.94×10^{-3}
Ingestion of Beef	2.52×10^{-6}	3.87×10^{-5}	1.04×10^{-6}	1.60×10^{-5}
Ingestion of Poultry	7.38×10^{-6}	6.54×10^{-4}	6.72×10^{-6}	5.96×10^{-4}
Ingestion of Pork	6.60×10^{-6}	2.18×10^{-5}	5.01×10^{-6}	1.66×10^{-5}
Ingestion of Eggs	4.38×10^{-6}	3.24×10^{-4}	2.07×10^{-6}	1.53×10^{-4}
Ingestion of Milk	9.06×10^{-7}	1.18×10^{-4}	7.50×10^{-6}	9.81×10^{-4}
Ingestion of Deer	4.41×10^{-8}	6.49×10^{-7}	0.00×10^{0}	0.00×10^{0}
Total	7.74×10^{-2}	**1.09×10^{1}**	1.33×10^{-1}	**1.86×10^{1}**
Pathway (unitless)	**Adult (Project Only)**		**Toddler (Project Only)**	
	Cadmium	**Lead**	**Cadmium**	**Lead**
River Water Ingestion	6.03×10^{-7}	4.43×10^{-6}	1.03×10^{-6}	7.59×10^{-6}
Soil Ingestion	9.55×10^{-12}	1.66×10^{-12}	1.64×10^{-10}	2.84×10^{-11}
Soil Dermal Contact	6.77×10^{-12}	9.45×10^{-13}	1.06×10^{-12}	1.84×10^{-12}
Dust Inhalation	6.02×10^{-12}	1.05×10^{-12}	1.29×10^{-11}	2.24×10^{-12}
Ingestion of Plants	1.84×10^{-11}	9.46×10^{-13}	1.94×10^{-11}	9.97×10^{-13}
Ingestion of Fish	8.71×10^{-10}	1.14×10^{-9}	9.14×10^{-10}	1.20×10^{-9}
Ingestion of Beef	1.96×10^{-11}	1.53×10^{-11}	8.10×10^{-12}	6.33×10^{-12}
Ingestion of Poultry	5.76×10^{-11}	2.60×10^{-10}	5.25×10^{-11}	2.37×10^{-10}
Ingestion of Pork	5.15×10^{-11}	8.73×10^{-12}	3.91×10^{-11}	6.64×10^{-12}
Ingestion of Eggs	3.42×10^{-11}	1.28×10^{-10}	1.62×10^{-11}	6.08×10^{-11}
Ingestion of Milk	7.07×10^{-12}	4.73×10^{-11}	5.86×10^{-11}	3.92×10^{-10}
Ingestion of Deer	3.44×10^{-13}	2.59×10^{-13}	0.00×10^{0}	0.00×10^{0}
Total	6.04×10^{-7}	4.43×10^{-6}	1.03×10^{-6}	7.59×10^{-6}

Note:
Bold and shaded values indicate HQ greater than 0.2.

Table 6.7.1-16: Summary of Post-closure Hazard Quotients for On-site Farm Receptors under Normal Evolution Scenario

Pathway (unitless)	Adult (Existing Background + Project)		Toddler (Existing Background + Project)	
	Cadmium	Lead	Cadmium	Lead
River Water Ingestion	7.73×10^{-2}	**1.09×10^{1}**	1.32×10^{-1}	**1.86×10^{1}**
Soil Ingestion	1.22×10^{-6}	8.13×10^{-5}	2.10×10^{-5}	1.39×10^{-3}
Soil Dermal Contact	6.98×10^{-8}	4.64×10^{-5}	1.36×10^{-7}	9.04×10^{-5}
Dust Inhalation	7.72×10^{-7}	5.13×10^{-5}	1.65×10^{-6}	1.10×10^{-4}
Ingestion of Plants	2.36×10^{-6}	4.64×10^{-5}	2.48×10^{-6}	4.89×10^{-5}
Ingestion of Fish	1.12×10^{-4}	2.80×10^{-3}	1.17×10^{-4}	2.94×10^{-3}
Ingestion of Beef	2.52×10^{-6}	3.87×10^{-5}	1.04×10^{-6}	1.60×10^{-5}
Ingestion of Poultry	7.38×10^{-6}	6.54×10^{-4}	6.73×10^{-6}	5.96×10^{-4}
Ingestion of Pork	6.60×10^{-6}	2.18×10^{-5}	5.01×10^{-6}	1.66×10^{-5}
Ingestion of Eggs	4.38×10^{-6}	3.24×10^{-4}	2.08×10^{-6}	1.53×10^{-4}
Ingestion of Milk	9.06×10^{-7}	1.18×10^{-4}	7.51×10^{-6}	9.81×10^{-4}
Ingestion of Deer	4.41×10^{-8}	6.49×10^{-7}	0.00×10^{0}	0.00×10^{0}
Total	7.74×10^{-2}	**1.09×10^{1}**	1.33×10^{-1}	**1.86×10^{1}**
Pathway (unitless)	**Adult (Project Only)**		**Toddler (Project Only)**	
	Cadmium	**Lead**	**Cadmium**	**Lead**
River Water Ingestion	3.20×10^{-5}	2.36×10^{-4}	5.49×10^{-5}	4.04×10^{-4}
Soil Ingestion	5.08×10^{-10}	8.82×10^{-11}	8.71×10^{-9}	1.51×10^{-9}
Soil Dermal Contact	2.90×10^{-11}	5.03×10^{-11}	5.65×10^{-11}	9.81×10^{-11}
Dust Inhalation	3.20×10^{-10}	5.56×10^{-11}	6.87×10^{-10}	1.19×10^{-10}
Ingestion of Plants	9.79×10^{-10}	5.04×10^{-11}	1.03×10^{-9}	5.30×10^{-11}
Ingestion of Fish	4.63×10^{-8}	6.08×10^{-8}	4.86×10^{-8}	6.38×10^{-8}
Ingestion of Beef	1.04×10^{-9}	8.16×10^{-10}	4.31×10^{-10}	3.37×10^{-10}
Ingestion of Poultry	3.06×10^{-9}	1.38×10^{-8}	2.79×10^{-9}	1.26×10^{-8}
Ingestion of Pork	2.74×10^{-9}	4.64×10^{-10}	2.08×10^{-9}	3.53×10^{-10}
Ingestion of Eggs	1.82×10^{-9}	6.83×10^{-9}	8.61×10^{-10}	3.23×10^{-9}
Ingestion of Milk	3.76×10^{-10}	2.51×10^{-9}	3.11×10^{-9}	2.08×10^{-8}
Ingestion of Deer	1.83×10^{-11}	1.38×10^{-11}	0.00×10^{0}	0.00×10^{0}
Total	3.21×10^{-5}	2.36×10^{-4}	5.50×10^{-5}	4.04×10^{-4}

Note:

Bold and shaded values indicate HQ greater than 0.2.

Human Intrusion (Exploration Borehole)

For the occurrence of a human intrusion, the worst-case scenario was evaluated, which encompassed following the 100-year institutional control period, an unsealed borehole into the reactor and improperly disposed of material being left on top of the WRDF. The total dose to a drill crew member (adult exposed during drilling the borehole) was below both the lower 1 mSv/a IAEA reference level for Disruptive Events and the upper 20 mSv/a IAEA reference level for Disruptive Events. It was also considered that trespassers could interact with the site following a human intrusion (Adult, child, infant and 3-month old assumed to be spending 1 hour a day on-site). The dose predictions for these human receptors were below both the upper (20 mSv/a) and lower (1 mSv/a) IAEA reference level for Disruptive Events (Table 6.7.1-17. The dominant contributor to the total dose is niobium-94 through groundshine (i.e., from the drilled material improperly disposed of on-site). Doses to the core transportation personnel and laboratory technicians were bounded by the dose calculations for the first two receptors as they would have a reduced exposure time.

Table 6.7.1-17: Summary of Total Radiological Dose for Trespassers under Human Intrusion Conditions

Age Group	Dose (mSv/a)	Percent of Public Dose Limit (for Normal Evolution scenarios)	Percent of IAEA Reference Level for Disruptive Events
Adult	1.98×10^{-1}	20%	1%
Child	2.01×10^{-1}	20%	1%
Infant	3.19×10^{-1}	32%	2%
3-Month Old	2.86×10^{-1}	29%	1%
Driller	6.35×10^{-3}	1%	0%

mSv/a = millisieverts per year

The doses to human receptors that could be exposed to the non-radionuclides nuclides identified as potentially occurring at elevated concentrations (i.e., HB-40, lead) as a result of a human intrusion event occurring during post-closure were calculated based on total concentration (background plus Project contribution). The HQ for HB-40 exceeded the target values for both the adult and the toddler for soil ingestion and soil dermal contact (i.e., exposure as a result of material being improperly disposed of on-site). The HQ for lead exceeded the target values for the adult and the toddler through soil ingestion, soil dermal contact and dust inhalation (i.e., exposure as a result of material being improperly disposed of on-site) and was exceeded for the driller through soil ingestion and soil dermal contact. Hazard quotients are summarized in Table 6.7.1-18. HQs greater than 0.2 (per pathway) are not statistical probabilities of harm occurring. Instead, they are a simple statement of whether (and by how much) an exposure dose exceeds the reference dose.

The TRVs for HB-40 and lead incorporate safety factors to account for uncertainty, making the results conservative. The HB-40 TRV incorporates a safety factor of 1,000 and the lead TRV incorporates a safety factor of 2 (EcoMetrix 2021). In this scenario, it was assumed that an exploration borehole was drilled through the engineered cover, grout, reinforced concrete, and WRDF from ground surface to bedrock. The waste emplacement strategy and design of the engineered cover is more robust than a typical hazardous waste landfill; therefore, the likelihood of installing an exploration borehole directly into the WRDF, as well as extruding the highest concentrations is low.

Table 6.7.1-18: Summary of Hazard Quotients for Human Intrusion Conditions

Age Group	Parameter	HQ by Pathway (unitless)			Total
		Soil Ingestion	Soil Dermal Contact	Dust Inhalation	
Adult	HB-40	**3.52**	**4.57×10^{-1}**	1.16×10^{-1}	**4.09**
	Lead	**3.41×10^{2}**	**2.21×10^{1}**	**1.12×10^{1}**	**3.74×10^{2}**
Toddler	HB-40	**2.05×10^{-1}**	**2.34×10^{1}**	5.40×10^{-2}	**4.93×10^{1}**
	Lead	**1.99×10^{1}**	**1.13×10^{1}**	**5.23**	**3.65×10^{1}**
Driller	HB-40	6.62×10^{-3}	7.55×10^{-2}	NA	8.21×10^{-2}
	Lead	**6.42×10^{-1}**	**3.66**	NA	**4.30**

Note:
Bold and shaded values indicate HQ greater than 0.2.

The assessment demonstrates that human intrusion into the WRDF, could result in exposures to human receptors to HB-40 and lead in waste material brought to the surface at levels where risk cannot be ruled out. As such, while this is a very unlikely worst-case scenario, reasonable effort is warranted to reduce the probability of these unplanned events from occurring. During the post-institutional control period, passive controls will still be in place including the limited footprint, the WRDF composition being relatively impervious and made of material of no economic value, and the land use restriction acting to reduce the likelihood of a human intrusion event.

WRDF Barrier Failure

The WRDF Barrier Failure Disruptive Event considers the potential for an uncontrolled release of contaminants from the WRDF into the geosphere. Specifically, the scenario considers a significant failure of the concrete foundation, or that the long-term performance of the foundation deteriorates rapidly due to unforeseen or underestimated physical, chemical, and/or biological processes. The source of exposure is due to a zone of increased permeability in a 2-m wide section (i.e., a fracture) spanning the full width of the containment barrier, and an elevated exposure to human and non-human receptors near the WL site to contaminated groundwater.

The WRDF Barrier Failure Disruptive Event was considered because the foundation was not originally designed as the primary containment barrier for an ISD facility. It is considered a containment barrier within the WRDF in the groundwater flow model based on its properties determined through the original design drawings and the building condition assessment carried out (Golder 2021). For this disruptive event to occur, a significant failure of large components or multiple smaller components of work planning, and execution must fail (e.g., failure to adhere to Quality Assurance programs when reviewing the condition of the existing foundation wall). This disruptive event could also be caused by a significant external event, such as a beyond design basis; earthquake that creates significant damage to the WRDF foundation.

This scenario was evaluated in the DSAR (Golder to demonstrate the importance of particular sources of uncertainty and provide meaningful illustration of future conditions to inform the Project design (Golder 2021). For modelling the scenario, a fracture was assumed in the foundation of the WR-1 Building (2 m wide, with hydraulic conductivity greater than the below bedrock) that will remain in place as a component of the WRDF. Exposure pathway characterization is the same as was modelled in the Normal Evolution Scenario, except that groundwater loadings to the surface water are based on an open fracture. As emissions from the WRDF are changed under a failure scenario, both the human and ecological receptors in the vicinity of the WL site could be affected. Predicted

exposures for human and non-human biota were compared to relevant dose guidelines for both radiological and non-radiological contaminants of potential concern.

As a conservative assumption, the maximum dose after a hypothetical WRDF barrier failure was assessed at a single point in time; however, a more realistic representation of predicted dose rate to human receptors shows that the peak doses from each radionuclide occur at different times (Figure 6.7.1-8), and thus would not overlap in a cumulative dose (Golder 2021).

For the residents of an on-site farm (located on the WRDF site, Farm A (located near the east bank of the Winnipeg River) and Harvester receptors, the total radiation dose during the post-closure period during barrier failure scenario are well below the lower 1 mSv/a IAEA reference level and the upper 20 mSv/a IAEA reference level for Disruptive Events (Table 6.7.1-19). The farm residents are year-round, full-time residents, and the Harvester represents a Traditional user exposed through harvesting country foods spending part of their time on-site, near Farm A, and at an unexposed location.

Table 6.7.1-19: Summary of Post-closure Total Dose for Human Receptors under Barrier Failure Conditions

Age Group	On-Site Farm			Farm A			Harvester		
	Dose (mSv/a)	Percent of Public Dose Limit (for Normal Evolution scenarios)	Percent of IAEA Reference Level for Disruptive Events	Dose (mSv/a)	Percent of Public Dose Limit (for Normal Evolution scenarios)	Percent of IAEA Reference Level for Disruptive Events	Dose (mSv/a)	Percent of Public Dose Limit (for Normal Evolution scenarios)	Percent of IAEA Reference Level for Disruptive Events
Adult	3.24×10^{-3}	0.32%	0.02%	3.35×10^{-4}	0.03%	<0.01%	4.81×10^{-5}	<0.01%	<0.01%
Child	3.25×10^{-3}	0.33%	0.02%	3.36×10^{-4}	0.03%	<0.01%	3.09×10^{-5}	<0.01%	<0.01%
Infant (cow's milk)	4.23×10^{-3}	0.42%	0.02%	4.37×10^{-4}	0.04%	<0.01%	2.03×10^{-5}	<0.01%	<0.01%
Infant (formula)	4.18×10^{-3}	0.42%	0.02%	4.36×10^{-4}	0.04%	<0.01%	—	—	—
3-month Old (nursing)	5.58×10^{-4}	0.06%	<0.01%	1.06×10^{-5}	0.00%	<0.01%	—	—	—
3-month Old (formula)	3.79×10^{-6}	<0.01%	<0.01%	7.12×10^{-8}	0.00%	<0.01%	—	—	—

Note:

1 millisievert per year (mSv/a) IAEA Lower Reference Level; 20 mSv/a IAEA Reference Level for Disruptive Events.

The risk to human receptors that could be exposed to the non-radiological contaminants potentially occurring at elevated concentrations (i.e., cadmium and lead) in surface water during post-closure were calculated based on total concentration (background plus Project contribution). Risk was quantified for the human receptor based on the calculation of a HQ by dividing the estimated exposure by a TRV that is known to be protective. To account for uncertainty in pathways beyond Project activities, a protective benchmark HQ value of 0.2 per medium was used for the assessment. This is consistent with the approach taken by Health Canada (2010) for human health quantitative risk assessment.

The HQs for the harvester are below the acceptable risk level of 0.2 for cadmium and lead for all ingestion pathways for the toddler and adult. The HQs for the On-Site Farm and Farm A are below the acceptable risk level of 0.2 for cadmium and lead for all pathways, except for lead from drinking water from the Winnipeg River. The HQs for all receptors are based on background plus project exposure. If only the project contribution is considered, the HQs for the toddler and adult for the On-Site Farm and Farm A are well below the acceptable risk level of 0.2. Therefore, adverse effects to human receptors are not anticipated from WRDF Barrier Failure.

Table 6.7.1-20: Summary of Post-closure Hazard Quotients for Harvester Receptors under Barrier Failure Conditions

Pathway (unitless)	Adult (Existing Background + Project)		Toddler (Existing Background + Project)	
	Cadmium	Lead	Cadmium	Lead
Ingestion of Fish	1.40×10^{-4}	3.50×10^{-3}	1.46×10^{-4}	3.67×10^{-3}
Ingestion of Wild Waterfowl	6.09×10^{-4}	6.10×10^{-3}	3.93×10^{-4}	3.93×10^{-3}
Ingestion of Moose	1.45×10^{-2}	1.42×10^{-2}	9.35×10^{-3}	9.15×10^{-3}
Ingestion of Weekay	2.94×10^{-3}	1.09×10^{-1}	4.14×10^{-3}	5.82×10^{-2}
Total	1.82×10^{-2}	1.33×10^{-1}	1.40×10^{-2}	7.49×10^{-2}
Pathway (unitless)	**Adult (Project Only)**		**Toddler (Project Only)**	
	Cadmium	**Lead**	**Cadmium**	**Lead**
Ingestion of Fish	2.95×10^{-8}	3.94×10^{-8}	3.09×10^{-8}	4.13×10^{-8}
Ingestion of Wild Waterfowl	1.29×10^{-7}	6.87×10^{-8}	8.30×10^{-8}	4.43×10^{-8}
Ingestion of Moose	3.06×10^{-6}	1.60×10^{-7}	1.98×10^{-6}	1.03×10^{-7}
Ingestion of Weekay	6.22×10^{-7}	4.65×10^{-7}	8.75×10^{-7}	6.55×10^{-7}
Total	3.84×10^{-6}	7.34×10^{-7}	2.97×10^{-6}	8.44×10^{-7}

Table 6.7.1-21: Summary of Post-closure Hazard Quotients for Farm A Receptors under Barrier Failure Conditions

Pathway (unitless)	Adult (Existing Background + Project)		Toddler (Existing Background + Project)	
	Cadmium	Lead	Cadmium	Lead
River Water Ingestion	7.72×10^{-2}	**1.09×10^{1}**	1.32×10^{-1}	**1.86×10^{1}**
Soil Ingestion	1.22×10^{-6}	8.13×10^{-5}	2.10×10^{-5}	1.39×10^{-3}
Soil Dermal Contact	6.98×10^{-8}	4.64×10^{-5}	1.36×10^{-7}	9.04×10^{-5}
Dust Inhalation	7.72×10^{-7}	5.13×10^{-5}	1.65×10^{-6}	1.10×10^{-4}
Ingestion of Plants	2.36×10^{-6}	4.64×10^{-5}	2.48×10^{-6}	4.89×10^{-5}
Ingestion of Fish	1.12×10^{-4}	2.80×10^{-3}	1.17×10^{-4}	2.94×10^{-3}
Ingestion of Beef	2.52×10^{-6}	3.87×10^{-5}	1.04×10^{-6}	1.60×10^{-5}
Ingestion of Poultry	7.38×10^{-6}	6.54×10^{-4}	6.72×10^{-6}	5.96×10^{-4}
Ingestion of Pork	6.60×10^{-6}	2.18×10^{-5}	5.01×10^{-6}	1.66×10^{-5}
Ingestion of Eggs	4.38×10^{-6}	3.24×10^{-4}	2.07×10^{-6}	1.53×10^{-4}
Ingestion of Milk	9.06×10^{-7}	1.18×10^{-4}	7.50×10^{-6}	9.81×10^{-4}
Ingestion of Deer	4.41×10^{-8}	6.49×10^{-7}	0.00	0.00
Total	7.74×10^{-2}	**1.09×10^{1}**	1.33×10^{-1}	**1.86×10^{1}**
Pathway (unitless)	**Adult (Project Only)**		**Toddler (Project Only)**	
	Cadmium	**Lead**	**Cadmium**	**Lead**
River Water Ingestion	6.03×10^{-7}	4.51×10^{-6}	1.03×10^{-6}	7.73×10^{-6}
Soil Ingestion	9.55×10^{-12}	1.66×10^{-12}	1.64×10^{-10}	2.84×10^{-11}
Soil Dermal Contact	6.77×10^{-12}	9.45×10^{-13}	1.06×10^{-12}	1.84×10^{-12}
Dust Inhalation	6.02×10^{-12}	1.05×10^{-12}	1.29×10^{-11}	2.24×10^{-12}
Ingestion of Plants	1.84×10^{-11}	9.46×10^{-13}	1.94×10^{-11}	9.97×10^{-13}
Ingestion of Fish	8.71×10^{-10}	1.17×10^{-9}	9.14×10^{-10}	1.22×10^{-9}
Ingestion of Beef	1.96×10^{-11}	1.56×10^{-11}	8.10×10^{-12}	6.45×10^{-12}
Ingestion of Poultry	5.76×10^{-11}	2.64×10^{-10}	5.25×10^{-11}	2.41×10^{-10}
Ingestion of Pork	5.15×10^{-11}	8.90×10^{-12}	3.91×10^{-11}	6.76×10^{-12}
Ingestion of Eggs	3.42×10^{-11}	1.31×10^{-10}	1.62×10^{-11}	6.20×10^{-11}
Ingestion of Milk	7.07×10^{-12}	4.82×10^{-11}	5.86×10^{-11}	3.99×10^{-10}
Ingestion of Deer	3.44×10^{-13}	2.64×10^{-13}	0.00×10^{0}	0.00×10^{0}
Total	6.04×10^{-7}	4.51×10^{-6}	1.03×10^{-6}	7.74×10^{-6}

Note:

Bold and shaded values indicate HQ greater than 0.2.

Table 6.7.1-22: Summary of Post-closure Hazard Quotients for On-site Farm Receptors under Barrier Failure Conditions

Pathway (unitless)	Adult (Existing Background + Project)		Toddler (Existing Background + Project)	
	Cadmium	Lead	Cadmium	Lead
River Water Ingestion	7.73×10^{-2}	**1.09×10^{1}**	1.32×10^{-1}	**1.86×10^{1}**
Soil Ingestion	1.22×10^{-6}	8.13×10^{-5}	2.10×10^{-5}	1.39×10^{-3}
Soil Dermal Contact	6.98×10^{-8}	4.64×10^{-5}	1.36×10^{-7}	9.04×10^{-5}
Dust Inhalation	7.72×10^{-7}	5.13×10^{-5}	1.65×10^{-6}	1.10×10^{-4}
Ingestion of Plants	2.36×10^{-6}	4.64×10^{-5}	2.48×10^{-6}	4.89×10^{-5}
Ingestion of Fish	1.12×10^{-4}	2.80×10^{-3}	1.17×10^{-4}	2.94×10^{-3}
Ingestion of Beef	2.52×10^{-6}	3.87×10^{-5}	1.04×10^{-6}	1.60×10^{-5}
Ingestion of Poultry	7.38×10^{-6}	6.54×10^{-4}	6.73×10^{-6}	5.96×10^{-4}
Ingestion of Pork	6.60×10^{-6}	2.18×10^{-5}	5.01×10^{-6}	1.66×10^{-5}
Ingestion of Eggs	4.38×10^{-6}	3.24×10^{-4}	2.08×10^{-6}	1.53×10^{-4}
Ingestion of Milk	9.06×10^{-7}	1.18×10^{-4}	7.51×10^{-6}	9.81×10^{-4}
Ingestion of Deer	4.41×10^{-8}	6.49×10^{-7}	0.00×10^{0}	0.00×10^{0}
Total	7.74×10^{-2}	**1.09×10^{1}**	1.33×10^{-1}	**1.86×10^{1}**
Pathway (unitless)	**Adult (Project Only)**		**Toddler (Project Only)**	
	Cadmium	**Lead**	**Cadmium**	**Lead**
River Water Ingestion	3.20×10^{-5}	2.40×10^{-4}	5.49×10^{-5}	4.11×10^{-4}
Soil Ingestion	5.08×10^{-10}	8.82×10^{-11}	8.71×10^{-9}	1.51×10^{-9}
Soil Dermal Contact	2.90×10^{-11}	5.03×10^{-11}	5.65×10^{-11}	9.81×10^{-11}
Dust Inhalation	3.20×10^{-10}	5.56×10^{-11}	6.87×10^{-10}	1.19×10^{-10}
Ingestion of Plants	9.79×10^{-10}	5.04×10^{-11}	1.03×10^{-9}	5.30×10^{-11}
Ingestion of Fish	4.63×10^{-8}	6.20×10^{-8}	4.86×10^{-8}	6.50×10^{-8}
Ingestion of Beef	1.04×10^{-9}	8.31×10^{-10}	4.31×10^{-10}	3.43×10^{-10}
Ingestion of Poultry	3.06×10^{-9}	1.41×10^{-8}	2.79×10^{-9}	1.28×10^{-8}
Ingestion of Pork	2.74×10^{-9}	4.73×10^{-10}	2.08×10^{-9}	3.60×10^{-10}
Ingestion of Eggs	1.82×10^{-9}	6.96×10^{-9}	8.61×10^{-10}	3.30×10^{-9}
Ingestion of Milk	3.76×10^{-10}	2.56×10^{-9}	3.11×10^{-9}	2.12×10^{-8}
Ingestion of Deer	1.83×10^{-11}	1.40×10^{-11}	0.00×10^{0}	0.00×10^{0}
Total	3.21×10^{-5}	2.40×10^{-4}	5.50×10^{-5}	4.11×10^{-4}

Note:

Bold and shaded values indicate HQ greater than 0.2.

Well in Plume

Human habitation was considered not feasible until after the 100-year institutional control period ends. During institutional control, long-term monitoring and maintenance activities will occur to demonstrate compliance with the safety case assumptions; therefore, unplanned human habitation is unlikely during institutional control. Groundwater concentrations used to calculate radiological and non-radiological dose are based on mass loadings post 100 years of institutional control. Following cessation of the Institutional Controls, it was assumed that an on-site farm will be established at the WRDF site as part of the Normal Evolution Scenario. As part of the Well In Plume disruptive scenario, the farm has a water well drilled through the WRDF groundwater plume. This was considered an unlikely disruptive scenario due to the low-permeability soils surrounding the WRDF not being suitable for water extraction (Golder 2021).

For the residents of an on-site farm who drink groundwater, the total radiation dose during this disruptive event is below the IAEA reference level of 20 mSv/a for Disruptive Events for all receptors, but is above the IAEA lower reference level of 1 mSv/a for most receptors other than the infant who drinks cow's milk(Table 6.7.1-23). The dominant contributor to the total dose is from tritium through ingestion of water (i.e., drinking the groundwater). For carbon-14, the time of maximum mass loading to the Winnipeg River occurs in approximately 1,000 years.

Table 6.7.1-23: Summary of Total Dose for Well in Plume Post-Institutional Control (with Groundwater Consumption)

Age Group	Dose (mSv/a)	Percent of IAEA Lower Reference Level for Disruptive Events	Percent of IAEA Upper Reference Level for Disruptive Events
Adult	**2.54×10^{0}**	**254.00%**	12.70%
Child	**1.34×10^{0}**	**134.00%**	6.70%
Infant (cow's milk)	4.23×10^{-3}	0.42%	0.02%
Infant (formula)	**1.96×10^{0}**	**196.00%**	9.80%
3-month Old (nursing)	**3.29×10^{0}**	**329.00%**	16.45%
3-month Old (formula)	**4.02×10^{0}**	**402.00%**	20.10%

Note:
Bolded cells indicate exceedance of the lower IAEA reference level for Disruptive Events of 1 mSv/a .

The doses to human receptors that could be exposed to the non-radiological contaminants identified as potentially occurring at elevated concentrations (i.e., cadmium and lead) during post-closure were calculated based on total concentration (background plus Project contribution). Risk was quantified for the human receptor based on the calculation of a HQ using the same approach as described above for the Normal Evolution Scenario. The HQs derived for both cadmium and lead were well below the protective benchmark for all pathways other than groundwater ingestion (Table 6.7.1-24). A calculated HQ of 0.01 represents 5% of the HQ target value of 0.2. For non-radiological contaminants the HQ for cadmium and lead exceeded the target value for both the adult and toddler. HQs greater than 0.2 (per medium) are not statistical probabilities of harm occurring. Instead, they are a simple statement of whether (and by how much) an exposure dose exceeds the reference dose.

Table 6.7.1-24: Summary of Post-closure Hazard Quotients for Well in Plume Post-Institutional Control (with Groundwater Consumption)

Pathway (unitless)	Adult		Toddler	
	Cadmium	Lead	Cadmium	Lead
Groundwater Ingestion	**8.26×10^{1}**	**3.04×10^{2}**	**1.42×10^{2}**	**5.21×10^{2}**
Soil Ingestion	1.22×10^{-6}	8.13×10^{-5}	2.10×10^{-5}	1.39×10^{-3}
Soil Dermal Contact	6.98×10^{-8}	4.64×10^{-5}	1.36×10^{-7}	9.04×10^{-5}
Dust Inhalation	7.72×10^{-7}	5.13×10^{-5}	1.65×10^{-6}	1.10×10^{-4}
Ingestion of Plants	2.36×10^{-6}	4.64×10^{-5}	2.48×10^{-6}	4.89×10^{-5}
Ingestion of Fish	1.12×10^{-4}	2.80×10^{-3}	1.17×10^{-4}	2.94×10^{-3}
Ingestion of Beef	2.52×10^{-6}	3.87×10^{-5}	1.04×10^{-6}	1.60×10^{-5}
Ingestion of Poultry	7.38×10^{-6}	6.54×10^{-4}	6.73×10^{-6}	5.96×10^{-4}
Ingestion of Pork	6.60×10^{-6}	2.18×10^{-5}	5.01×10^{-6}	1.66×10^{-5}
Ingestion of Eggs	4.38×10^{-6}	3.24×10^{-4}	2.08×10^{-6}	1.53×10^{-4}
Ingestion of Milk	9.06×10^{-7}	1.18×10^{-4}	7.51×10^{-6}	9.81×10^{-4}
Ingestion of Deer	4.41×10^{-8}	6.49×10^{-7}	0.00	0.00
Total	**8.26×10^{1}**	**3.04×10^{2}**	**1.42×10^{2}**	**5.21×10^{2}**

Note:
Bold and shaded values indicate HQ greater than 0.2.

The assessment demonstrates that human habitation with groundwater use for drinking water could result in exposures to cadmium and lead at levels where risk cannot be ruled out. The TRV for lead incorporates a safety factor of 2 to account for uncertainty, making the results conservative (EcoMetrix 2021). While the TRV for cadmium does not incorporate a safety factor, the assessment is considered conservative as it assumes that the maximum concentrations of COPCs occur at the same time, where in reality maximum concentrations occur at different timeframes during post-closure.

During institutional control, long-term monitoring and maintenance activities will occur to demonstrate compliance with the safety case assumptions; therefore, a well in the groundwater plume is unlikely. Additionally, for a well situated in this area, the well capacity is too low and therefore, cannot be used for purposes other than drinking. This is supported by observations during routine groundwater sampling campaigns at boreholes on the WL site (i.e., inability to obtain sufficient groundwater for sampling in 2018 and 2019).

Overall, the failure of passive controls to prevent human intrusion into the WRDF and/or human habitation of the WRDF during the post-institutional control period (after 100 years) is conceivable; however, is unlikely. The assessment was conservatively conducted to predict exposures to human receptors under these unlikely future conditions.

6.7.1.8 Prediction Confidence and Uncertainty

The HHRA assumptions are conservative to accommodate inherent uncertainties in the modelling and meet the objective of protecting human health during the closure and post-closure phases. The conceptual model for human health is considered to be complete for the majority of general public exposures in the vicinity of the WL site. The selected receptors are expected to lead to conservative estimates of health risks. The selected exposure

pathways are consistent with available guidance (e.g., CSA N288.1-14), and are expected to account for primary exposure pathways for human receptors in the area.

There is uncertainty in the estimated inventory of radioactive and non-radioactive material that could be present within the WR-1 Building. The estimated inventory of WR-1 and its associated systems were derived by two general methods; physical samples, and computer models. Computer models formed the basis of the inventory estimate and were supplemented by physical sample characterization data to fill gaps and validate model estimates. In all cases, the most conservative results of either the physical samples or computer models were used to derive the final inventory estimate. Each estimation method also included aspects of conservatism in their individual approaches, contributing further to the conservatism built into the final inventory estimate. This compounded conservatism is based on physical data specific to WR-1 and provides an appropriate level of realism to the estimate.

There is also uncertainty in how long each closure activity will take (e.g., how long it will take to grout the heavy water moderator system). As such, there is uncertainty in the COPC release rates to the atmosphere and geosphere. To address this uncertainty, appropriate assumptions are integrated into the model to provide an appropriate level of conservatism. For example, although the duration of demolition prior to grouting may be carried out in 1 to 2 months, it has been conservatively assumed that it will occur for 6 months. Prior to the execution of closure activities, system characterizations and radiological surveys will be completed to inform detailed work planning. This work will provide greater accuracy; however, it is expected that any variation would be well encompassed by the conservatism build into the model.

The IMPACT model was used to predict dose to identified human receptors during the closure and post-closure phases. The IMPACT model used is a steady state model; however, it includes time dependent equations to account for buildup in soil from irrigation, for all radionuclides released. It includes progeny buildup through use of progeny inclusive dose coefficients. Forty years of ingrowth was used to develop the progeny inclusive dose coefficients for each radionuclide, which is the timeframe is used in CSA N288.1-14 for development of progeny-inclusive dose coefficients for sediment and soil exposure. Exposure factors were based on best-available information from literature with preference for exposure factors identified in CSA N288.1-14. For parameters that did not have exposure factors in CSA N288.1-14, surrogate parameters were identified based on proximity in the periodic table, which is considered appropriate.

There are uncertainties in the predicted radiological and non-radiological release rates to the atmosphere; however, the estimates are expected to be appropriate as they are based on best available information on existing inventory of radiological and non-radiological contaminants in WR-1. Conservative assumptions were made about duration of release (constant release at peak) and particulate release rates (highest release rates). Considering the conservatism in the estimation of releases, and in the air model, it is reasonable to conclude that doses arising from closure activities have not been underestimated.

A constant release at the peak time for each radionuclide over the modelling period during the post-closure phase was assumed, which is a conservative assumption. Within each time window, over the timeframe of the groundwater model, the doses from all radionuclides were summed, ensuring that all dose contributions were captured in the total dose. For each radionuclide, the highest release rate within the time window was assumed, which is also a conservative assumption. Considering the conservatism in the estimation of releases it is reasonable to conclude that doses arising from post-closure activities have not been underestimated.

The uncertainties from the exposure assessment include model uncertainty and uncertainty in the exposure factors selected. The uncertainties from the toxicity assessment include conservatisms built into the radiation dose constraint. Taken together, the approaches to exposure and toxicity assessment have ensured that the characterization of dose and risk has been undertaken in a manner that has not underestimated dose or risk.

6.7.1.9 Residual Effects Classification and Determination of Significance

The residual effects analysis methods for the HHRA are different in some notable ways from those used by other VCs. Specifically, the assessment of potential effects to human health VCs results in the generation of risk factors that inherently consider the geographic extent, duration, frequency and other characteristics of the predicted changes to the environment that may result from Project activities. As such, these inherent attributes cannot be used to determine environmental significance, as they can with other components. Instead, significance for human health is evaluated based on: (i) the potential magnitude of the response, as indicated by the comparison to benchmarks and (ii) the degree of conservatism and uncertainty in the analysis.

Results of the radiological dose assessment for the closure and post-closure phases indicates that doses to human health VCs are below the CNSC public dose limit of 1 mSv/a, as well as the dose constraint for the Project of 0.25 mSv/a. The hazard quotients derived for constituents of potential concern were below the protective benchmark for all receptors and pathways, other than the river water drinking water pathway. If only the Project contribution is considered, the HQs are well below the protective benchmark for all receptors (the Project contribution to the total is 0.002% for lead). This indicates that the Project contribution to the total HQ is minimal and the exceedance is from existing background concentrations of lead in the Winnipeg River. Although uncertainties in the assessment exist, conservatism, such as using the highest release rates, has been included in the modelling so that residual effects are not greater than predicted. As such, residual effects are considered to be not significant for all human health VCs during the closure and post-closure phases.

For all Disruptive Events the total radiation dose to human receptors during the post-closure phase are below the IAEA Reference Level for Disruptive Events of 20 mSv/a. For exposure to non-radiological COPCs (i.e., cadmium and lead) the HQ exceeded the target values for some scenarios. However, the assessment was conservatively conducted to predict exposures to human receptors under these future unlikely conditions. Further, controls can be put in place to reduce the probability of the Disruptive Events (e.g., land use restrictions during post-institutional control period to reduce the likelihood of a human intrusion event).

6.7.1.10 Monitoring and Follow-up

As part of the CNL's licence (NRTEDL-W5-8.00/2024), environmental monitoring of the WL site is required. It is anticipated that for closure, the monitoring at the WL site and surrounding area will continue in accordance with CNL's existing Environmental Monitoring Program. This includes sampling and analysis of ambient air, surface water and groundwater, including the Winnipeg River, sediment, vegetation, garden produce, game animals and fish. CNL's Environmental Monitoring Program includes assessment of dose to members of the public, based on emissions monitoring and measurements in environmental media. Additionally, the dose to workers at WL site is monitored and reported to the CNSC annually. As decommissioning of the site proceeds, the environmental monitoring for the site is anticipated to evolve to reflect the creation, removal or limitation of hazards during the period of institutional control.

CNL will implement an Environmental Assessment Follow-up Program for the Project to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented, identify any unanticipated effects and provide for the implementation of adaptive management to limit these effects, if required.

This monitoring will be integrated with that for the existing Environmental Assessment Follow-up Program at the WL site, where practical.

The Environmental Assessment Follow-up Program for the Project will be undertaken during the closure and post-closure phases. Once the WL site has been decommissioned, monitoring to support institutional control will continue, as well as any other requirements identified in the Environmental Assessment Follow-up Program for the Project.

CNL has committed to working collaboratively with the First Nations and the Manitoba Métis Federation to support each Indigenous Nation to participate in environmental monitoring at the WL site. Some of the key elements of the initiative may include expansion and evolution of the monitoring program at WL, through incorporation of feedback, recommendations, Traditional Knowledge, capacity development, including training in environmental monitoring, and opportunities for monitors from each First Nation and the Red River Métis to collect samples on site and in the surrounding area. For example, CNL has had discussions with First Nations and the Manitoba Métis Federation on how future monitoring on the WL site could incorporate Indigenous interests, such as fish species of interest, and traditional knowledge. The goal of the initiative is to help address concerns regarding protection of the environment, health of people, confidence in the health of country foods and stigma associated with the Project.

It is noted that data generated by the monitoring program will be evaluated on an ongoing basis within an adaptive management framework. Modifications to the program may be appropriate to confirm data continue to fulfill program objectives. For example, should a contaminant of potential concern reach concentrations outside the range predicted in the EIS or Decommissioning Safety Assessment Report, including the findings from the Environmental Risk Assessment, the frequency of sampling may be increased and additional locations may be sampled to investigate the source of the increased concentrations. Conversely, cessation of a monitoring activity might be appropriate once it has been shown that an effect has stabilized, or has been reduced to a level where it is no longer considered significant with respect to regulatory requirements or community concerns. Any proposals for modifications to the monitoring program, and the rationale for the modifications will be communicated to the CNSC prior to implementation.

The Environmental Assessment Follow-up Program for the Project will expand on the regulatory requirements of *CSA N288.5-11: Effluent Monitoring Programs at Class 1 Nuclear Facilities and Uranium Mines and Mills* (CSA Group 2011) for the management of emissions from the Project. The Environmental Assessment Follow-up Program for the Project will be required to demonstrate compliance with the effective dose limit of 1 mSv/a for members of the public established by the *Nuclear Safety and Control Act* as well as the WL site public dose limit of 0.25 mSv/a. For a comprehensive summary of the monitoring and follow-up recommendations made based on the results of the environmental assessment refer to Section 11.0 Summary of Monitoring and Follow-up Programs. The monitoring a follow-up programs for human health are outlined in Table 6.7.1-25.

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Table 6.7.1-25: Monitoring and Follow up Programs for Human Health

Valued Component	Project Phase, Potential Effect and Conceptual Monitoring Program	Monitoring Program Objective	Suggested Duration	Implementing Program
Human Health	**Potential Source(s) of Effects:** ■ Closure activities will result in the release of airborne effluent from the WR-1 Building which could affect human health. ■ Release of solutes into the groundwater as the grout and reactor components gradually deteriorate over time during the post-closure phase may cause changes in groundwater quality which could migrate towards the Winnipeg River and affect receptors along the Winnipeg River. **Proposed Monitoring:** ■ Monitoring for air quality as noted above (i.e., for dust, gross alpha, beta and gamma radiation monitoring of the filters). ■ Verification monitoring for tritium in air (post venting through the WR-1 stack). ■ Passive tritium in air network monitoring (semi-annual change out) will be included as part of the Environmental Assessment Follow-up Program for the Project. Monitoring locations (approximately 4 of them) will be selected to be within the main upriver and downriver windrose sectors, at the site boundary and on-site mainly to monitor airborne tritium plumes potentially originating from the WRDF. ■ Estimate combustible gases (e.g., based on project-related traffic and equipment), as per atmospheric environment above; ■ Monitor contaminants of concern (e.g., lead, asbestos, tritium) in air displaced from grouting the below-grade structure, as per the atmospheric environment above. ■ Groundwater monitoring surrounding the WRDF, as noted above. ■ Surface water quality monitoring in the Winnipeg River, as noted above. **Trigger for Further Action:** ■ Investigation if parameters are above applicable guidelines identified.	■ Verify effects predictions related to air quality, groundwater quality and surface water quality to confirm no health effects are anticipated as a result of exposure to COPCs from the Project. ■ Verify mitigation is effective.	■ Dust monitoring would be carried out during the closure phase. ■ WL currently conducts industrial hygiene assessments of lead, asbestos and mould within facilities as part of the decommissioning planning process. ■ Monitoring of tritium in air will be initiated when the stack monitoring system is discontinued. This monitoring would be on-going during post-closure. The need for and duration of monitoring will be assessed based on annual review of monitoring data. ■ Groundwater and surface water quality monitoring would be on-going during closure and post-closure. The need for and duration of monitoring will be assessed based on an annual review of monitoring data.	■ Air quality monitoring for the Project will be captured through the implementation of CNL's WL Effluent Verification and WL Environmental Monitoring Programs. ■ Groundwater monitoring for the Project will be integrated into the overall CNL WL Groundwater Monitoring Program. ■ Surface water monitoring in the receiving environment is already completed through CNL's WL Environmental Monitoring Program. No new surface water quality monitoring is proposed for the Project.

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6.7.1.11 Conclusions

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). The HHRA focused on public health and the health of on-site workers not involved in performing closure activities. Assessment endpoints are qualitative expressions used to assess the significance of residual effects on human health VCs and represent the key properties of the VCs that should be protected for future human generations (i.e., incorporates sustainability). The assessment endpoint is the protection of human health. Measurement endpoints represent properties of the environment, that when changed, could result in or contribute to an effect on an assessment endpoint. Measurement endpoints for the human health assessment include changes in air quality, groundwater quality and surface water quality.

The receptors for the HHRA were selected to be appropriate for assessment of both radiological and non-radiological stressors on human health. Off-site members of the public will potentially be exposed to low levels of airborne contaminants from decommissioning of the WR-1 Building. The most-affected off-site members of the public are defined as the “critical group” which include:

- Farm A and Farm F (year-round occupants, with livestock) for closure and post-closure;
- On-site Farm (post-closure); and
- Harvesters for closure and post-closure.

For the closure phase, the relevant COPCs are expected to be released via atmospheric releases from the WR-1 Building as reactor systems are dismantled, transported off-site or entombed within the WRDF. It has been assumed that the WR-1 Building stack is removed during the closure phase; therefore, atmospheric releases are assumed to occur at ground level. Doses to workers will be monitored and managed as part of CNL’s Radiation Protection Program. The application of the Radiation Protection Program provides that exposures will be kept ALARA and below the effective dose limit of 100 mSv over 5 years, and below 50 mSv in any single year.

An environmental transport and pathways model was used to evaluate the effects of contaminants on the local environment including human receptors. The calculated radiological doses for all human receptors in the candidate critical groups are all below the CNSC public dose limit of 1 mSv/a, as well as the dose constraint for the Project of 0.25 mSv/a limit for the Project. Since the dose estimates are a small fraction of the public dose limit, no discernable health effects are anticipated due to exposure to radioactive releases from Project activities. For the closure phase, all predicted air concentration for non-radiological COPCs were below their relevant ambient air quality criteria; therefore, no non-radiological COPCs were identified for the closure phase and no health effects are anticipated as a result of airborne effluents from the Project.

The closure activities are well encompassed by existing engineering and administrative controls currently in place at the WL site. Although there are some uncertainties to be defined (e.g., exact quantities of hazardous substances), the existing programs and procedures can be applied to manage these potential hazards. Proven operational programs will be in effect ensuring worker doses are below regulatory criteria and are ALARA.

The total radiation dose to human receptors during the post-closure phase are below the CNSC public dose limit of 1 mSv/a, as well as the dose constraint for the Project of 0.25 mSv/a. Since the dose estimates are a small fraction of the public dose limit, no discernable health effects are anticipated due to exposure of potential critical groups to radioactive releases from the WL site during post-closure.

The doses to human receptors that could be exposed to the non-radiological COPCs (i.e., cadmium and lead) in surface water during post-closure were calculated based on total concentration (background plus Project contribution). Risk was quantified for the human receptor based on the calculation of a HQ by dividing the estimated exposure by a toxicity reference value TRV that is known to be protective. The HQs were compared to a benchmark HQ of 0.2, which is consistent with approach taken by Health Canada (2010) in their guidance on human health quantitative risk assessment. The HQs derived for COPCs were below the protective benchmark for all receptors and pathways, other than the river drinking water pathway. If only the Project contribution is considered, the HQs are well below the protective benchmark, indicating the Project contribution to the risk is minimal. Although uncertainties in the assessment exist, conservatism, such as using the highest release rates, has been included in the modelling so that residual effects are not greater than predicted.

A key concern of Indigenous peoples was effects to the health of harvesters from consuming fish, plants, and wildlife in the vicinity of the WL site. Overall, residual effects from radiological and non-radiological COPCs are considered to be not significant for all human health VCs, including harvesters, during the closure and post-closure phases.

Three Disruptive Events were also assessed to address uncertainties that arose during the definition of scenarios and conceptual models. These were:

- Inadvertent Human Intrusion: an exploration borehole drilled into the WRDF and exposure of wastes;
- Substantial Failure of In Situ Decommissioning Structure (WRDF Barrier Failure); and
- Well in Plume: an on-site resident drinking groundwater from a well capturing the plume from the WRDF.

For all Disruptive Events the total radiation dose to human receptors during the post-closure phase are below the IAEA Upper Reference Level for Disruptive Events of 20 mSv/a. For exposure to non-radiological COPCs (i.e., cadmium and lead) the HQ exceeded the target values for some scenarios. However, the assessment was conservatively conducted to predict exposures to human receptors under these future unlikely conditions. Further, controls can be put in place to reduce the probability of the Disruptive Events (e.g., land use restrictions during post-institutional control period to reduce the likelihood of a human intrusion event).

Indigenous peoples have interest in the current and future monitoring proposed for the Project. CNL will implement an Environmental Assessment Follow-up Program for WR-1 to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. CNL will implement an Environmental Assessment Follow-up Program for the Project as identified for other environmental components to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. This monitoring will be integrated with that for the existing Environmental Assessment Follow-up Program for the WL site, where practical.

As part of CNL's licence (NRTEDL-W5-8.00/2024), environmental monitoring of the WL site is required. It is anticipated that for closure, the monitoring at the WL site and surrounding area will continue to proceed in accordance with CNL's existing Environmental Monitoring Program. This includes sampling and analysis of ambient air, surface water and groundwater, including the Winnipeg River, sediment, vegetation, garden produce, game animals and fish. These activities will verify effects predictions for human health.

6.7.2 Ecological Health

6.7.2.1 Scope of the Assessment

The scope of the assessment focuses on summarizing the potential health effects to non-human biota (plants and animals) from Project activities. The general approach to ISD involves permanently encasing with grout the below-grade WR-1 systems. In situ disposal is a permanent, passive decommissioning end state. The decommissioning activities proposed as part of the Project include:

- preparation for ISD;
- grouting of below-grade structures and systems;
- removal of above-grade WR-1 Building;
- installation of a concrete cap and engineered cover over the WRDF;
- final site restoration;
- preparation of institutional control; and
- institutional control.

The above-grade structures will be demolished and removed using traditional demolition methods. During decommissioning, equipment from the PHT system that is currently located on the ground-level reactor floor will be placed below-grade for ISD. The above-grade structures will be demolished and removed using traditional demolition methods. A concrete cap and engineered cover will then be constructed over the below-grade structure (refer to Section 3.5 for more detail) and the Project site will be regraded and reclaimed. The end state of the Project (i.e., after the WR-1 Building is demolished, grouted and covered with a concrete cap and engineered cover) is referred to as the WRDF. Environmental monitoring will be completed to confirm that the WRDF is functioning as intended in the long-term (see Section 11.0 Summary of Monitoring and Follow-up Programs).

The ecological health risk assessment (EcoRA) follows the overall environmental assessment approach and methods described in Section 6.1 Environmental Assessment Approach. The assessment is completed in the following steps:

- **Step 1 – Identify Valued Components (VCs) and define the spatial boundaries, temporal boundaries and assessment cases** (refer to Section 6.7.2.3 Valued Components and Section 6.7.2.4. Assessment Boundaries) for the EcoRA. The VCs, assessment endpoints and measurement indicators used to assess Project related changes to ecological health, the spatial and temporal boundaries at which the assessment occurred and the assessment cases considered are described.
- **Step 2 – Describe the existing conditions** (refer to Section 6.7.2.5 Description of the Existing Environment). Existing conditions in the local and regional areas are described, including the combined effects of previous and existing developments (Base Case). The existing environment represents the historical and current environmental pressures that have shaped the observed patterns in the environment (i.e., natural variation).

- **Step 3 – Evaluate Project interactions and mitigation** (refer to Section 6.7.2.6 Project Interactions and Mitigation). Project components and/or activities with the potential to affect ecological health are identified and mitigation options to limit or avoid effects are presented. A pathways analysis is then used to focus on key interactions between the Project and ecological health by evaluating the different effect pathways to determine if, after incorporation of mitigation, there is still potential to cause residual effects. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. Where effects are adequately mitigated and are not forwarded to further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are articulated. Primary pathways that may lead to residual effects to ecological health after incorporating mitigation are carried forward to Step 4 for further analysis and residual effects characterization.
- **Step 4 – Present the methods and results of the residual effects analysis** (refer to Section 6.7.2.7 Residual Effects Analysis). This section outlines the methods used to predict and characterize residual effects to ecological health from primary effect pathways. The analysis results are also presented including the characterization of: (i) residual incremental effects of the Project and the effects of the Project in combination with past and present developments on ecological health (Application Case); and (ii) residual effects of the Project in combination with past and present developments, as well as other reasonably foreseeable developments (Reasonably Foreseeable Development [RFD] Case). A key outcome of this section is the predicted effects to ecological health that are passed on to other VCs for inclusion in their assessment.
- **Step 5 – Describe the level of certainty and management of uncertainty** (refer to Section 6.7.2.8 Prediction Confidence and Uncertainty). Evaluate the available literature, data and models used for the assessment and describe the level of certainty that can be placed on predicted residual effects. This section will also identify how the uncertainty has been managed so that the effects are not underestimated.
- **Step 6 – Classify and determine the significance of the predicted residual effects** (refer to Section 6.7.2.9 Residual Effects Classification and Determination of Significance). Residual effects predicted from primary pathways are classified using a common set of criteria: direction, magnitude, geographic extent, duration, reversibility, frequency and likelihood. A determination of the significance of the predicted residual effects of the Project on ecological health is made. Relative to other sections, the EcoRA uses a slightly different approach to the classification of residual effects and evaluation of significance, because several of the criteria (e.g., geographical extent, duration, frequency and reversibility) are already incorporated into the risk estimates and, therefore, are not independent variables.
- **Step 7 – Identify monitoring and follow-up** (refer to Section 6.7.2.10 Monitoring and Follow-up) required to confirm effect predictions and address uncertainty.
- **Step 8 – Present a consolidated summary of conclusions and outcomes of the assessment** (refer to Section 6.7.2.11 Conclusions) of residual effects on ecological health.

6.7.2.2 Indigenous Engagement Feedback – Key Interests and Concerns

Interests and concerns raised by Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations during engagement related to the human health risk assessment are summarized in Table 6.7.1-1. These concerns were gathered through direct engagement and through the analysis of the array of studies provided to CNL. Other general concerns and questions raised during Indigenous engagement activities are documented in Section

4 Indigenous Engagement. Specific interests and concerns from each community are consolidated in Section 4 Appendices.

Table 6.7.2-1: Summary of Issues Raised During Engagement Activities Related to the Ecological Health Risk Assessment

Interest and Concern	Inclusion Status	Additional information and Rationale
Health of the Environment ■ Long-term effects of the Project on water quality ■ Accumulation of contaminants in fish over time ■ Long-term health effects of the Project on plants and wildlife important to Indigenous people ■ Concern that communities have seen changes to the health of the animals they harvest ■ Animals may cross the barriers and come into contact with hazardous materials	Encompassed by the initial environmental assessment Moose was added as a VC to the Ecological Health Assessment	Potential changes in ecological health considered a broad suite of ecological valued components, including a number of fish, plant and wildlife species (see Section 6.7.2.3). Effects on fish, plants, and wildlife health are assessed in Section 6.7.2.7 Residual Effects Analysis. A summary of concerns and observations of Indigenous Nations on the changes to the health of animals is provided in Section 6.6.5.7 Traditional Knowledge. During closure, sensory disturbance (noise, equipment use, presence of humans) is anticipated to deter wildlife from the active work area (see Section 6.6.6 Project Interactions and Mitigation)
Monitoring ■ Current monitoring practices ■ Future monitoring practices	Encompassed by the initial environmental assessment	Information on the current monitoring program at the WL site is described in Section 6.7.1.5 Description of the Environment. Information on the monitoring program for the Project is available in Section 6.7.2.10 Monitoring and Follow-up.

6.7.2.3 Valued Components

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). It is generally an impractical task to assess the effect of radiological and non-radiological emissions on all the species of biota within a natural ecosystem, and specifically within the ecosystem around the WL site. Therefore, representative organisms are chosen for dose and risk analysis. These organisms are selected because they are known to exist on the site, and are representative of major taxonomic groups or exposure pathways, or have a special importance or value. CNL verified the list of important species identified by each Indigenous community to confirm that each was adequately represented by the selected representative organisms. Based on feedback from Indigenous peoples during engagement activities, moose was added as a VC to the ecological health assessment given the species importance to Indigenous people.

During closure, the focus is on terrestrial VCs because releases are only expected via atmospheric pathways. During post-closure phase, the focus is on aquatic and riparian VCs, because releases are only expected via

groundwater to surface water pathways. Valued components and rationale for their selection for the EcoRA are provided in Table 6.7.2-2.

Table 6.7.2-2: Valued Components for the Ecological Health Risk Assessment

Category	Valued Component	Rationale
Closure Phase		
Terrestrial Invertebrates	Earthworm	Detritivore. Exposure to atmospheric release through soil.
Terrestrial Birds	American Robin	Observed on-site. Exposure to atmospheric release through the ingestion of soil invertebrates. A surrogate for insect eating birds including various Species at Risk under COSEWIC, ESEA or SARA.
	Loggerhead Shrike	Historically observed on-site. Exposure to atmospheric release through the ingestion of soil invertebrates, small mammals and birds. Identified as a Species at Risk under COSEWIC, ESEA or SARA. A surrogate for other predatory birds identified as Species at Risk under COSEWIC, ESEA or SARA.
Terrestrial Plants	Grass and shrubs	Present on-site. Exposure to atmospheric release through soil. Food source for other VCs.
	Berries	Present in the area. Exposure to atmospheric release through soil. Food source for VCs.
Terrestrial Mammals	Meadow Vole	Common in the area. Exposure to atmospheric release through ingestion of terrestrial plants. A food source for VCs.
	Common Shrew	Common in the area. Exposure to atmospheric release through ingestion of soil invertebrates. A food source for VCs.
	Snowshoe Hare	Common in the area. Exposure to atmospheric release through ingestion of terrestrial plants. A game species.
	White-tailed Deer	Common in the area. Over winters on-site. Exposure to atmospheric release through ingestion of terrestrial plants. A game species. An important game species for Traditional Communities.
Closure Phase		
Terrestrial Mammals	Red Fox	Common in the area. Exposure to atmospheric release through the ingestion of small mammals and birds. A surrogate for the Grey Fox identified as a Species at Risk under COSEWIC, ESEA or SARA.
	Little Brown Myotis	Bats observed roosting in forested areas of the WL site. Exposure to atmospheric release through ingestion of soil invertebrates. Exposure to aquatic release through ingestion of aerial stages of benthic invertebrates. Identified as a Species at Risk under COSEWIC, ESEA or SARA. A surrogate for other bats identified as Species at Risk under COSEWIC, ESEA or SARA.
Post-closure Phase		
Terrestrial Birds	Barn Swallow	Observed on-site. Exposure to aquatic release through ingestion of aerial stages of benthic invertebrates. Identified as a Species at Risk under COSEWIC, ESEA or SARA. A surrogate for aquatic insect eating birds including various Species at Risk under COSEWIC, ESEA or SARA.
Terrestrial Mammals	Little Brown Myotis	Bats observed roosting in forested areas of the WL site. Exposure to atmospheric release through ingestion of soil invertebrates. Exposure to aquatic release through ingestion of aerial stages of benthic invertebrates. Identified as a Species at Risk under COSEWIC, ESEA or SARA. A surrogate for other bats identified as Species at Risk under COSEWIC, ESEA or SARA.
	Moose	Present on-site to a limited extent. Identified as a game animal of interest for some Indigenous Nations. Exposure to aquatic release through ingestion of aquatic plants.

Table 6.7.2-2: Valued Components for the Ecological Health Risk Assessment

Category	Valued Component	Rationale
Fish	Carmine Shiner	Present in the Winnipeg River. Exposure to aquatic release through surface water and sediment. Identified as a Species at Risk under COSEWIC, ESEA or SARA. Small-bodied forage fish. A food source for other VCs.
	Lake Sturgeon	Present in the Winnipeg River. Exposure to aquatic release through surface water and sediment. Identified as a Species at Risk under COSEWIC, ESEA or SARA.
	Walleye	Present in the Winnipeg River. Exposure to aquatic release through surface water. A sport fish. A surrogate for other pelagic fish in the Winnipeg River such as Northern Pike and Mooneye.
Aquatic Plants	Aquatic Plants	Present in the Winnipeg River. Exposure to aquatic release through surface water. Food source for other VCs.
Aquatic Invertebrates	Benthic Invertebrate	Present in the Winnipeg River. Exposure to aquatic release through surface water and sediment. Food source for other VCs.
Riparian Birds	Horned Grebe	Present in the area. Exposure to aquatic release through ingestion of water and fish. Identified as a Species at Risk under COSEWIC, ESEA or SARA. Food source for other VCs. Surrogate for other important species such as the common loon and red-necked grebe.
	Trumpeter Swan	Observed on-site. Exposure to aquatic release through ingestion of water and aquatic plants. Identified as a Species at Risk under COSEWIC, ESEA or SARA.
	Mallard	Representative of waterfowl. Exposure to aquatic release through ingestion of water, aquatic plants and benthic invertebrates. Food source for other VCs and human receptors.
Riparian Mammals	Mink	Present in the area. Exposure to aquatic release through ingestion of water, waterfowl and fish.

COSEWIC = Committee on the Status of Endangered Wildlife in Canada; ESEA = Manitoba's *Endangered Species and Ecosystems Act*; SARA = *Species at Risk Act;* VC = valued component.

Assessment endpoints are qualitative expressions used to assess the significance of residual effects on VCs and represent the key properties of the VC that should be protected for future human generations (i.e., incorporates sustainability). Measurement endpoints represent properties of the environment, that when changed, could result in or contribute to an effect on an assessment endpoint. The measurement endpoints for the ecological health assessment are outlined in Table 6.7.2-3. The ecological health section draws on many other assessments within the EIS (e.g., air quality).

Table 6.7.2-3: Assessment Endpoints and Measurement Indicators for the Ecological Health Risk Assessment

Valued Components	Assessment Endpoint	Measurement Indicator
Terrestrial Invertebrates (Earthworm)	Viability of Populations	■ Changes to air quality ■ Changes to groundwater quality ■ Changes to surface water quality ■ Changes to soil quality ■ Changes to vegetation quality
Terrestrial Birds (American Robin, Loggerhead Shrike, Barn Swallow)		
Terrestrial Plants (Grasses, shrubs, berries)		
Terrestrial Mammals (Meadow Vole, Common Shrew, Snowshoe Hare, White-Tailed Deer, Red Fox, Moose, Little Brown Myotis)		
Aquatic Plants		■ Changes to air quality ■ Changes to groundwater quality ■ Changes to surface water quality ■ Changes to sediment quality
Aquatic Invertebrates (Benthic Invertebrates)		
Fish (Carmine Shiner, Lake Sturgeon, Walleye)		
Riparian Birds (Horned Grebe, Trumpeter Swan, Mallard)	Viability of Populations	■ Changes to air quality ■ Changes to groundwater quality ■ Changes to surface water quality ■ Changes to sediment quality ■ Changes to soil quality ■ Changes to vegetation quality
Riparian Mammals (Mink)		

Viability of Populations is evaluated in the ERA by estimating VC exposures for the COPC and comparing those to benchmarks that are protective of growth, survival and reproduction. COPCs are further defined in Section 6.7.2.7.1 and 6.7.2.7.2.

6.7.2.4 Assessment Boundaries

6.7.2.4.1 Spatial Boundaries

In order to assess the potential effects of the Project on ecological health, an appropriate spatial boundary was defined, with consideration given to locations where VCs could be affected by Project activities directly or where they could be indirectly affected by interacting with other aquatic and terrestrial VCs affected by Project activities (Figure 6.7.1-1).

- **Site Study Area (SSA):** is the WR-1 Building and represents the Project footprint (i.e., where project activities will be undertaken). The size of the SSA is approximately 0.07 ha.
- **Local Study Area (LSA):** is defined as the area within which there is potential for measurable changes to measurement indicators resulting from the proposed Project activities. The LSA was adapted from the surface water RSA and is designated to include receptors from both the HHRA and EcoRA. Therefore, the south boundary of the LSA extends from the west shore of the Winnipeg River to the east fence on the property line about 400 m north of Provincial Highway 211. The eastern boundary of the LSA follows the fence on the property line to the north property line. The north boundary follows the north fence on the property line about 1.6 km and then turns north for about 400 m before turning west and extending to the west side of the Winnipeg River. The west boundary follows the west bank of the Winnipeg River for about

1.5 km and then turns west for 370 m, north for 1.4 km and then turns east for 630 m to the west side of the Winnipeg River. The LSA has an approximate size of 4,174 ha.

- **Regional Study Area:** is defined as the area within which the potential effects of the Project may interact with the effects of other existing or reasonably foreseeable projects. The RSA was adapted from the air quality study area and is defined as a 12 km by 12 km rectangle surrounding the LSA.

6.7.2.4.2 Temporal Boundaries

The temporal boundaries of the assessment are the timeframe during which Project activities are actively occurring and the duration of predicted residual effects. The duration of an effect is defined as the amount of time between the start and end of a Project activity or stressor (which is related to the project phases) plus the time required for the residual effect to be reversed. In some cases, a residual effect may be irreversible within the temporal boundaries of the Project if the effect is predicted to last so far into the future that the duration cannot be predicted with any level of certainty (e.g., residual effect lasts for thousands of years). The following phases were identified for the Project:

- **Closure Phase:** Preparation and implementation of ISD, which includes preparation for ISD, grouting of below-grade structures and systems, removal of above-grade WR-1 structures and systems, installation of the concrete cap and engineered cover, and environmental controls and final site restoration. These activities last from 2022 to 2027.
- **Post-closure Phase:** The post-closure phase has two discrete periods: institutional control and post institutional control. Institutional control is estimated to be at least 100 years during which long-term monitoring and maintenance activities will continue to demonstrate WRDF performance is in compliance with the safety case assumptions and performance modelling. The 100 year timeframe is not related to the design life of the WRDF barriers. The 100-year active monitoring period was selected to ensure that sufficient opportunity is provided to verify the WRDF is performing as expected. Additionally, beyond 100 years, there is less confidence that institutional controls, like access restrictions, can be relied upon. Although the duration of institutional control is estimated at 100 years, it is recognized that it will continue until the CNSC, or the appropriate authority at the time, agrees it is no longer needed.

  Post-institutional control occurs after year 2127 and continues indefinitely. The post-closure phase will continue indefinitely; however, the timeframe defined for assessment of potential effects as part of the normal evolution of the Project is 10,000 years. This time period encompasses the phase in which peak effects are anticipated.

6.7.2.4.3 Assessment Cases

The assessment cases considered for ecological health include the Base Case, Application Case and the Reasonably Foreseeable Development (RFD) Case:

- **Base Case:** represents existing conditions and characterizes combined effects from previous and existing developments and activities. The Base Case reflects the effects of existing disturbances, such as forestry, hydro-electric dams, transportation, agricultural, mining and residential and recreational development. Current effects from the existing WL facilities and operations, for example, are considered part of the Base Case. In addition, effects from the decommissioning and reclamation activities already completed at the WL site are also considered as part of the Base Case. The base case is represented in the assessment by baseline air quality (Section 6.2.1.5 Description of the Environment) and surface water quality

(Section 6.4.2.5 Description of the Environment); for guidelines that limit total exposures, the Project contribution and background are included.

- **Application Case**: represents the effects of the Base Case combined with predicted effects from the Project. The Application Case includes post-closure activities, and therefore, the associated effects during the post-closure phase of the Project represent the bounding case.
- **RFD Case**: represents the predictions of the cumulative effects of the Application Case, plus projects that are currently under application review or that have officially entered a regulatory application process and which overlap with the ecological health RSA. There are no RFDs expected in the RSA other than the continued decommissioning of the remaining WL facilities, as the CSR (AECL 2001). The CSR indicated that no decrease in water quality is expected and effluent emissions to the Winnipeg River are expected to decline following decommissioning. Results of the assessment concluded that no effect on aquatic species is expected as doses were below the limit at which no effects on aquatic populations is expected. Current effects from the existing WL facilities and operations are considered part of the Base Case (i.e., existing conditions). Consequently, cumulative effects of the Base Case and the potential effects from the Project are evaluated in the Application Case. As such, an RFD Case is not applicable to the EcoRA and is not further discussed (Table 6.7.2-4).

Table 6.7.2-4: Reasonably Foreseeable Developments considered in the Ecological Health Assessment

Type of Project	Location	Description	Timeframe	Overlap with Valued Components
Infrastructure Decommissioning	WL	Decommissioning of remaining infrastructure on the WL site (includes ISD of the low-level waste trenches).	2016 to 2027	Yes – however, effects are evaluated as part of the Application Case
Environmental Remediation	WL	Remediation of affected lands, with the exception of the low-level waste trenches.	2016 to 2027	Yes – however, effects are evaluated as part of the Application Case

6.7.2.5 Description of the Environment

Monitoring of at the WL site and surrounding area will proceed as described in CNL's ongoing Environmental Assessment Follow-up Program at the WL site. This includes sampling and analysis of ambient air, surface water and groundwater, including the Winnipeg River, sediment, vegetation, garden produce, game animals and fish. A summary of concentrations of radionuclides and non-radionuclide concentrations within the various environmental media are discussed in the "Description of the Existing Environment" section of the relevant discipline section in the EIS. The descriptions incorporate the associated Traditional Knowledge provided by Indigenous Nations.

6.7.2.6 Project Interactions and Mitigation

6.7.2.6.1 Methods

This section describes the process by which interactions between Project components and activities and ecological health were identified and evaluated. Potential effect pathways are identified and mitigation options to eliminate and/or reduce effects are presented. A pathways analysis is then used to focus on key interactions

between the Project and the environment. Where effects will be adequately mitigated and are not forwarded for further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are articulated. Primary pathways that may lead to residual effects after incorporation of mitigation are further characterized in Section 6.7.2.7 Residual Effects Analysis. As such, this section helps to focus the remainder of the assessment on those interactions (effects pathways) likely to result in residual adverse effects.

The first part of the analysis was to identify the potential effects pathways for all phases of the Project. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. The next step in the analysis was the development of environmental design features and mitigation practices that could be incorporated into the Project to eliminate and/or reduce adverse effects to ecological health. Environmental design features included Project design elements, environmental best practices and management policies and procedures. Environmental design features and mitigation were developed through an iterative process between the Project's engineering and environmental teams, combined with input from Project specific or regional engagement with other interested parties. The design features and/or mitigation activities were selected considering their effectiveness for implementation and maintenance and their appropriateness within the context of the identified effect pathways.

After incorporation of mitigation, potential pathways were evaluated into the following categories using scientific knowledge, logic, experience with similar developments and the effectiveness of environmental design features and mitigation:

- **No linkage pathway –** pathway is removed by environmental design features or mitigation such that the Project would not be expected to result in a measurable environmental change relative to Base Case values and therefore would have no residual effects to ecological health.
- **Secondary pathway –** the pathway could result in a measurable minor environmental change, but would have a negligible residual effect on ecological health relative to Base Case and/or guideline values and is not expected to contribute cumulatively to other Project effects or to the effects of other past, present or reasonably foreseeable developments to cause a significant effect.
- **Primary pathway –** the pathway is likely to result in an environmental change relative to the Base Case and/or guideline values that could contribute to residual effects to ecological health.

Environmental design features and mitigation that have been or could be incorporated into the Project to eliminate and/or reduce adverse effects were considered. Potential pathways that were completely removed due to implementation of environmental design or mitigation were not assessed further. Pathways that were assessed to be secondary and demonstrated to have a negligible residual effect to ecological health through simple qualitative or semi-quantitative evaluation of the pathway were also not advanced for further assessment. Primary pathways were carried forward for more detailed quantitative and qualitative effects analysis to characterize the residual effects of the Project.

6.7.2.6.2 Results

Pathways through which the Project may interact with the ecological health VCs are summarized in Table 6.7.2-5. Accidents and malfunctions related to Project activities are also possible and are assessed separately in Section 7.0 Accidents and Malfunctions.

Table 6.7.2-5: Pathways Analysis for the Ecological Health Valued Components

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
General Project activities during the closure phase	Closure activities will alter concentrations of non-radiological indicator compounds (e.g., particulate matter and carbon dioxide), which could affect human health, including: ■ use vehicles and equipment that combust fuel and emit indicator compounds; ■ material handling, for grouting and demolition; ■ vehicles travelling on paved roads; ■ operation of batch mixing plant for grout production.	■ Implementation of CNL's *Environmental Protection* (CNL 2021b) and *Management and Monitoring of Emissions* (CNL 2018a), which includes operational control monitoring, air verification monitoring and environmental monitoring. ■ Implementation of CNL's Occupational Safety and Health Program, including work permit system and personal protection equipment and clothing. ■ Implementation of dust management techniques. ■ On-site vehicles and equipment engines will meet Tier 3 emission standards, where possible, and be maintained in good working order. ■ Limit idling of vehicles on-site and speed on roads. ■ Use of tarps or 3 sided enclosures for raw material storage.	Secondary
General Project activities during the closure phase	Closure activities will result in the atmospheric release of radiological and non-radiological compounds from the WR-1 Building	■ Implementation of CNL's Radiation Protection Program and Procedure, which includes Radiation Safety Zones, detailed work planning to limit doses to as low as reasonably achievable (ALARA), dose monitoring and contamination control procedures (e.g., stabilizing and immobilizing agents). ■ Implementation of CNL's Occupational Safety and Health Program, including work permit system and training requirements. ■ Implementation of CNL's *Environmental Protection* (CNL 2021b) and *Management and Monitoring of Emissions* (CNL 2018a), which includes operational control monitoring, air verification monitoring and environmental monitoring.	Primary

Table 6.7.2-5: Pathways Analysis for the Ecological Health Valued Components

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
Long-term performance during the post-closure phase	Release of solutes into the groundwater as the grout and reactor components gradually deteriorate over time may cause changes in groundwater quality which could migrate towards the Winnipeg River	■ Encapsulation of the reactor by a multi-component WRDF (i.e., geosphere, concrete foundation, grout and facility systems and components) to mitigate groundwater flow into the ISD waste. ■ Installation of a concrete cap and engineered cover system to mitigate moisture infiltration into the WRDF and hence limit release of solutes into the groundwater. ■ Environmental monitoring will be completed throughout the post-closure phase for the Project to confirm that the cover and grout is functioning as intended, and to confirm modelling predictions.	Primary
	Release of chemical and radiological contaminants in the long-term during the post-closure phase from the previous activities completed at the WL site.	■ As part of CNL's Licence No. NRTEDL-W5-8.00/2024 with the CNSC, environmental monitoring around the WL site will continue for the Project. ■ Follow-up monitoring during the post-closure phase will continue to verify effect predictions and to provide information for use in adaptive management to address potential unforeseen effects.	Secondary

6.7.2.6.2.1 No Linkage Pathway

There are no pathways identified as having no linkages to effects to the ecological health VCs.

6.7.2.6.2.2 Secondary Pathways

In some cases, a Project source of effect and an interaction with an assessment endpoint exists but mitigation is expected to cause minor changes to ecological health relative to the existing Base Case and/or guidelines. The following pathway is expected to result in negligible effects on the ecological health VCs and will not be evaluated further in the EIS.

- **Closure activities will alter concentrations of non-radiological indicator compounds (e.g., particulate matter and carbon dioxide), which could affect ecological health.**

Closure activities will result in the release of CACs and fugitive dust emissions. Sources of dust deposition and air emissions include stack emissions, fuel use, aggregate material handling, on-site batch mixing plant and road dust. Environmental design features and mitigation have been incorporated into the Project to reduce potential adverse effects from dust deposition and air emissions. CNL's *Environmental Protection* (CNL 2021b) and *Management and Monitoring of Emissions* (CNL 2018a) includes operational control monitoring, air verification monitoring and implementation of dust management techniques developed for the Project.

The release of CACs (particulate matter, nitrogen oxides, sulphur dioxide and carbon monoxide) and fugitive dust were assessed as part of the air quality VC in Section 6.21.7 Residual Effects Analysis. Predicted concentrations for the Application Case (Section 6.2.1.7.2 Application Case Results) are below applicable air quality guidelines and/or standards. Therefore, the release of CACs and fugitive dust is not expected to result in effects to ecological health.

- **Release of chemical and radiological contaminants in the long-term during the post-closure phase from the previous activities completed at the WL site.**

The CSR considered potential effects on the Winnipeg River and management of releases to ensure no residual effect. No decrease in water quality is expected and effluent emissions to the Winnipeg River are expected to decline to virtually zero following decommissioning. Re-suspension of contaminated sediments is also not expected to lead to a decrease in water quality (see Section 7.0 of AECL 2001).

The CSR (AECL 2001) also considered the potential for effects via groundwater quality from the low-level waste that may be managed in situ in the WMA, and their potential to affect the Winnipeg River and human health (see also Section 6.4.2.6.2.2 Project Interactions and Mitigation [surface water quality assessment]). The assessment considered three general exposure pathways: upward migration (with potential contamination of soils and vegetation), near-surface later migration (with potential contamination to local discharge in perimeter and roadside ditches) and downward migration and contamination of the sand and gravel aquifer and subsequently the river). Only the near-surface lateral migration scenario was considered in further detail. With respect to downward migration and release to the river it was determined that the general hydrology of the site limits or eliminates this pathway.

Water concentrations in the ditch were predicted and compared to established guidelines for several of the contaminants in the WMA. Radionuclide modelling in the CSR (Appendix C of AECL 2001) indicated that three radionuclides have the potential to exit the WMA through migration over a 200-year period, namely tritium, technetium-99 and carbon-14. Of these three radionuclides only technetium-99 is potentially present in nonzero concentrations in the ditch adjacent to the WMA in as early as 20 years. The carbon-14 and tritium will be lost to the atmosphere, and when this is modelled there is no release of these radionuclides to the perimeter ditch. The preliminary exposure assessment for radiological contamination of the ditch resulted in a dose of 0.16 mSv/a at the predicted peak concentration of technetium-99 (Appendix C of AECL 2001).

With respect to non-radiological contaminants, some exceedances of applicable standards were predicted. Further refinement of the modelling and potential need for selective remediation to remove the hazard was recommended (AECL 2001). Organic contaminants were also considered; it was concluded that the remaining concentrations of the solvents and DDT are very small and unlikely to present a residual hazard.

Consequently, there is no overlap of effects between the Project and previous activities at the WL site (i.e., effects from the WMA) and changes to surface water quality in the Winnipeg River.

As part of CNL's Licence No. NRTEDL-W5-8.00/2024 with the CNSC, environmental monitoring around the WL site will continue for the Project. Follow-up monitoring during the post-closure phase will continue to verify effect predictions and to provide information for use in adaptive management to address potential unforeseen effects. Consequently, changes to surface water quality from the closure of the WL site, are predicted to be negligible.

6.7.2.6.2.3 Primary Pathways

The following primary pathways were identified between the Project and ecological health and therefore, are carried forward to the residual effects analysis:

- **Closure activities will result in the atmospheric release of radiological and non-radiological compounds from the WR-1 Building.**
- **Release of radiological and non-radiological solutes into the groundwater as the grout and reactor components gradually deteriorate over time may cause changes in groundwater quality; which could affect Winnipeg River water quality as groundwater migrates towards the Winnipeg River.**

6.7.2.7 Residual Effects Analysis

An ERA (EcoMetrix 2021) was completed for the Project to assess potential adverse effects of the Project on ecological health during the closure and post-closure phases of the Project. A summary of the methods and results of this assessment during the closure and post-closure phases of the Project is provided in Sections 6.7.2.7.1 Application Case – Closure Phase and 6.7.2.7.2 Application Case – Post-closure Phase, respectively.

6.7.2.7.1 Application Case – Closure Phase

6.7.2.7.1.1 Methods

This section summarizes the specific methods used to assess the residual effects on ecological health during the closure phase for the Project activities and pathways identified as primary in Table 6.7.2-5. Policies, guidelines and standards considered in the analysis, as well as the model used to predict residual effects are described.

Receptor Selection and Characterization

As described in Section 6.7.2.3, the focus for the closure phase is on terrestrial VCs because releases are only expected via atmospheric pathways. The following VCs are evaluated for the closure phase, rationale for their selection is provided in Table 6.7.2-2:

- earthworm;
- American robin;
- loggerhead shrike;
- grass and shrubs;
- berries;
- meadow vole;
- common shrew;
- snowshoe hare;
- white-tailed deer;
- red fox; and
- little brown myotis.

Contaminants of Potential Concern

For the closure phase, the relevant COPCs may be released via atmospheric releases from the WR-1 Building. It has been assumed that the WR-1 Building stack is removed during the closure phase; therefore, any atmospheric releases are assumed to occur at ground level. Atmospheric deposition to the Winnipeg River is considered to be negligible, consistent with COG DRL guidance (COG 2013), therefore, aquatic pathways and VCs are not considered during closure.

Selection of Radiological COPCs

The radionuclides that are considered in the ERA for the closure phase are those radionuclides that have been found in WL's airborne effluent or are reasonably expected to be found in the airborne effluent (CNL 2020b). Radionuclides are considered of public and regulatory interest and therefore all radionuclides identified were carried forward quantitatively in the ERA.

During closure, operational controls and procedures in place to prevent or limit the release of airborne radionuclides will be in effect (e.g., during demolition the above-grade building will be in place, the waste collection system and proven emergency response plans and personnel will all be operational and adequate ventilation and infiltration will be established). As well, decontamination, and the use of stabilizing and immobilizing agents prior to dismantling the WR-1 Building will be used to control the release of airborne radionuclides. Release of radionuclides to the atmosphere during closure are not anticipated to be above those observed during the operation phase of the facility. During demolition of above-grade structures, radionuclides may be released from the PHT system, and some existing surface radionuclides may become airborne. During grouting, remaining radionuclides may be released from the reactor core and biological shield (Table 6.7.2-6. Tritium may also be released, for example, when disruptive activities on the helium and heavy water system are executed during closure. In accordance with *REGDOC-2.9.1, Environmental Protection: Environmental Principles, Assessments and Protection Measures* (CNSC 2020), average and maximum emission rates have been provided for the Application Case (refer to Section 6.2.1, Tables 6.2.1-11 and 6.2.1-12).

Table 6.7.2-6: Potential Radionuclide Release during the Closure Phase

Reactor Core	Biological Shield	Primary Heat Transport System
■ Carbon-14 ■ Iron-55 ■ Cobalt-60 ■ Nickel-59 ■ Nickel-63 ■ Niobium-94 ■ Silver-108m ■ Tritium	■ Chlorine-36 ■ Calcium41 ■ Nickel-63 ■ Carbon-14 ■ Cobalt-60 ■ Europium-152	■ Strontium-90 ■ Caesium-137 ■ Europium-154 ■ Europium-155 ■ Technetium-99 ■ Iodine-129 ■ Uranium-235 ■ Uranium-238 ■ Neptunium-237 ■ Neptunium-239 ■ Plutonium-238 ■ Plutonium-239 ■ Plutonium-240 ■ Plutonium-241 ■ Americium-241 ■ Americium-243 ■ Curium-244 ■ Silver-108m ■ Cobalt-60

Selection of Non-Radiological COPCs

A select number of non-radiological airborne COPCs have been identified as potentially being released during the closure phase from the WL site. These include:

- asbestos (friable [contains more than 1% asbestos by weight or area and can be crumbled by the human hand] and non-friable [material that contains more than 1% asbestos and cannot be crumbled under hand pressure] asbestos containing materials);
- organic coolant (HB-40 used as reactor coolant, also known as OS-84, primarily hydrogenated terphenyl) in the PHT system;
- lead based paint and lead shielding;
- polychlorinated biphenyls (PCBs) in fluorescent light fixture ballasts;
- small quantities of mercury in thermostats and switches; and
- mould.

With the exception of HB-40, the identified hazardous substances are routinely addressed in construction projects. HB-40 consists mainly of hydrogenated terphenyl (74% to 87%), with smaller fractions of partially hydrogenated terphenyls and terphenyl. Since HB-40 is an oil, or a tar if irradiated, its release to air with dust should be limited.

Non-radiological COPCs are identified through an official screening process and these COPCs are carried forward into the EcoRA. The screening consists of comparing the maximum predicted air concentration during closure to selected benchmarks. If concentration exceeds benchmark it indicates additional risk assessment work is required to demonstrate protection of the public and environment. For closure it was identified that no non-radiological COPCs were required to be carried forward into the EcoRA.

Exposure Pathways

During the closure phase, releases to surface water are not expected, because any release from the grouted reactor would occur after closure, and contaminant transport via groundwater to surface water would take additional time. Accordingly, the focus for the closure phase is on terrestrial VCs because releases are only expected via atmospheric pathways. Relevant exposure for ecological receptors is presented in Table 6.7.2-7 and illustrated on Figure 6.7.2-1. Exposure pathways include the routes of contaminant dispersion from the source to the receptor location and the routes of contaminant transport through the food chain or other media to the receptor organism.

Airborne COPCs partition to soil and plants, and ingestion pathways dominate over inhalation and air immersion for most COPCs. The latter pathways are omitted for ecological receptors in this assessment, except for COPCs such as noble gases, if released, since inhalation and air immersion pathways for these are expected to be important.

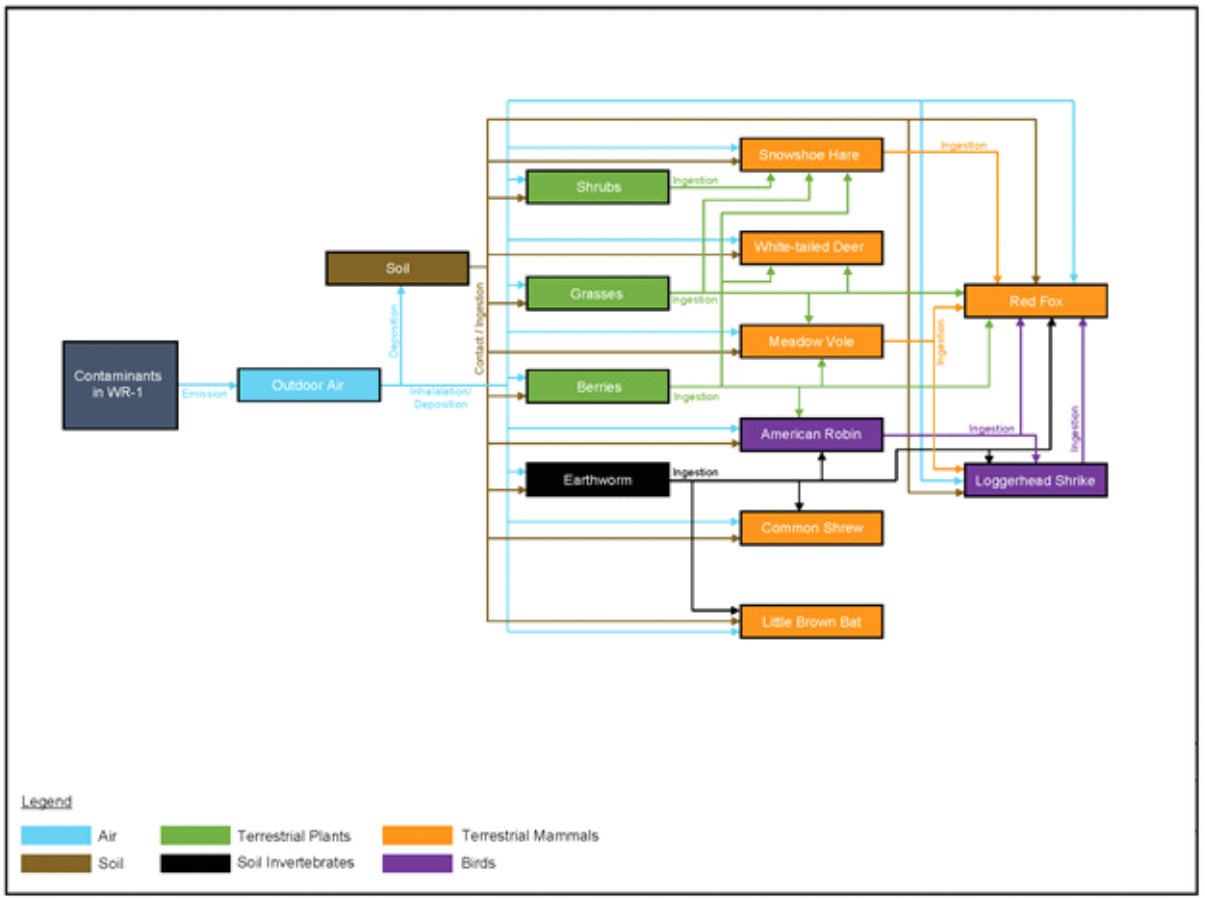
The software used for the exposure pathways analysis and for the calculation of radiological doses was IMPACT Version 5.5.1, which is consistent with the equations outlined in CSA N288.1-14 (CSA Group 2014) and the methods outlined in CSA N288.6-12 (CSA Group 2012). The Tool Qualification Report for IMPACT describes the verification and validation activities performed on IMPACT (EcoMetrix 2021).

Table 6.7.2-7: Exposure Pathways for Selected Valued Components during the Closure Phase

Receptor Category	Receptor	Exposure Pathways	Environmental Media
Terrestrial Invertebrates	Earthworm	Direct Contact	■ In Soil
Terrestrial Plants	Grasses/Shrubs	Direct Contact	■ On Soil
	Berries	Direct Contact	■ On Soil
Terrestrial Birds	American Robin	Direct Contact	■ On Soil
		Ingestion	■ Soil ■ Earthworms ■ Fruit/Berries
	Loggerhead Shrike	Direct Contact	■ On Soil
		Ingestion	■ Soil ■ Earthworms ■ American Robin ■ Meadow Vole
Terrestrial Mammals	Meadow Vole	Direct Contact	■ On Soil
		Ingestion	■ Soil ■ Grasses ■ Fruit/Berries
	Common Shrew	Direct Contact	■ On Soil
		Ingestion	■ Soil ■ Earthworms
	Snowshoe Hare	Direct Contact	■ On Soil
		Ingestion	■ Soil ■ Grasses ■ Fruit/Berries ■ Shrubs
	White-tailed Deer	Direct Contact	■ On Soil
		Ingestion	■ Soil ■ Grasses ■ Fruit/Berries
	Red Fox	Direct Contact	■ In and on Soil
		Ingestion	■ Soil ■ Grasses ■ Fruit/Berries ■ American Robin ■ Loggerhead Shrike ■ Meadow Vole ■ Snowshoe Hare
	Little Brown Myotis	Direct Contact	■ On Soil
		Ingestion	■ Soil ■ Earthworm

Note: Soil is considered to be clay as defined in the Hydrogeology Study Report (Dillon 2018)

PATH: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0015_EIS_Sec_6.7\20145046-0015-HL-0009_Figure 6_7_2-1 Ecological Conceptual Model for Closure Phase.mxd PRINTED ON: 2022-12-06 AT: 9:30:28 PM



REFERENCE(S)

CLIENT
CANADIAN NUCLEAR LABORATORIES

CONSULTANT
WSP GOLDER

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
ECOLOGICAL CONCEPTUAL MODEL FOR CLOSURE PHASE

MM-YYYY	DECEMBER 2022
DESIGNED	PR
PREPARED	RRD
REVIEWED	KL
APPROVED	MM

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Model Software

An environmental transport and pathways model was used to evaluate the effects of contaminants on the local environment including human and ecological receptors. The software used for the exposure pathways analysis and for the calculation of radiological doses was IMPACT Version 5.5.1, which is consistent with the equations outlined in CSA N288.1-14 (CSA Group 2014) and the methods outlined in CSA N288.6-12 (CSA Group 2012). The Tool Qualification Report for IMPACT describes the verification and validation activities performed on IMPACT. A more detailed description of the model is provided in the ERA (EcoMetrix 2021).

6.7.2.7.1.2 Results

A radiation dose benchmark of 0.1 mGy/hr (2.4 mGy/day) (UNSCEAR 2008) was selected for the WL assessment of effects on terrestrial biota (Table 6.7.2-8) as recommended in CSA N288.6-12 (CSA Group 2012). This is a total dose benchmark, therefore the dose to biota due to each radionuclide of concern is summed to compare against this benchmark.

Table 6.7.2-8: Summary of Total Dose during Closure Phase for Selected Valued Components

Ecological Receptor / Exposure Scenario	Dose (mGy/day)	Percent of Dose Benchmark
Demolition		
American Robin		
Demolition - Maximum	5.27×10^{-5}	<0.01%
Demolition - Average	1.39×10^{-5}	<0.01%
Loggerhead Shrike		
Demolition - Maximum	7.86×10^{-5}	<0.01%
Demolition - Average	2.07×10^{-5}	<0.01%
Meadow Vole		
Demolition - Maximum	9.71×10^{-6}	<0.01%
Demolition - Average	2.56×10^{-6}	<0.01%
Common Shrew		
Demolition - Maximum	4.84×10^{-5}	<0.01%
Demolition - Average	1.27×10^{-5}	<0.01%
Deer		
Demolition - Maximum	1.38×10^{-4}	<0.01%
Demolition - Average	3.62×10^{-5}	<0.01%
Rabbit		
Demolition - Maximum	1.70×10^{-3}	0.07%
Demolition - Average	4.48×10^{-4}	0.02%
Red Fox		
Demolition - Maximum	1.28×10^{-4}	<0.01%
Demolition - Average	3.37×10^{-5}	<0.01%

Table 6.7.2-8: Summary of Total Dose during Closure Phase for Selected Valued Components

Ecological Receptor / Exposure Scenario	Dose (mGy/day)	Percent of Dose Benchmark
Demolition (cont'd)		
Little Brown Bat		
Demolition - Maximum	1.50×10^{-5}	<0.01%
Demolition - Average	3.95×10^{-6}	<0.01%
Forage		
Demolition - Maximum	5.11×10^{-4}	0.02%
Demolition - Average	1.34×10^{-4}	<0.01%
Grass		
Demolition - Maximum	5.15×10^{-4}	0.02%
Demolition - Average	1.35×10^{-4}	<0.01%
Fruits		
Demolition - Maximum	3.95×10^{-5}	<0.01%
Demolition - Average	1.04×10^{-5}	<0.01%
Earthworm		
Demolition - Maximum	9.18×10^{-5}	<0.01%
Demolition - Average	2.41×10^{-5}	<0.01%
Grouting		
American Robin		
Grouting - Maximum	8.57×10^{-6}	<0.01%
Grouting – Average	4.82×10^{-6}	<0.01%
Loggerhead Shrike		
Grouting - Maximum	8.83×10^{-6}	<0.01%
Grouting – Average	4.93×10^{-6}	<0.01%
Meadow Vole		
Grouting - Maximum	8.04×10^{-6}	<0.01%
Grouting – Average	4.47×10^{-6}	<0.01%
Common Shrew		
Grouting - Maximum	8.98×10^{-6}	<0.01%
Grouting – Average	4.97×10^{-6}	<0.01%
Deer		
Grouting - Maximum	1.03×10^{-6}	<0.01%
Grouting – Average	5.71×10^{-6}	<0.01%
Rabbit		
Grouting - Maximum	1.06×10^{-6}	<0.01%
Grouting – Average	5.84×10^{-6}	<0.01%

Table 6.7.2-8: Summary of Total Dose during Closure Phase for Selected Valued Components

Ecological Receptor / Exposure Scenario	Dose (mGy/day)	Percent of Dose Benchmark
Grouting (cont'd)		
Red Fox		
Grouting - Maximum	7.31×10^{-6}	<0.01%
Grouting – Average	4.03×10^{-6}	<0.01%
Little Brown Bat		
Grouting - Maximum	4.49×10^{-6}	<0.01%
Grouting – Average	2.59×10^{-6}	<0.01%
Forage		
Grouting - Maximum	1.70×10^{-5}	<0.01%
Grouting – Average	9.46×10^{-6}	<0.01%
Grass		
Grouting - Maximum	2.54×10^{-5}	<0.01%
Grouting – Average	1.34×10^{-5}	<0.01%
Fruits		
Grouting - Maximum	5.74×10^{-6}	<0.01%
Grouting – Average	3.57×10^{-6}	<0.01%
Earthworm		
Grouting - Maximum	9.29×10^{-6}	<0.01%
Grouting – Average	5.44×10^{-6}	<0.01%

There are no exceedances of the 2.4 mGy/day radiation benchmark for terrestrial VCs on or near the WL site. All predicted doses are well below this level. Therefore, it is unlikely that there would be significant adverse effects on terrestrial populations or communities as a result of radionuclide releases from closure activities. For the closure phase, all predicted air concentration for non-radiological COPCs were below their relevant ambient air quality criteria (see Section 6.2.1.7.2 Application Case Results); therefore, no non-radiological COPCs were identified for the closure phase and no health effects are anticipated as a result of airborne effluent from the Project.

6.7.2.7.2 Application Case – Post-closure Phase

6.7.2.7.2.1 Methods

This section describes the specific methods used to assess the residual effects on ecological health, during the post-closure phase, for the Project activities and pathways identified in Table 6.7.1-5 Policies, guidelines and standards considered in the analysis, as well as the model used to predict residual effects are described.

Scenarios

Similar to the Human Health assessment, the ecological health assessment considered multiple scenarios including the Normal Evolution Scenario and Disruptive Events. These scenarios are described in Section 6.7.1.7.2.1. Only the WRDF Barrier Failure Disruptive Event was anticipated to interact with ecological health VCs. The Human Intrusion Disruptive Event would result in localized exposure to a person, and is unlikely to result in exposure to ecological health VCs. The Well in Plume Disruptive Events would result in human exposure to groundwater through drinking water. Ecological health VCs would not be exposed to well water.

Receptor Selection and Characterization

As described in Section 6.7.2.3, the focus for the post-closure phase is on aquatic and riparian VCs because releases are only expected via groundwater to surface water pathways. The following VCs are evaluated for the post-closure phase for the Normal Evolution Scenario and WRDF Barrier Failure Disruptive Event and rationale for their selection is provided in Table 6.7.2-2:

- barn swallow;
- little brown myotis;
- Carmine Shiner;
- Lake Sturgeon;
- Walleye;
- aquatic plants;
- benthic invertebrates;
- horned grebe;
- trumpeter swan;
- mallard
- moose; and
- mink.

Contaminants of Potential Concern

For the post-closure phase, no atmospheric releases are expected as the grouting will be completed and the above-grade building and components will have been removed. A concrete cap and engineered cover will have been installed on top of the buried material. During the first 100 years of the post-closure phase the site will be under institutional control. The main potential release mechanism during post-closure is via leakage through the WRDF to groundwater and subsequent migration of groundwater to surface water at the Winnipeg River.

Selection of Radiological COPCs

The radionuclides that are considered in the ERA for the post-closure phase included those that have been historically been found in WL's liquid effluent, are reasonably expected to be found in the WRDF and have the potential to migrate from groundwater to surface water during the post-closure phase (EcoMetrix 2021), or have been measured in river sediment. All radionuclides identified were carried forward quantitatively in the ERA. The radionuclides included for the post-closure scenario were:

- Actinium-225
- Actinium-227
- Americium-241;
- Americium-243;
- Silver-108m;
- Bismuth-210
- Carbon-14;
- Calcium-41;
- Chlorine-36;
- Curium-244;
- Cobalt-60;
- Caesium-137;
- Europium-152;
- Europium-154;
- Europium-155;
- Iron-55;
- Gadolinium-55
- Iodine-129;
- Niobium-94;
- Nickel-59;
- Nickel-63;
- Neptunium-237;
- Neptunium-237;
- Protactinium-231;
- Protactinium-233;
- Lead-210;
- Polonium-210;
- Plutonium-238;
- Plutonium-239;
- Plutonium-240;
- Plutonium-241;
- Radium-223:
- Radium-224;
- Radium-225;
- Radium-226;
- Radium-228;
- Strontium-90;
- Technetium-99;
- Thorium-227;
- Thorium-228;
- Thorium-229;
- Thorium-230;
- Thorium-231;
- Thorium-232;
- Thorium-234;
- Uranium-233;
- Uranium-234;
- Uranium-235;
- Uranium-236;
- Uranium-237;
- Uranium-238;
- Yttrium-90.

Selection of Non-Radiological COPCs

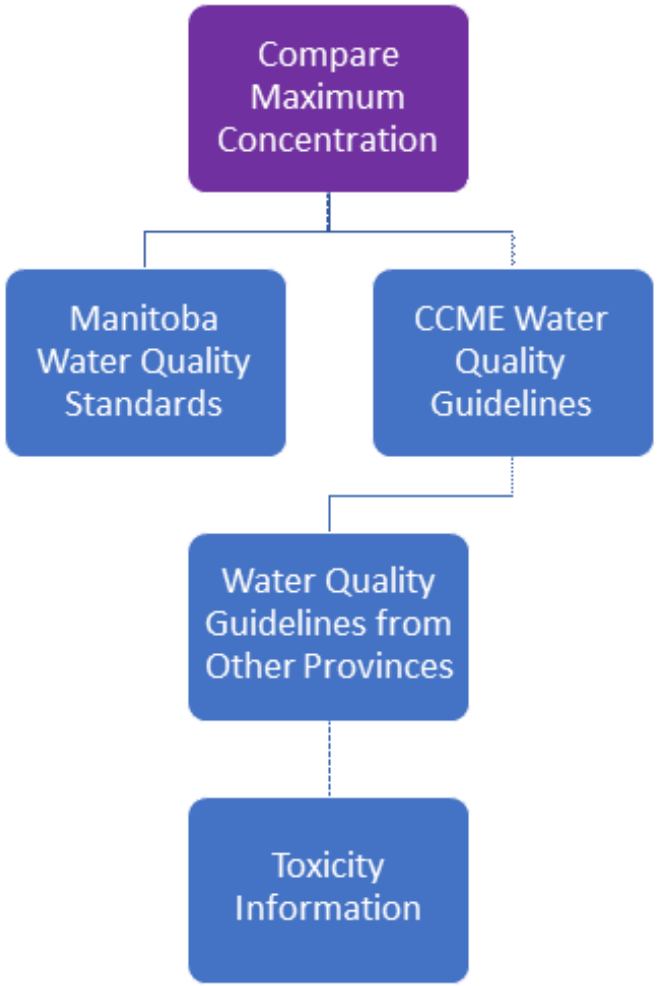
CNL has determined that a select number of non-radiological waterborne COPCs may potentially be released from the WL site during the post-closure phase (CNL 2017). These include:

- Boron;
- Cadmium;
- Chromium;
- HB-40;
- Mercury;
- Palladium;
- Potassium hydroxide; and
- Xylene.

The groundwater model predicted mass loadings for non-radiological contaminants from the WRDF to groundwater for the duration of the modelling assessment timeframe (500,000 years). Maximum mass loadings for each non--radiological parameter were converted to groundwater concentrations using the anticipated flowrate through the WRDF for the time period of maximum mass loadings. The maximum predicted groundwater concentrations were compared to available federal and provincial guidelines and objectives to determine potential COPCs relevant to ecological health. If there was no such guideline or objective, screening criteria were obtained from toxicity benchmarks (e.g., no effect levels) in the literature.

Non-radiological contaminants with maximum concentrations exceeding the selected benchmarks shown on Figure 6.7.2-2, were carried forward in this assessment. Based on the screening process, cadmium, lead, HB-40 and xylene were carried forward for further quantitative assessment in the ERA for the post-closure phase.

PATH: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0015_EIS_Sec_6.7\20145046-0015-HL-0010_Figure 6_7_2-2 Selection Process for Ecological Health Screening of Non-Radiologic.mxd PRINTED ON: 2022-12-06 AT: 9:30:29 PM



REFERENCE(S)

CLIENT
CANADIAN NUCLEAR LABORATORIES

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	PR
PREPARED	RRD
REVIEWED	NDR
APPROVED	MM

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
SELECTION PROCESS FOR ECOLOGICAL HEALTH SCREENING OF NON-RADIOLOGICAL COPCS

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0015	4	**6.7.2-2**

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Exposure Pathways

Exposure pathways include the routes of contaminant dispersion from the source to the receptor location and the routes of contaminant transport through the food chain or other media to the receptor organism. The post-closure phase is not expected to result in airborne effluent, as the grouting will have been completed, the above-grade building will have been completely decommissioned and a concrete cap and engineered cover will have been installed over the WRDF. The relevant chemical and radiological contaminants may be released via leakage through the grouting to groundwater and subsequent migration via groundwater to surface water at the Winnipeg River. Accordingly, the focus for the post-closure phase is on aquatic and riparian VCs because releases are only expected via groundwater to surface water pathways.

Exposure pathways for aquatic and riparian biota are described in Table 6.7.2-9 and illustrated on Figure 6.7.2-3. Exposure pathways include the routes of contaminant dispersion from the source to the receptor location and the routes of contaminant transport through the food chain or other media to the receptor organism. Airborne COPCs are not relevant during the post-closure phase. For fish and aquatic plants, contact with water and contaminant uptake from water via bioaccumulation represents the main exposure pathway. The dominant exposure pathways for birds and mammals are through the uptake of contaminants via the ingestion of water, incidental ingestion of soil or sediment and ingestion of food. The exposure pathways are the same for the Normal Evolution Scenario and the WRDF Barrier Failure Disruptive Event.

Table 6.7.2-9: Exposure Pathways for Selected Valued Components during the Post-closure Phase

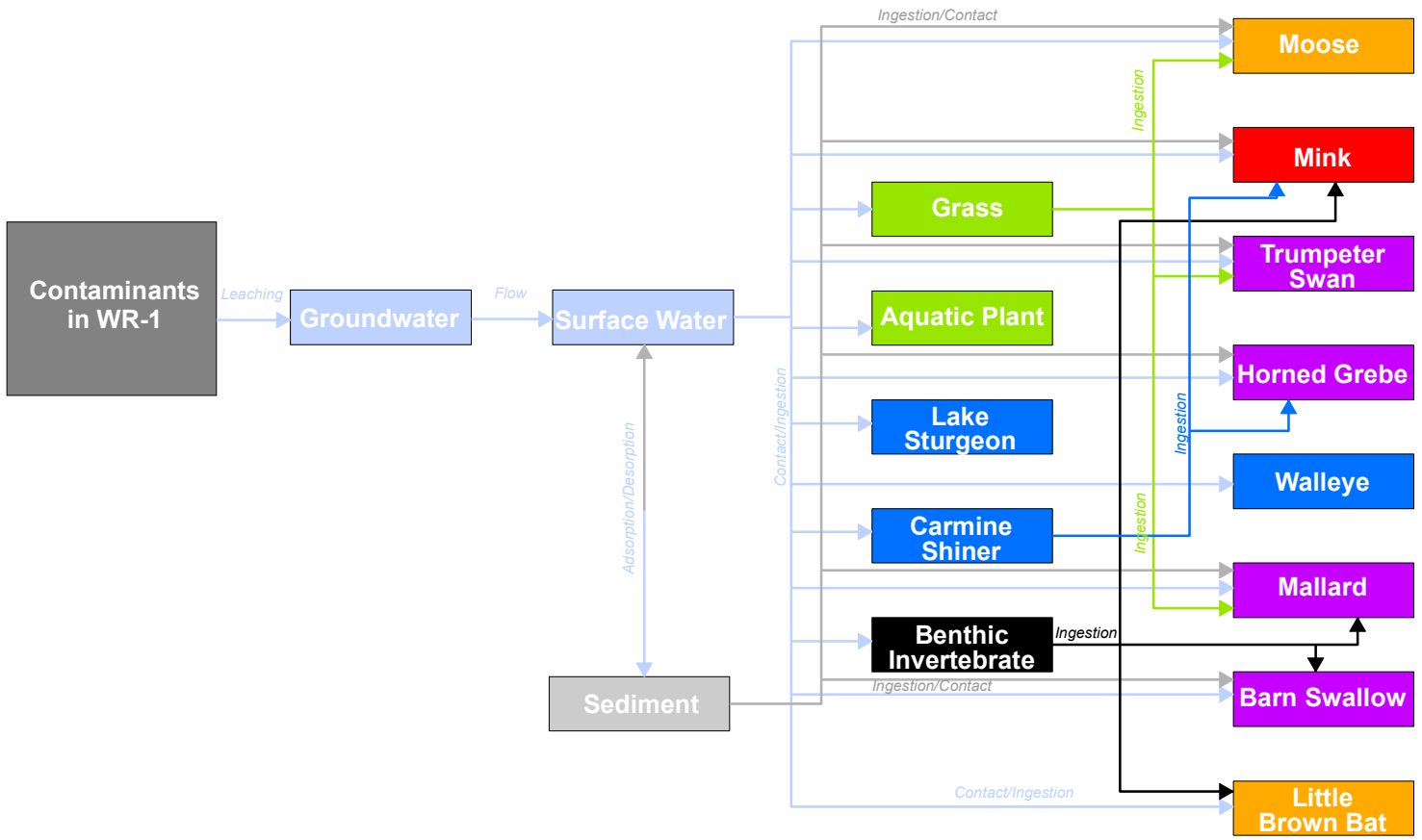
Receptor Category	Receptor	Exposure Pathways	Environmental Media
Bottom Feeding Fish	Lake Sturgeon	Direct Contact	■ In Water[(a)] ■ On Sediment
	Carmine Shiner	Direct Contact	■ In Water[(a)] ■ On Sediment
Pelagic Fish	Walleye	Direct Contact	■ In Water[(a)]
Aquatic Plants	Aquatic Plant	Direct Contact	■ In Water[(a)]
Aquatic Invertebrates	Benthic Invertebrate	Direct Contact	■ In Water[(a)] ■ In Sediment
Riparian Birds	Horned Grebe	Direct Contact	■ On Sediment
		Ingestion	■ Water ■ Sediment ■ Fish (forage) ■ Benthic Invertebrates
	Trumpeter Swan	Direct Contact	■ On Sediment
		Ingestion	■ Water ■ Sediment ■ Aquatic Plants
	Mallard	Direct Contact	■ On Sediment
		Ingestion	■ Water ■ Sediment ■ Benthic Invertebrates ■ Aquatic Plants

Table 6.7.2-9: Exposure Pathways for Selected Valued Components during the Post-closure Phase

Receptor Category	Receptor	Exposure Pathways	Environmental Media
Riparian Mammals	Mink	Direct Contact	■ On Sediment
		Ingestion	■ Water ■ Sediment ■ Benthic Invertebrates ■ Fish (forage)
Terrestrial Birds	Barn Swallow	Direct Contact	■ On Sediment
		Ingestion	■ Water ■ Sediment ■ Benthic Invertebrates
Terrestrial Mammals	Little Brown Myotis	Direct Contact	■ None
		Ingestion	■ Water ■ Benthic Invertebrates
	Moose	Direct Contact	■ On Sediment
		Ingestion	■ Water ■ Sediment ■ Aquatic Plants ■ Grasses

Note: Soil is considered to be clay as defined in the Hydrogeology Study Report (Dillon 2018)

a) The uptake calculated from a water concentration, using a bioaccumulation factor (BAF), implicitly represents uptake from all aquatic media, since water partitions to all media and all uptake pathways operate when a BAF is measured.



REFERENCE(S)

CLIENT
CANADIAN NUCLEAR LABORATORIES

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	PR
PREPARED	RRD
REVIEWED	KL
APPROVED	MM

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
ECOLOGICAL CONCEPTUAL MODEL FOR POST-CLOSURE PHASE

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0015	4	**6.7.2-3**

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Model Software

An environmental transport and pathways model was used to evaluate the effects of contaminants on the local environment including human and ecological receptors. The software used for the exposure pathways analysis and for the calculation of radiological doses was IMPACT Version 5.5.1, which is consistent with the equations outlined in CSA N288.1-14 (CSA Group 2014) and the methods outlined in CSA N288.6-12 (CSA Group 2012). The Tool Qualification Report for IMPACT describes the verification and validation activities performed on IMPACT. A more detailed description of the model is provided in the ERA (EcoMetrix 2021).

6.7.2.7.2.2 Results

Normal Evolution Scenario

The total doses are compared to dose benchmarks of 9.6 mGy/day for aquatic biota and 2.4 mGy/day for terrestrial and riparian biota (Table 6.7.2-10), respectively, as recommended in CSA N288.6-12 (CSA Group 2012). This is a total dose benchmark, therefore the dose to biota due to each radionuclide of concern is summed to compare against this benchmark.

Table 6.7.2-10: Summary of Total Dose during the Post-closure Phase for Select Valued Components

Ecological Receptor / Exposure Scenario	Dose (mGy/day)	Percent of Dose Benchmark
Barn Swallow	8.13×10^{-6}	<0.01%
Little Brown Bat	6.58×10^{-6}	<0.01%
Carmine Shiner	1.14×10^{-4}	<0.01%
Lake Sturgeon	1.14×10^{-4}	<0.01%
Walleye	4.10×10^{-6}	<0.01%
Freshwater plant	4.26×10^{-6}	<0.01%
Benthic Invertebrate	5.77×10^{-4}	<0.01%
Benthic Invertebrate (Groundwater)	5.71×10^{0}	55.52%
Horned Grebe	1.55×10^{-4}	<0.01%
Trumpeter Swan	1.53×10^{-4}	<0.01%
Wild Waterfowl	1.52×10^{-4}	<0.01%
Mink	1.54 x 10-4	<0.01%
Moose	1.01×10^{-5}	<0.01%

mGy/day = milligrays per day.

There are no exceedances of the 9.6 mGy/day radiation benchmark for the aquatic biota in the Winnipeg River. Similarly, there are no exceedances of the 2.4 mGy/day radiation benchmark for terrestrial and riparian biota on or near the WL site. All predicted doses are well below these levels. Therefore, it is unlikely that there would be significant adverse effects on either aquatic or terrestrial populations or communities as a result of radionuclide releases from post-closure activities.

The HQs for non-radiological COPCs for aquatic receptors are presented in Table 6.7.2-11 and the HQs for mammals and birds are presented in Table 6.7.2-12.

Table 6.7.2-11: Non-Radiological Hazard Quotients for Aquatic Valued Components

Parameter	Benthic Invertebrates (unitless)	Benthic Invertebrates in Groundwater (unitless)	Fish (unitless)	Aquatic Plants (unitless)
Cadmium	6.69×10^{-2}	**3.57×10^{1}**	5.90×10^{-3}	5.02×10^{-3}
HB-40	1.96×10^{-4}	**2.92×10^{1}**	4.56×10^{-6}	8.35×10^{-6}
Lead	2.12×10^{-1}	**5.93×10^{0}**	1.38×10^{-1}	5.20×10^{-3}
Xylene	4.18×10^{-6}	6.96×10^{-1}	1.56×10^{-7}	1.07×10^{-7}

Note:
Bold and shaded values indicate a HQ greater than 1.

Table 6.7.2-12: Non-Radiological Hazard Quotients for Birds and Mammal Valued Components

Parameter	Barn Swallow (unitless)	Horned Grebe (unitless)	Trumpeter Swan (unitless)	Wild Waterfowl (unitless)	Little Brown Myotis (unitless)	Mink (unitless)	Moose (unitless)
Cadmium	5.36×10^{-5}	1.85×10^{-5}	9.87×10^{-4}	1.22×10^{-3}	4.97×10^{-5}	1.92×10^{-5}	1.82×10^{-3}
HB-40	NV	NV	NV	NV	2.04×10^{-3}	1.04×10^{-3}	1.00×10^{-4}
Lead	6.87×10^{-3}	2.15×10^{-3}	4.54×10^{-2}	5.65×10^{-2}	3.58×10^{-4}	1.42×10^{-4}	5.90×10^{-5}
Xylene	3.46×10^{-6}	1.21×10^{-6}	2.06×10^{-7}	5.37×10^{-7}	2.57×10^{-7}	9.96×10^{-8}	2.98×10^{-8}

Note:
NV = no value available to calculate HQ.

There are no exceedances of the HQs identified for exposure of the ecological receptors to cadmium, lead, HB-40 (with the exception of benthic invertebrates in groundwater) and xylene. Therefore, no significant adverse effects on either aquatic or terrestrial populations or communities as a result of these chemical releases are predicted.

The HQs for cadmium, lead and HB-40 exceeded 1 for the scenario where benthic invertebrates are exposed directly to groundwater. However, this does not necessarily imply a significant adverse effect. The assumption of direct exposure to undiluted groundwater is conservative because a diffusion gradient will exist across the sediment-water interface, resulting in some degree of dilution into the top layer of sediment where most benthic organisms reside. Moreover, the seepage area represents a small part of the benthic community habitat, and the maximum groundwater concentration assumed represents the worst-case time period. As such, benthic invertebrates may not be at risk due to cadmium, lead and HB-40 exposure, and any adverse effects will be spatially and temporally limited, such that the community as a whole is not expected to be significantly affected. Overall, no significant adverse effects on terrestrial populations or communities as a result of these chemical releases are predicted. Additional recommendations on monitoring are discussed in Section 6.7.2.10.

There were no data to determine HB-40 benchmarks for birds. As such there is uncertainty around the potential health risks to birds due to HB-40 exposure. Nevertheless, considering that the major constituent of HB-40 (e.g., hydrogenated terphenyl) is closely related to the aromatic hydrocarbon group and that petroleum hydrocarbons are metabolized by vertebrates (CCME 2008), it can be suggested that exposure of birds to HB-40 is likely to be limited because HB-40 will be readily metabolized by birds and therefore is not anticipated to accumulate. In addition, assuming that birds are similar to mammals in terms of HB-40 toxicity, if the HB-40 TRV for mammals is used for birds, all bird doses are far below the TRV. This assumption is considered reasonable, as the thresholds for Birds and Mammals are similar for the other COPCs (same order of magnitude), and the

HQs calculated for mammals are all well below the HQ limit of 1. This provides confidence that there will not likely be any impacts to birds, based on the low exposure levels predicted in the assessment.

Disruptive Events – WRDF Barrier Failure

As indicated in Section 6.7.2.7.2.1, the only Disruptive Event expected to interact with ecological health VCs is the WRDF Barrier Failure. Radiation dose benchmarks of 2.4 mGy/day (UNSCEAR 2008) for terrestrial and riparian biota and 9.6 mGy/day for aquatic biota were used to evaluate effects to ecological receptors. These are total dose benchmarks, therefore the dose to biota due to each radionuclide of concern is summed to compare against this benchmark. All predicted doses are well below these levels indicating that no adverse residual effects are expected. Therefore, it is unlikely that there would be significant adverse effects on either aquatic or terrestrial populations or communities as a result of radionuclide releases under a barrier failure scenario (Table 6.7.2-13).

Table 6.7.2-13: Summary of Post-closure Total Dose for Ecological Receptors under Barrier Failure Conditions

Ecological Receptor	Dose (mGy/day)	Percent of Dose Benchmark
Barn Swallow	8.28×10^{-6}	<0.01%
Little Brown Bat	6.70×10^{-6}	<0.01%
Carmine Shiner	1.14×10^{-4}	<0.01%
Lake Sturgeon	1.14×10^{-4}	<0.01%
Walleye	4.17×10^{-6}	<0.01%
Freshwater plant	4.34×10^{-6}	<0.01%
Benthic Invertebrate	5.77×10^{-4}	<0.01%
Horned Grebe	1.55×10^{-4}	<0.01%
Trumpeter Swan	1.53×10^{-4}	<0.01%
Wild Waterfowl	1.52×10^{-4}	<0.01%
Mink	1.54×10^{-4}	<0.01%
Moose	1.02×10^{-5}	<0.01%

The risk to ecological receptors that could be exposed to the non-radiological contaminants identified as potentially occurring at elevated concentrations (i.e., cadmium and lead) during post-closure in a WRDF barrier failure scenario were calculated based on total concentration (background plus Project contribution). Hazard quotients are summarized in Table 6.7.2-14. For the ecological health assessment, the HQ benchmark is 1, all calculated HQs were below 1% of protective HQ benchmark (i.e., all below 0.01). All predicted exposures are well below protective benchmark values, therefore, no adverse effects to human or ecological receptors are anticipated from a barrier failure.

Table 6.7.2-14: Summary of Hazard Quotients for Ecological Receptors under Barrier Failure Conditions

Receptor	Cadmium	HB-40	Lead	Xylene
Benthic Invertebrates	6.69×10^{-2}	2.00×10^{-4}	2.12×10^{-1}	4.44×10^{-6}
Fish	5.90×10^{-3}	4.65×10^{-6}	1.38×10^{-1}	1.66×10^{-7}
Aquatic Plants	5.02×10^{-3}	8.50×10^{-6}	5.20×10^{-3}	1.14×10^{-7}
Barn Swallow	5.36×10^{-5}	NV	6.87×10^{-3}	3.68×10^{-6}
Horned Grebe	1.85×10^{-5}	NV	2.15×10^{-3}	1.29×10^{-6}
Trumpeter Swan	9.87×10^{-4}	NV	4.54×10^{-2}	2.19×10^{-7}
Wild Waterfowl	1.22×10^{-3}	NV	5.65×10^{-2}	5.71×10^{-7}
Little Brown Myotis	4.97×10^{-5}	2.07×10^{-3}	3.58×10^{-4}	2.73×10^{-7}
Mink	1.92×10^{-5}	1.23×10^{-4}	1.42×10^{-4}	1.22×10^{-8}
Moose	1.82×10^{-3}	1.02×10^{-4}	5.90×10^{-3}	3.16×10^{-8}

Note:
NV = no value available to calculate HQ.

6.7.2.8 Prediction Confidence and Uncertainty

The ERA assumptions are conservative to accommodate inherent uncertainties in the modelling and meet the objective of protecting ecological health during the closure and post-closure phases. The conceptual model for ecological health is considered to be complete for the majority of ecological exposures in the vicinity of the WL site. The comprehensive selection of COPCs and receptors is expected to represent all important exposures to contaminants in the vicinity of the WL site.

There is uncertainty in the estimated inventory of radioactive and non-radioactive material that could be present within the WR-1 Building. The estimated inventory of WR-1 and its associated systems were derived by two general methods; physical samples, and computer models. Computer models formed the basis of the inventory estimate and were supplemented by physical sample characterization data to fill gaps and validate model estimates. In all cases, the most conservative results of either the physical samples or computer models were used to derive the final inventory estimate. Each estimation method also included aspects of conservatism in their individual approaches, contributing further to the conservatism built into the final inventory estimate. This compounded conservatism is based on physical data specific to WR-1 and provides an appropriate level of realism to the estimate.

There is also uncertainty in how long each closure activity will take (e.g., how long it will take to grout the heavy water moderator system). As such, there is uncertainty in the COPC release rates to the atmosphere and geosphere. To address this uncertainty, appropriate assumptions are integrated into the model to provide an appropriate level of conservatism. For example, although the duration of demolition prior to grouting may be carried out in 1 to 2 months, it has been conservatively assumed that it will occur for 6 months. Prior to the execution of closure activities, system characterizations and radiological surveys will be completed to inform detailed work planning. This work will provide greater accuracy; however, it is expected that any variation would be well encompassed by the conservatism build into the model.

The IMPACT model was used to predict dose to identified ecological receptors during the closure phase. The IMPACT model used was a steady state model; however, it included time dependent equations to account for buildup in soil from irrigation, for all radionuclides released. Uncertainties in predictions of media concentrations arise from inherent uncertainty in the air model in IMPACT. The model reports an average concentration, and

typically over-predicts this concentration by a factor of 1.5. Considering the conservatism in the estimation of releases, and in the air model, it is reasonable to conclude that doses arising from closure activities have not been underestimated.

There are uncertainties associated with the components contributing to the overall risk assessment. This includes receptor exposure factors, such as transfer factors, intake rates and bioaccumulation factors and dose coefficients, as well as benchmark values used to determine risk of potential effects. Overall, considering uncertainties in the exposure assessment and in the benchmark values, the risk characterization has been undertaken in a manner that has not underestimated risk; the results are either overestimates or realistic estimates of risk, both of which are considered acceptable.

Exposure factors were based on best-available information from literature with preference for exposure factors identified in CSA N288.1-14. For parameters that did not have exposure factors in CSA N288.1-14, surrogate parameters were identified based on proximity in the periodic table, which is considered appropriate. Since the exposure assessment is predictive, BAFs were used to calculate uptake into tissues. The BAFs used for the exposure assessment were taken from reputable sources (e.g., CSA N288.1-14) and are considered to be representative of the conditions found at the site. Wildlife exposure factors, such as intake rates and diets, are a potential source of uncertainty. Reputable sources are used for these factors and they are considered to be representative for the organisms assessed.

Dose coefficients were obtained from reputable sources for reference organisms (ICRP 2008; ERICA Tool 2016) but have not been derived specifically for all the organisms assessed. Dose coefficients for surrogate organisms were often used. They were selected with attention to similar body size and exposure habits, and are believed to adequately represent the organism assessed. Dose coefficients for each receptor were not adjusted for body size and dimensions.

Uncertainties in the exposure assessment include the representativeness of the predicted concentrations used in the assessment at each location. Maximum predicted concentrations of COPCs were used for each location and environmental medium as an upper bound on exposure. These values are, by definition, not representative for mobile organisms that can move around the site, effectively averaging their exposure concentrations. Maximum values are representative for exposures of any sessile organisms that reside at the location of the maximum value. Therefore, maximum concentrations are considered to overestimate exposure for all mobile receptors.

The uncertainties from the exposure assessment include model uncertainty and uncertainty in the exposure factors selected. The uncertainties from the toxicity assessment include conservatisms built into the radiation dose constraint. Taken together, the approaches to exposure and toxicity assessment have ensured that the characterization of dose and risk has been undertaken in a manner that has not underestimated dose or risk.

6.7.2.9 Residual Effects Classification and Determination of Significance

The residual effects analysis methods for the EcoRA are different from those used by other VCs. Specifically, the assessment of potential effects to ecological health VCs results in the generation of risk factors that inherently consider the geographic extent, duration, frequency and other characteristics of the predicted changes to the environment that may result from Project activities. As such, these inherent attributes cannot be used to determine environmental significance, as they can with other components. Instead, significance for ecological health is evaluated based on: (i) the potential magnitude of the response, as indicated by the comparison to benchmarks and (ii) the degree of conservatism and uncertainty in the analysis.

There are no exceedances of the 2.4 mGy/day radiation benchmark for terrestrial VCs on or near the WL site for the closure phase. All predicted doses are well below this level. Therefore, it is unlikely that there would be significant adverse effects on terrestrial populations or communities as a result of radionuclide releases from closure activities. For the closure phase, all predicted air concentration for non-radiological COPCs were below their relevant ambient air quality criteria; therefore, no non-radiological COPCs were identified for the closure phase and no health effects are anticipated as a result of airborne effluent from the Project during the closure phase.

There are no exceedances of the 9.6 mGy/day radiation benchmark for the aquatic biota in the Winnipeg River during the post-closure phase. Similarly, there are no exceedances of the 2.4 mGy/day radiation benchmark for terrestrial and riparian biota on or near the WL site. All predicted doses are well below these levels for the post-closure phase. Therefore, it is unlikely that there would be significant adverse effects on either aquatic or terrestrial populations or communities as a result of radionuclide releases from post-closure activities.

There are no exceedances of the HQs identified for exposure of the ecological receptors to cadmium, lead, HB-40 (with the exception of benthic invertebrates in groundwater) and xylene. Therefore, no significant adverse effects on either aquatic or terrestrial populations or communities as a result of these chemical releases are predicted.

The HQs for cadmium, lead and HB-40 exceeded 1 for the scenario where benthic invertebrates are exposed directly to groundwater. However, this does not necessarily imply a significant adverse effect. The assumption of direct exposure to undiluted groundwater is conservative because a diffusion gradient will exist across the sediment-water interface, resulting in some degree of dilution into the top layer of sediment where most benthic organisms reside. Moreover, the seepage area represents a small part of the benthic community habitat, and the maximum groundwater concentration assumed represents the worst-case time period. As such, benthic invertebrates may not be at risk due to cadmium, lead and HB-40 exposure, and any adverse effects will be spatially and temporally limited, such that the community as a whole is not expected to be significantly affected.

For the WRDF Barrier Failure Disruptive Event, all predicted radiological and non-radiological doses are well below their respective protective benchmark values indicating that no adverse residual effects are expected. Therefore, it is unlikely that there would be significant adverse effects on either aquatic or terrestrial populations or communities as a result of radionuclide and non-radionuclide releases under a barrier failure scenario.

6.7.2.10 Monitoring and Follow-up

As part of the CNL's licence (NRTEDL-W5-8.00/2024), environmental monitoring of the WL site is required. It is anticipated that for closure, the monitoring at the WL site and surrounding area will continue in accordance with CNL's existing Environmental Monitoring Program. This includes sampling and analysis of ambient air, surface water and groundwater, including the Winnipeg River, sediment, vegetation, garden produce, game animals and fish. CNL's Environmental Monitoring Program includes assessment of dose to members of the public, based on emissions monitoring and measurements in environmental media. Additionally, the dose to workers at WL is monitored and reported to the CNSC annually. As decommissioning of the site proceeds the environmental monitoring for the site is anticipated to evolve to reflect the creation, removal or limitation of hazards during the institutional control period.

CNL will implement an Environmental Assessment Follow-up Program for the Project to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented, identify any unanticipated effects and provide for the implementation of adaptive management to limit these effects, if required. This monitoring will be integrated with that for the existing Environmental Assessment Follow-up Program at the

WL site, where practical. The Environmental Assessment and Follow-up Program for the Project will be undertaken during the closure and post-closure phases. Once the WL site has been decommissioned, monitoring to support institutional control will continue, as well as any other requirements identified in the Environmental Assessment and Follow-up Program for the Project.

CNL has committed to working collaboratively with the First Nations and the Manitoba Métis Federation to support the Indigenous Nations to participate in environmental monitoring at the WL site. Some of the key elements of the initiative may include expansion and evolution of the monitoring program at WL, through incorporation of feedback, recommendations, Traditional Knowledge, capacity development, including training in environmental monitoring, and opportunities for monitors from each First Nation and the Red River Métis to collect samples on site and in the surrounding area. For example, CNL has had discussions with First Nations and the Manitoba Métis Federation on how future monitoring on the WL site could incorporate Indigenous interests, such as fish species of interest, and traditional knowledge. The goal of the initiative is to help address concerns regarding protection of the environment, health of people, confidence in the health of country foods and stigma associated with the Project.

It is noted that data generated by the monitoring program will be evaluated on an ongoing basis within an adaptive management framework. Modifications to the program may be appropriate to confirm data continue to fulfill program objectives. For example, should a contaminant of potential concern reach concentrations outside the range predicted in the EIS or Decommissioning Safety Assessment Report, including the findings from the Environmental Risk Assessment, the frequency of sampling may be increased and additional locations may be sampled to investigate the source of the increased concentrations. Conversely, cessation of a monitoring activity might be appropriate once it has been shown that an effect has stabilized, or has been reduced to a level where it is no longer considered significant with respect to regulatory requirements or community concerns. Any proposals for modifications to the monitoring program, and the rationale for the modifications will be communicated to the CNSC prior to implementation.

The Environmental Assessment Follow-up Program for the Project will expand on the regulatory requirements of *CSA N288.5-11: Effluent Monitoring Programs at Class 1 Nuclear Facilities and Uranium Mines and Mills* (CSA Group 2011) for the management of emissions from the Project. For a comprehensive summary of the monitoring and follow-up recommendations made based on the results of the environmental assessment refer to Section 11.0.0 Summary of Monitoring and Follow-up Programs. Table 6.7.2-15 outlines the monitoring and follow up programs for ecological health.

Table 6.7.2-15: Monitoring and Follow up Programs for Ecological Health

Valued Component	Project Phase, Potential Effect and Conceptual Monitoring Program	Monitoring Program Objective	Suggested Duration	Implementing Program
Ecological Health	**Potential Source(s) of Effects:** ■ Closure activities will result in the release of airborne effluent from the WR 1 Building which could affect ecological health. ■ Release of solutes into the groundwater as the grout and reactor components gradually deteriorate over time during the post-closure phase may cause changes in groundwater quality which could migrate towards the Winnipeg River and affect receptors along the Winnipeg River. **Proposed Monitoring:** ■ Monitoring for air quality as noted above (i.e., for dust). ■ Verification monitoring for tritium in air (post venting through the WR-1 stack). ■ Passive tritium in air network monitoring (semi-annual change out) will be included as part of the Environmental Assessment Follow-up Program for the Project. Monitoring locations (approximately 4 of them) will be selected to be within the main upriver and downriver windrose sectors, at the site boundary and on-site mainly to monitor airborne tritium plumes potentially originating from the WRDF. ■ Estimate combustible gases (e.g., based on project-related traffic and equipment), as per atmospheric environment above; ■ Monitor contaminants of concern (e.g., lead, asbestos, tritium) in air displaced from grouting the below-grade structure, as per the atmospheric environment above. ■ Groundwater monitoring surrounding the Whiteshell Reactor Disposal Facility, as noted above. ■ Surface water quality monitoring in the Winnipeg River, as noted above. **Trigger for Further Action:** ■ Investigation if parameters are above applicable guidelines identified.	■ Verify effects predictions related to air quality, groundwater quality and surface water quality to confirm no health effects are anticipated as a result of exposure to COPCs from the Project. ■ Verify mitigation is effective.	■ Dust monitoring would be initiated during the closure phase. ■ WL currently conducts industrial hygiene assessments of lead, asbestos and mould within facilities as part of the decommissioning planning process. ■ Monitoring of tritium in air will be initiated when the stack monitoring system is discontinued. This monitoring would be on-going during post-closure. The need for and duration of monitoring will be assessed based on annual review of monitoring data. ■ Groundwater and surface water quality monitoring would be on-going during closure and post-closure. The need for and duration of monitoring will be assessed based annual review of monitoring data.	■ Air quality monitoring for the Project will be captured through the implementation of CNL's WL Effluent Verification and WL Environmental Monitoring Programs. ■ Groundwater monitoring for the Project will be integrated into the overall CNL WL Groundwater Monitoring Program. ■ Surface water monitoring in the receiving environment is already completed through CNL's WL Environmental Monitoring Program. No new surface water quality monitoring is proposed for the Project.

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6.7.2.11 Conclusions

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). It is generally an impractical task to assess the effect of radiological and non--radiological emissions on all the species of biota within a natural ecosystem, and specifically within the ecosystem around the WL site. Therefore, representative organisms are chosen for dose and risk analysis. These organisms are selected because they are known to exist on the site and are representative of major taxonomic groups or exposure pathways, or have a special importance or value. For example, based on feedback from Indigenous peoples during engagement activities, moose was added as a VC to the ecological health assessment given the species importance to Indigenous people.

Assessment endpoints are qualitative expressions used to assess the significance of residual effects on VCs and represent the key properties of the VC that should be protected for future human generations (i.e., incorporates sustainability). The assessment endpoint is the protection of ecological health. Measurement endpoints represent properties of the environment, that when changed, could result in or contribute to an effect on an assessment endpoint. Measurement endpoints for the EcoRA include changes in air quality, groundwater quality, surface water quality, sediment quality, soil quality and vegetation.

An environmental transport and pathways model was used to evaluate the effects of contaminants on the local environment including ecological receptors. During closure, the focus is on terrestrial VCs because releases are only expected via atmospheric pathways. During post-closure phase, the focus is on aquatic and riparian VCs, because releases are only expected via groundwater to surface water pathways.

Results of the radiological dose assessment for the closure and post--closure phases indicate that doses to ecological health VCs are below their respective benchmark values. In addition, there are no exceedances of the HQs identified for exposure of the ecological receptors to cadmium, lead, HB-40 (with the exception of benthic invertebrates in groundwater) and xylene. Therefore, no significant adverse effects on either aquatic or terrestrial populations or communities as a result of these chemical releases are predicted.

The HQs for cadmium, lead and HB-40 exceeded 1 for the scenario where benthic invertebrates are exposed directly to groundwater; however, this does not necessarily imply a significant adverse effect. The assumption of direct exposure to undiluted groundwater is conservative and the seepage area represents a small part of the benthic community habitat, and the maximum groundwater concentration assumed represents the worst-case time period. As such, benthic invertebrates may not be at risk due to cadmium, lead and HB-40 exposure, and any adverse effects will be spatially and temporally limited, such that the community as a whole is not expected to be significantly affected.

For the WRDF Barrier Failure Disruptive Event, all predicted radiological and non-radiological doses are well below their respective protective benchmark values indicating that no adverse residual effects are expected. Therefore, it is unlikely that there would be significant adverse effects on either aquatic or terrestrial populations or communities as a result of radionuclide and non-radionuclide releases under a barrier failure scenario.

The uncertainties from the exposure assessment include model uncertainty and uncertainty in the exposure factors selected. The uncertainties from the toxicity assessment include conservatisms built into the radiation dose constraint. Taken together, the approaches to exposure and toxicity assessment have ensured that the characterization of dose and risk has been undertaken in a manner that has not underestimated dose or risk.

A key concern of Indigenous peoples was long-term effects of the Project on fish, plants and wildlife important to Indigenous peoples. Overall, residual effects from radiological and non-radiological COPCs are considered to be not significant for all ecological VCs during the closure and post-closure phases.

Indigenous peoples have interest in the current and future monitoring proposed for the Project. CNL will implement an Environmental Assessment Follow-up Program for WR-1 to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. CNL will implement an Environmental Assessment Follow-up Program for the Project as identified for other environmental components to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. This monitoring will be integrated with that for the existing Environmental Assessment Follow-up Program for the WL site, where practical.

As part of CNL's licence (NRTEDL-W5-8.00/2024), environmental monitoring of the WL site is required. It is anticipated that for closure, the monitoring at the WL site and surrounding area will continue to proceed in accordance with CNL's existing Environmental Monitoring Program. This includes sampling and analysis of ambient air, surface water and groundwater, including the Winnipeg River, sediment, vegetation, garden produce, game animals and fish. These activities will verify effects predictions for ecological health.

6.8 Land and Resource Use

This section of the Environmental Impact Statement (EIS) for the Canadian Nuclear Laboratories (CNL) In Situ Decommissioning of WR-1 at the Whiteshell Laboratories Site (the Project) seeks to understand and characterize the potential residual effects of the Project and past, present, and reasonably foreseeable developments on traditional land and resource use (Section 6.8.1) and other land and resource use (Section 6.8.2).

6.8.1 Traditional Land and Resource Use

The assessment of traditional land and resource use considers traditional land and resource use activities in proximity to the Project, including hunting, trapping, and gathering by Indigenous Peoples, archaeological and cultural sites, and the overall importance of the Winnipeg River.

6.8.1.1 Scope of the Assessment

The assessment on traditional land and resource use follows the overall environmental assessment approach and methods described in Section 6.1 Environmental Assessment Approach. The assessment is completed in the following steps.

- **Step 1 – Identify Valued Components (VCs) and define the spatial boundaries, temporal boundaries and assessment cases** (refer to Sections 6.8.1.3 Valued Components and Section 6.8.1.4 Assessment Boundaries) for the assessment of traditional land and resource use. The VCs, the assessment endpoints and measurement indicators used to assess the Project related changes to traditional land and resource use; the spatial and temporal boundaries at which the assessment occurred; and the assessment cases considered.
- **Step 2 – Describe the existing conditions** (refer to Section 6.8.1.5 Description of the Environment). Existing conditions in the local and regional areas are described, including the combined effects of previous and existing developments (Base Case). The existing conditions present historical (to the extent information is available) and current traditional land and resource use and the associated conditions that affected current traditional land and resource use practices (e.g., industrial development, legislation).
- **Step 3 – Evaluate Project interactions and mitigation** (refer to Section 6.8.1.6 Project Interactions and Mitigation). Project components and/or activities with the potential to affect traditional land and resource use are identified and mitigation options are presented to limit or avoid effects. A pathways analysis is then used to focus on key interactions between the Project and the environment and determine if mitigation can limit or eliminate the predicted residual effects. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. Where effects are adequately mitigated and are not forwarded for further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are described. Primary pathways that may lead to residual effects to traditional land and resource use after incorporating mitigation are carried forward to Step 4 for further analysis and residual effects characterization.
- **Step 4 – Present the methods and results of the residual effects analysis**. This step was not required as no primary pathways were identified in the traditional land and resource use assessment.
- **Step 5 – Describe the level of certainty and management of uncertainty.** This step was not required as no primary pathways were identified in the traditional land and resource use assessment.

- **Step 6 – Classify and determine the significance of the predicted residual effects**. This step was not required as no primary pathways were identified in the traditional land and resource use assessment.
- **Step 7 – Identifying monitoring and follow-up** (refer to Section 6.8.1.7 Monitoring and Follow-up) required to confirm effects predictions and address uncertainty.
- **Step 8 – Present a consolidated summary of conclusions and outcomes of the assessment** (refer to Section 6.8.1.8 Conclusions) on traditional land and resource use.

6.8.1.2 Indigenous Engagement Feedback – Key Interests and Concerns

Interests and concerns raised by Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations during engagement related to the traditional land and resource use assessment are summarized in Table 6.8.1.2-1. Other general concerns and questions raised during Indigenous engagement activities are documented in Section 4.0 Indigenous Engagement.

Table 6.8.1.2-1: Summary of Key Interests and Concerns Raised During Indigenous Engagement Activities Related to the Traditional Land and Resource Use Assessment

Interest and Concern	Inclusion Status	Additional Information and Rationale
Effects to the Winnipeg River as an important location for traditional land and resource use.	Already included in the environmental assessment.	The Winnipeg River was included as a valued component, and potential effects on it are considered in sections 6.4.1 Surface Water Quality and 6.5 Aquatic Environment.
Cumulative effects on surface water quality, fish and fish habitat, wild rice, berries, medicinal and food plants, and animals as it supports traditional way of life, traditional land and resource use, and harvesting rights.	Already included in the environmental assessment. Section 6.8.1.5.2.2 Traditional Land and Resource Use by Indigenous Peoples has been updated to include a description of how traditional land and resource use activities have changed in response to past historical events and external pressures, which has been summarized from the Traditional Knowledge and Land Use Studies.	CNL has helped to fund four Traditional Knowledge and Land Use Studies with six Indigenous Nations. The results of these studies and continued dialogue with Indigenous Nations is described in Sections 6.8.1.5.2.2 Traditional Land and Resource Use by Indigenous Peoples and 6.8.1.6 Project Interactions and Mitigation. Section 6.4.2 Surface Water Quality, Section 6.5 Aquatic Environment, and Section 6.8.1.6 Project Interactions and Mitigation describes existing conditions for and Project effects to surface water quality, fish and fish habitat, and wild rice, medicinal plants and animals, respectively. Participation in monitoring going forward is described in Section 6.8.1.7 Monitoring and Follow-up.

Table 6.8.1.2-1: Summary of Key Interests and Concerns Raised During Indigenous Engagement Activities Related to the Traditional Land and Resource Use Assessment

Interest and Concern	Inclusion Status	Additional Information and Rationale
Future Land Use, including how much of the current site will be available for use and return of traditional lands to Indigenous Nations, to be considered collaboratively with Indigenous Nations (i.e., change the proportion of the site that will have restrictions on use)	Already included in the environmental assessment. The commitment by CNL to determine the future use of the WL site, including collaboration with Indigenous Nations has been added to Section 6.8.1.6.2 Results.	Changes to access restrictions associated with the WL site end state as a result of the Project are described in Section 6.8.1.6.2 Results.
Impacts on Future Land Use caused by fear, stigma and associated alienation, due to the creation of a permanent radioactive waste disposal facility through ISD, and associated psycho-social impacts on Indigenous peoples.	Suitability of the site for future uses is assessed in Section 6.8.1.6.2.2 Secondary Pathways.	Psychosocial impacts are assessed directly only if they are the result of a biophysical impact of the Project. As the Project is not predicted to have any biophysical impacts, psychosocial impacts are not complete pathways. However, due to the significant importance of this concern, and in the spirit of understanding and cooperation, the EIS discusses the psychosocial impacts of perceptions of the Project in Section 4.0 Indigenous Engagement, as well as mitigations CNL has and will put in place to address concerns related to fear and stigma associated with the site.
Effects on Indigenous cultural, archeological, and sacred sites, spiritual places, practices and ceremonies as a result of Project activities.	Already included in the environmental assessment. CNL has made a commitment to support reconnection to the land on the WL site through ceremony or other cultural activities. This commitment has been added to Section 6.8.1.7 Monitoring and Follow-up.	There are no documented cultural, archaeological, or sacred sites within the WL site boundary; however, mitigation has been incorporated if an unexpected discovery of a heritage resource is made during Project activities. Mitigation is described in Section 6.8.1.6.2 Results.
All site clean-up and release criteria and deviation of desired end-state(s) for the Whiteshell Reactor Disposal Facility should be developed collaboratively with affected Indigenous Nations.	The commitment by CNL to determine the future use of the WL site, including collaboration with Indigenous Nations has been added to Section 6.8.1.6.2.2 Secondary Pathways.	As discussed in Section 6.8.1.6.2 Results, CNL will develop appropriate criteria for site remediation and clean-up activities of the WL site, aligned with meeting Canadian Council of Ministers of the Environment land use criteria, and based on feedback received from Indigenous Nations and other stakeholders.

Table 6.8.1.2-1: Summary of Key Interests and Concerns Raised During Indigenous Engagement Activities Related to the Traditional Land and Resource Use Assessment

Interest and Concern	Inclusion Status	Additional Information and Rationale
Concerns about the spatial boundaries used in the assessment not being reflective of those employed in traditional land use studies.	Adjusted in assessment boundaries in Section 6.8.1.4.1 Spatial Boundaries	CNL has separated Indigenous traditional land and resource use from other non-Indigenous land and resource use in order to reflect spatial boundaries that more closely reflect the boundaries as identified in traditional land use studies, combined with consideration of where effects are likely to be measurable.
Concerns that the assessment approach relies on a “damaged base case” resulting in conclusions that cannot result in a significant adverse effect.	Factors contributing to existing conditions are described in Section 6.8.1.5 Description of the Existing Environment.	The methodology used in the assessment regarding use of the current conditions as the baseline are in line with guidance on assessments under CEAA 2012
Safe Transportation of Waste and effects on the public roads	Already included in the environmental assessment.	Transportation of waste is considered in connection with public safety in Section 6.9 Socio-economic Environment and in Section 7.0 Accidents and Malfunctions.
Uncertainty about Conclusions in the Assessment	Already included in the environmental assessment. Section 6.8.1.6.2.2 Secondary Pathways has been updated to include a summary of Indigenous Nation’s conclusions about the potential effects of the Project, which has been summarized from the Traditional Knowledge and Land Use Studies.	To address the differing conclusions and uncertainty, CNL’s commitment to involving Indigenous Nations in monitoring and to engaging with them over the long-term to address ongoing concerns is described in Section 6.8.1.7 Monitoring and Follow-up.
Concerns about future monitoring and distrust of monitoring results.	Already included in the environmental assessment. CNL’s commitment to involving Indigenous Nations in monitoring and engaging with them over the long-term to address ongoing concerns has been added to Section 6.8.1.7 Monitoring and Follow-up.	CNL will implement an Environmental Assessment Follow-up Program for the Project as described in Section 6.8.1.7 Monitoring and Follow-up.

Table 6.8.1.2-1: Summary of Key Interests and Concerns Raised During Indigenous Engagement Activities Related to the Traditional Land and Resource Use Assessment

Interest and Concern	Inclusion Status	Additional Information and Rationale
Concerns about the extent of Indigenous participation in the assessment of effects to traditional land and resource use (from the identification of pathways to the verification of results)	Sagkeeng First Nation and the Manitoba Métis Federation have had the opportunity to review Section 6.8.1 Traditional Land and Resource Use in advance of the submission of the EIS Rev 3D2. As a result of the feedback received the spatial boundaries (Section 6.8.1.4.1 Spatial Boundaries) for the assessment of traditional land and resource use were modified. Section 6.8.1.6.2.2 Secondary Pathways has been updated to include a summary of Indigenous Nation's conclusions about the potential effects of the Project, which has been summarized from the Traditional Knowledge and Land Use Studies.	CNL has separated Indigenous traditional land and resource use from other non-Indigenous land and resource use in order to reflect spatial boundaries that more closely reflect the boundaries as identified in traditional land use studies, combined with consideration of where effects are likely to be measurable. To address the differing conclusions and uncertainty, CNL's commitment to involving Indigenous Nations in monitoring and to engaging with them over the long-term to address ongoing concerns is described in Section 6.8.1.7 Monitoring and Follow-up.

6.8.1.3 Valued Components

Valued components refer to socio economic and environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). The traditional land and resource use VCs chosen for the Project to reflect identified concerns, professional judgement and/or standard practice in environmental assessment are Cultural and Archaeological Sites, Traditional Land and Resource Use by Indigenous Peoples and the Winnipeg River. The rationale for selecting these VCs is discussed in Table 6.8.1.3-1.

Table 6.8.1.3-1:Valued Components for the Traditional Land and Resource Use Assessment

Valued Component	Rationale for Selection
Cultural and Archaeological Sites	Cultural and archaeological sites are those sites protected under legislation and administered by the Manitoba Heritage Resource Branch. Cultural and archaeological sites are important for revealing past and present land use, cultural identity and relationships with other cultures and the social and biophysical environments. Potential alteration or loss of cultural and archaeological sites can have an effect on Indigenous people. Consideration of physical and cultural heritage is a requirement under Section 5 of the *Canadian Environmental Assessment Act, 2012*. The cultural and archaeological sites VC is of known importance to Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations as identified through Traditional Knowledge and Land Use Studies, engagement with CNL, and verification discussions. Consideration of physical and cultural heritage is a requirement under Section 5 of the *Canadian Environmental Assessment Act, 2012*.

Table 6.8.1.3-1:Valued Components for the Traditional Land and Resource Use Assessment

Valued Component	Rationale for Selection
Traditional Land and Resource Use by Indigenous People	Traditional Land and Resource Use is defined as the land and resource by Indigenous Peoples for traditional purposes, including hunting, fishing, trapping and gathering. Traditional land and resource use by Indigenous people is important for maintaining meaningful connections with cultural identity and community history, for food security, economic self-sufficiency, and the maintenance of individual and population health. Traditional land and resource use can also promote intergenerational connections within communities as knowledge is passed down from elders to community members, including youth. Potential changes to traditional land and resource use by Indigenous people can have an adverse effect on Indigenous people by preventing them from fully expressing their cultural identity and Treaty rights. The traditional land and resource use by Indigenous people VC is representative of the values identified by Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations, as identified through Traditional Knowledge and Land Use Studies, engagement with CNL, and verification discussions. Consideration of current land and resources use for traditional purposes is a requirement under Section 5 of *Canadian Environmental Assessment Act, 2012*.
Winnipeg River	The public and Indigenous peoples identified the importance of the Winnipeg River. A number of communities depend on the river for drinking water, recreation, cultural vitality, inter-generational knowledge transfer and food security. The river flows into the Lake Winnipeg, one of the largest lakes in the world. The eastern shore of the lake is included in a United Nations World Heritage Site proposal (Manitoba Wildlands 2008). This watershed is valued for many reasons by many people and groups. Indigenous peoples identified the Winnipeg River as a critical resource for traditional and rights-based activities, including harvesting of fish, waterfowl, plants and other animals. The river was identified as a source of drinking water and as a transportation corridor. Further, Indigenous peoples recognize the sacredness of water, the interconnectedness of all life and the importance of protecting water. The Winnipeg River VC is of known importance to Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations as identified through Traditional Knowledge and Land Use Studies, engagement with CNL, and verification discussions.

Assessment endpoints are qualitative expressions used to assess the significance of residual effects on VCs and represent the key properties of the VC that should be protected for future generations. The assessments of each VC has incorporated the community and/or traditional knowledge provided. Measurement indicators represent properties of the environment and VCs that, when changed in comparison to existing conditions, could result in or contribute to an effect on a VC. Changes in measurement indicators were used to evaluate potential changes in the status of each VC relative to the assessment endpoints. The assessment endpoints and measurement indicators associated with the land and resource assessment are outlined in Table 6.8.1.3-2.

Table 6.8.1.3-2: Assessment Endpoints and Measurement Indicators for the Traditional Land and Resource Use Assessment

Valued Component	Assessment Endpoints	Measurement Indicators
Cultural and Archaeological Sites	Protection and preservation of cultural and archaeological sites.	■ Value, quantity, and quality of cultural and archaeological sites.
Traditional Land and Resource Use by Indigenous Peoples	Continued opportunity for, and desire to engage in, traditional activities such as hunting, fishing, swimming, , trapping and plant, berry, wild rice and medicine gathering.	■ Relative abundance and distribution of fish species. ■ Relative abundance and distribution of plant species. ■ Relative abundance and distribution of wildlife species. ■ Changes to vegetation, fish and wildlife habitat. ■ Relative abundance and distribution of vegetation and fish and wildlife habitat. ■ Changes to opportunities for traditional land use ■ Perceived and observed changes to the area's suitability for land use and/or quality of harvested resources.
Winnipeg River	Maintenance of self-sustaining and ecologically effective fish populations that are available for traditional use	■ Changes to ambient levels of surface water parameters ■ Relative abundance and distribution of fish species. ■ Relative abundance and distribution of aquatic plant species (wild rice). ■ Changes to aquatic vegetation and fish habitat. ■ Relative abundance and distribution of aquatic plant and fish habitat. ■ Expanded opportunities for traditional use. ■ Perceived and observed qualities of water, aquatic plant species, fish, and aquatic habitat by traditional users.

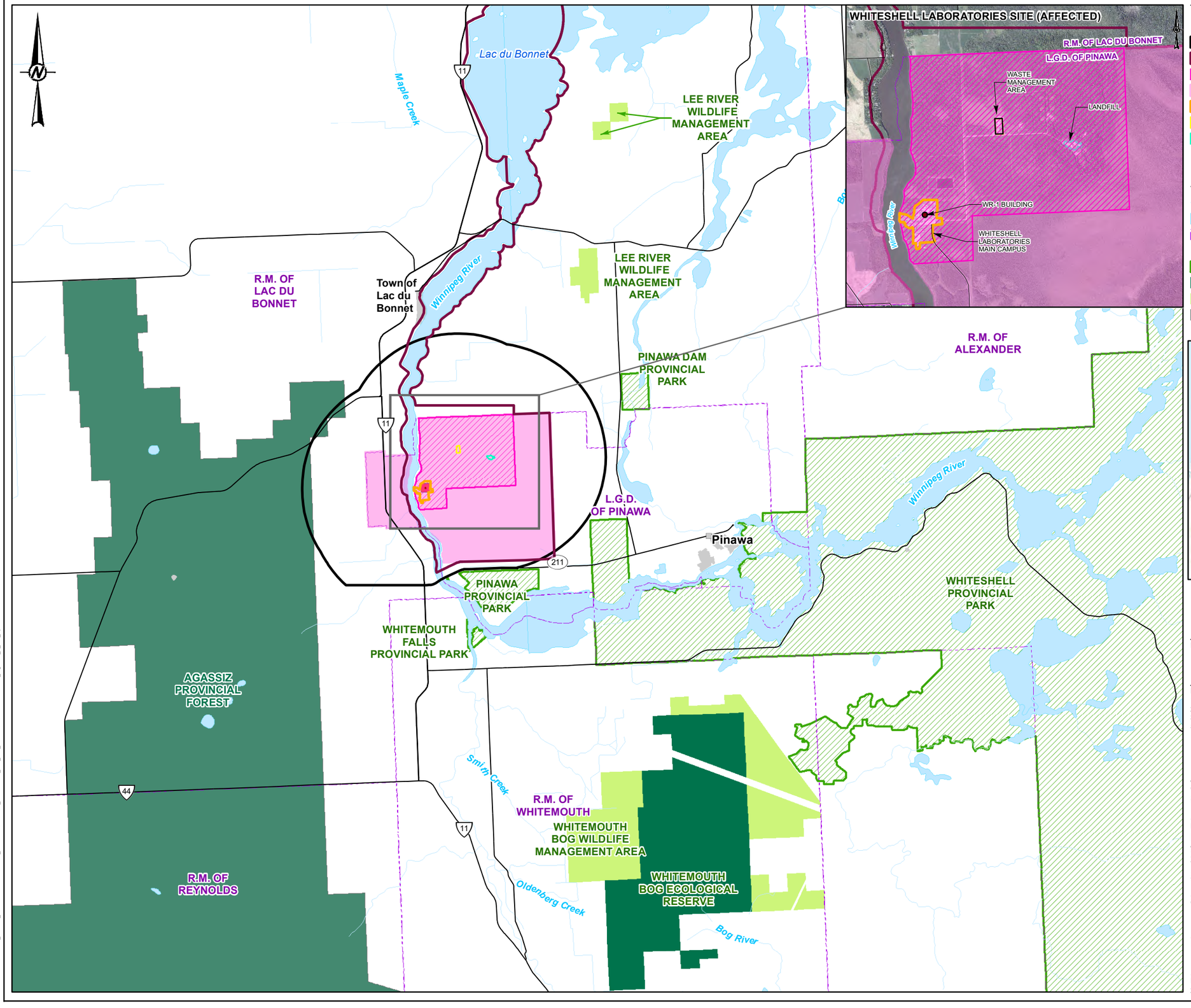
6.8.1.4 Assessment Boundaries

6.8.1.4.1 Spatial Boundaries

The spatial boundaries selected for the traditional land and resource use assessment were chosen because they permit description of Base Case conditions in sufficient detail to enable potential project-VC interactions and effects to be identified, understood, and assessed, including understanding and assessing the contribution of the Project to cumulative effects. These boundaries were developed in consideration of known land and resource use around the WL site, including resource harvesting and traditional land and resource use by Indigenous peoples and the study areas of other disciplines (e.g., Terrestrial Environment; Human Health) that may have an effect on land and resource use. The spatial boundaries selected for the traditional land and resource use assessment are presented on Figure 6.8.1-1 and are described below.

- **Site Study Area (SSA)** is the WR-1 Building and represents the Project footprint (i.e., where Project activities will be undertaken; 0.07 ha).

- **Local Study Area (LSA)** is defined as the area within which there is potential for measurable changes resulting from the proposed Project activities. The LSA is intended to capture traditional land and resource use within proximity of the WL site and extends approximately 5 km beyond the WL site boundaries (approximately 11,917 ha).
- **Regional Study Area (RSA)** represents the area where potential effects on traditional land and resource use are expected to be experienced at a broader scale and where indirect effects of the Project may interact with the effects of other existing or reasonably foreseeable projects. The RSA includes the RSAs for aquatic environment and the terrestrial environment as these are used for the assessments of Project effects on resources that support traditional land and resource use and also extends downstream on the Winnipeg River. Therefore, the south boundary of the RSA extends from the west shore of the Winnipeg River to the east fence on the property line about 400 m north of Provincial Highway 211. The eastern boundary of the RSA follows the fence on the property line to the north property line. The north boundary follows the north fence on the property line about 1.6 km and then turns north for about 400 m before turning west and extending to the west side of the Winnipeg River. To incorporate input from Indigenous Nations, the RSA was revised to include the Winnipeg River from the WL site downstream to Lake Winnipeg with a 100 m buffer on either side of the river to capture traditional land and resource use activities on either shore of the river (approximately 14,182 ha).



LEGEND

- WR-1 BUILDING (SITE STUDY AREA)
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- WHITESHELL LABORATORIES SITE (AFFECTED)
- WHITESHELL LABORATORIES SITE (UNAFFECTED)
- WHITESHELL LABORATORIES MAIN CAMPUS
- WASTE MANAGEMENT AREA
- LANDFILL

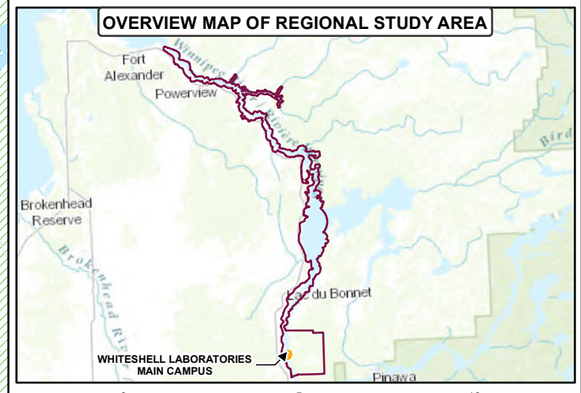
BASE FEATURES

- CITY/TOWN
- MAJOR ROAD
- WATERCOURSE
- WATERBODY
- MUNICIPAL BOUNDARY

PROTECTED AREAS

- PROVINCIAL PARK
- ECOLOGICAL RESERVE
- WILDLIFE MANAGEMENT AREA
- PROVINCIAL FOREST

OVERVIEW MAP OF REGIONAL STUDY AREA



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NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY PROVIDED BY CNL (2016-11-22)
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
SPATIAL BOUNDARIES FOR THE ASSESSMENT OF LAND AND RESOURCE USE

CONSULTANT

wsp GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	SO\RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
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Path: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PRO\20145046\40_PRO\0016_EIS_Sec_6.8\20145046-0016HL-0001_Figure 6_8_1-1_Spatial Boundaries For The Land and Resource Use Assessment.mxd

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6.8.1.4.2 Temporal Boundaries

The temporal boundary of the assessment includes effects observed under existing conditions, the timeframe during which Project activities are actively occurring and the duration of predicted residual effects. The duration of an effect is defined as the amount of time between the start and end of a Project activity or stressor (which is related to the Project phases) plus the time required for the residual effect to be reversed. In some cases, a residual effect may be irreversible within the temporal boundaries of the Project if the effects were predicted to last so far into the future that they could not be predicted with any level of certainty (e.g., residual effect lasts for thousands of years). The following phases were identified for the Project:

- **Closure Phase:** Preparation and implementation of in situ disposal (ISD), which includes preparation for ISD, grouting of below-grade structures and systems, removal of above-grade WR-1 structures and systems, installation of the concrete cap and engineered cover, and environmental controls and final site restoration. These activities last from 2022 to 2027.
- **Post-closure Phase:** The post-closure phase has two discrete periods: institutional control and post-institutional control. Institutional control is estimated to last 100 years during which long-term monitoring and maintenance activities will continue, to demonstrate WRDF performance is in compliance with the safety case assumptions and performance modelling. The 100-year timeframe is not related to the design life of the WRDF barriers. The 100-year active monitoring period was selected to ensure that sufficient opportunity is provided to verify the WRDF is performing as expected. Additionally, beyond 100 years, there is less confidence that institutional controls, like access restrictions, can be relied upon. Although the duration of institutional control is estimated at 100 years, it is recognized that it will continue until the CNSC, or the appropriate authority at the time, agrees it is no longer needed.

  Post-institutional control occurs after year 2127 and continues indefinitely. The post-closure phase will continue indefinitely; however, the timeframe defined for assessment of potential effects as part of the normal evolution of the Project is 10,000 years. This time period encompasses the phase in which peak effects are anticipated.

6.8.1.4.3 Assessment Cases

The assessment on traditional land and resource use has three assessment cases.

- **Base Case**: This scenario represents existing conditions and characterizes combined effects from previous and existing developments and activities. The Base Case reflects the effects of existing disturbances, such as forestry, transportation, agricultural, mining and residential and recreational development. Current effects from the existing WL facilities and operations, for example, are considered part of the Base Case. In addition, effects from the decommissioning and reclamation activities already completed at the WL site are also considered as part of the Base Case.
- **Application Case**: The Application Case represents predictions of the effects that may results from the Project combined with the existing effects of the Base Case.

- **Reasonably Foreseeable Developments (RFD) Case**: This scenario represents the effects of the Base Case combined with the predicted incremental effects from the Project, as well as effects from other RFDs within the RSA that are currently under application review or that have officially entered a regulatory application process. There are no RFDs expected in the RSA other than the continued decommissioning of the remaining facilities at the WL site, as described in the Comprehensive Study Report (AECL 2001). Cumulative effects from the Project in combination with the decommissioning of the remaining infrastructure and support facilities, and reclamation of the affected areas at the WL site (see Table 6.8.1.4-1) are presented as part of this assessment.

Table 6.8.1.4-1: Reasonably Foreseeable Developments considered in the Traditional Land and Resource Use Assessment

Type of Project	Location	Description	Timeframe	Overlap with Valued Components
Infrastructure Decommissioning	WL	Decommissioning of remaining infrastructure on the WL site (includes ISD of some low-level waste trenches).	2016 to 2027	Yes – there is both spatial and temporal overlap of effects with the Project
Environmental Remediation	WL	Remediation of affected lands, with the exception of the low-level waste trenches.	2016 to 2027	Yes – there is both spatial and temporal overlap of effects with the Project

6.8.1.5 Description of the Environment

This section describes the setting and characterization for traditional land and resource use as relevant for the assessment of the Project. It describes the existing conditions against which potential changes from the Project are compared and evaluated.

6.8.1.5.1 Methods

The characterization of the existing environment for traditional land and resource use reflects review of both primary and secondary data sources. Data collection began with a review of existing literature and databases from a variety of public sources. Where sufficient detail was not available from secondary data sources to describe the existing environment, primary data collection was undertaken in the form of key person interviews.

6.8.1.5.1.1 Literature Review

The review of literature and databases included the following sources:

- federal, provincial and municipal government reports and data;
- documents produced for other environmental assessment processes (e.g., environmental impact statements, regulatory submissions);
- academic literature (dissertations, cultural chronologies);
- archival research;
- the Whiteshell Laboratories Decommissioning Project: Comprehensive Study Report (AECL 2001);

- Project-specific Indigenous traditional knowledge studies:
  - For Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation: api migizik pii pa giiot – When Eagles Call Traditional Knowledge and Land Use Study for the WR-1 Nuclear Reactor In Situ Decommissioning Project (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019);
  - For Sagkeeng First Nation: Sagkeeng Anicinabe Land Use and Occupancy Study Specific to Canadian Nuclear Laboratories' Proposed In Situ Decommissioning of the WR-1 Reactor at Whiteshell Laboratories (Firelight and Sagkeeng 2018);
  - For the Manitoba Métis Federation: Whiteshell Reactor #1 Decommissioning: Manitoba Métis Traditional Knowledge, Land Use and Occupancy Study (SVS 2019).
  - For Wabaseemong Independent Nations: Traditional Knowledge and Environmental Impact Assessment (WIN 2018).
- Other community-led studies:
  - Sagkeeng Anicinabe Psychosocial Impact Assessment (Narratives 2020);
- the Environmental Assessment and Follow-up Program for Whiteshell Laboratories (CNL 2002); and
- online sources (e.g., community websites, online business profiles).

6.8.1.5.1.2 Primary data collection

Primary data collection, in the form of interviews or other techniques, was undertaken at the discretion of First Nations and the Métis in undertaking community-directed traditional land use or other studies. As such, the analysis is bound by the availability of data presented and any confidentiality associated with the data as determined by the various studies authors.

6.8.1.5.1.3 Indigenous Engagement

Information shared by the public and from Indigenous peoples was also used to inform both the base case and application case. Where applicable within this section, interests and information gained through the engagement program relevant to traditional land and resource use has been highlighted for each community (Table 6.8.1.2-1). For example, historical and present-day traditional land and resource use by First Nations and the Red River Métis is described in Section 6.8.1.5.2.2, which was considered in the identification of Project interactions in Section 6.8.1.6.2. Further detail on the outcomes of engagement processes can be found in Section 4.0 Indigenous Engagement.

6.8.1.5.2 Results

6.8.1.5.2.1 Archaeological and Cultural Sites

A review of the documented archaeological site data from the Government of Manitoba's Historic Resources Branch, Sport, Culture and Heritage provided the following cultural overview. As no site can be examined in isolation, archaeological sites recorded within 5,000 m (5 km) of the Winnipeg River, from the Manitoba/Ontario border to the mouth were reviewed to consider the wider landscape and establish the wider context of contemporary sites in the broader region.

Human occupation of the Winnipeg River system most likely began after the meltwater of glacial Lake Agassiz drained from the area *ca*. 8,500 years ago, prior to that the area was covered by the Late Wisconsinan ice sheet (MAS 1998; Teller and Clayton 1983; Steinbring 1980; Bowe 1999). A cultural chronology or timeline has been created, which is based on technological innovations and historical happenings. The chronology comprises two major time periods: Pre-European Contact and Post-European Contact. These are further divided into Early (Paleo-Indian [Northern Plano]), Middle (Archaic [Shield, Plains]) and Late (Woodland [Initial, Terminal]) sub-periods.

Human movement in the Winnipeg River system possibly began during the Paleo Indian Period (*ca*. 11,000 to 7,000 years ago) after the continental glacier and associated glacial Lake Agassiz retreated from the area approximately *ca*. 8,500 years ago (MAS 1998; Teller and Clayton 1983). During the period of deglaciation and meltwater drainage, the plant succession progressed northwards, followed by a wide range of animal species and by people. These semi-nomadic people were big game hunters, whom archaeologists refer to as the Plano (Pettipas 1984). Archaeological sites from this period are represented by solely lithic assemblages, which include slender leaf-shaped points, knives, scrapers and other tools. Over 30 registered archaeological sites within 5,000 m of the Winnipeg River system have been identified as being occupied during the Paleo-Indian Period.

Several important cultural adaptations are found within the Middle Archaic Period, including the appearance of notched or stemmed projectile points, end scrapers, adzes and other cutting implements (OAS 2011). The appearance of new style projectile points and the introduction of the atlatl (a spear extender, which provided leverage to the spear thus increasing the velocity and accuracy of the projectile) suggest adaptive technological changes for procuring food resources. Raw materials used by the Archaic period people became much more diverse, including the appearance and use of native copper which was used for making tools and adornments. The range of dates suggests cultural interaction and movement across a vast landscape (Wright 1972). Culturally, this was a society of hunters, fishers and gatherers whose members subsisted on a seasonally diverse diet of large game, fish and local plants (Wright 1972; Kennett and Winderhalder 2006). The lithic tool kit included plains grasslands projectile point/dart forms such as Logan Creek (*ca*. 500 to 6,500 years ago), Oxbow (*ca*. 3,500 to 5,300 years ago), McKean (*ca*. 2,800 to 3,200 years ago) and Pelican Lake (*ca*. 1,600 to 3,200 years ago), along with stone knives and scrapers. However, most Shield Archaic projectile points were “home-grown” stemmed and side-notched variants. An Archaic occupation is represented at over 80 sites along the Winnipeg River. Ancient copper mines located at Isle Royale on Lake Superior have been identified as the source material for projectile points within the southern part of Manitoba (Wright 1972; Steinbring 1980; Bouge 2007), to which at least seven sites have been documented along the Winnipeg River.

The introduction of native clay pottery marks the differentiation between the Woodland (*ca*. 3,000 to 360 years ago) (Wright 1972) and Archaic periods. The Eastern Woodland Tradition has shown to have first developed in eastern North America and moved westwards. In Manitoba, the Woodland Period is further divided into two temporal periods, Middle and Late, which is based on vessel construction and stylistic attributes.

The Middle Woodland people using pottery in Manitoba are represented by the Laurel Culture (*ca*. 2,700 to 1,000 years ago) and the type of ceramic ware produced during this time period. Pottery was conical in shape, manufactured using a coiling method and was decorated with various stamping techniques and incised design. The Laurel lithic toolkit consisted of a variety of lithic tools including triangular projectile points and copper awls and beads (Stoltman 1973). The Middle Woodland Culture is also characterized by people representing a shift from a reliance on grassland to forest and aquatic resources, including fish and wild rice harvesting (MAS 1998).

The Late Woodland Tradition contains several important pottery types that represent local variations that made them distinctive. Although pottery construction is believed to use similar techniques, there are signature differences within this tradition. For the Winnipeg River study area, Blackduck, Minontoba and Selkirk pottery styles are the three main derivatives (Hyslop 2012, 2014). The peoples associated with these types of pottery constructed globular shaped vessels made from masses of wet clay, using a lamination technique. Archaeologists believe that these pots were pre-formed in a woven bag that left a distinct fabric impression on the exterior. Vessel rims, necks and lips were embellished with combinations of design attributes such as decorative punctuates, small cord-wrapped-stick impressions, or incising (OAS 2011).

Lithic tools associated with the Late Woodland Tradition include small triangular and side-notched projectile points, stone drills and smoking pipes (Wright 1972). Over 200 sites along the Winnipeg River contain the cultural materials of a Woodland occupation.

The largest concentration of petroform sites in Manitoba is found within the Winnipeg River's drainage system (Steinbring 1980). These rock mosaics were created by placing stones and/or boulders on bedrock surfaces to achieve the desired outline, usually human or animal effigies. There has been no success in assigning these cultural features to a particular time period. However, there is a direct link between the people of the Late Pre-Contact Period and the Anishinaabe who continued to use and occupy this area, and who continue to use some of the major petroforms in their ceremonies (Manitoba Sustainable Development n.d.d). There are over 20 documented sites comprised of boulder foundations within 5,000 m of the Winnipeg River.

With guidance from the local Indigenous peoples who had well-established trade routes for thousands of years, French explorers and early traders first gained entry into the interior by way of the Winnipeg River (Steinbring 1980). With the help of Auchagah, a Cree guide, La Vérendrye identified the Winnipeg River as a trade route and established fur trade forts near native camps throughout the area, including Fort Maurepas (1735) (Burpee 1927). Gradually European trade goods filtered into the local Indigenous settlements and traditional products, such as clay pottery and stone tools were generally replaced by copper and brass pots, metal knives and guns.

The Winnipeg River became an important travel route in accessing lands west of the Great Lakes (Rich 1967) With the granting of a charter in 1670 to the London, England based Hudson's Bay Company the commercial fur trade began and a long term relationship with local Indigenous peoples was established. Indigenous individuals and groups acted as traders and middlemen and undoubtedly benefited from the increased competition between the Hudson's Bay Company and the Montreal-based independents, which were generally referred to as "les Canadians." In 1779, the Montreal traders formed an organization to reduce expenses and ease the rivalry between traders, which became the North West Company. Later on, the intense rivalry between the Hudson's Bay Company and the Northwest Company for control the fur trade sparked the establishment of numerous trade houses in close proximity to one another; this had the effect of increasing the trading opportunities for Indigenous trappers. Fort Bas de la Rivière was established by the Northwest Company in 1792 at the mouth of the Winnipeg River. The Hudson's Bay Company built Fort Alexander in 1795 to counter the Northwest Company post.

Extreme demands in Europe for fur coats and beaver hats and the intense competition between the two companies led to a severe depletion of the fur resources. In 1821, the social and financial stress of both the Hudson's Bay Company and North West Company resulted in the companies amalgamating under the banner of the Hudson Bay Company, a fur trading monopoly resulted that covered one-quarter of North America. Reorganization caused closure of numerous unprofitable posts and outpost, affecting local employment opportunities.

According to the Manitoba Heritage Resource Branch archaeological site database, cultural materials of the historic period have been documented at over 50 sites along the Winnipeg River. This is most likely an inaccurate representation as material culture from Pre-European Contact Periods would take precedence in recording value.

During the early twentieth century, physical changes to the Winnipeg River began with the construction of the hydroelectric dams. Hydro development began on the Winnipeg River in 1903 with the construction of the Pinawa Dam, completed in 1906. Subsequently six more dams were constructed, Pointe du Bois (1926), Great Falls (1928), Slave Falls (1948) Seven Sisters (1952), Pine Falls (1952) and McArthur (1955) (Manitoba Hydro 2018). The Pinawa Dam ceased operation in 1951 and has since been designated a Provincial Heritage Site (Manitoba Sustainable Development n.d.e).

6.8.1.5.2.1.1 Archaeological Sites

The tangible history of the Winnipeg River is documented by physical artifacts and features that are distributed over the landscape. Much of this rich history was recorded by archaeologist Anthony Buchner, who conducted a two-year archaeological investigation of the waterway between Great Falls to McArthur Falls and Seven Sisters to Sturgeon Falls. The cultural materials collected during the Winnipeg River Archaeological Project (1980 to 1982) documented a human occupation dating back to the Late Paleo Indian Period (*ca*. 8,500 to 6,000 years ago) (Buchner 1982a).

A review of the registered archaeological site data provided by the Historic Resource Branch reveals the presence of 434 registered sites within 5,000 m of the Winnipeg River spanning from the Manitoba/Ontario border to the mouth at Lake Winnipeg. While there are no documented archaeological sites within the WL site boundary, it should not be assumed that sites are not present as the Sieg Serpent Site (formally called Sweet Creek Petroform) is located approximately 1,700 m south of the property (AECL 2001). In addition, three important sites can be found approximately 3,500 m south at the confluence of the Whitemouth and Winnipeg Rivers. Excavated in the 1960s and 1970s by Dr. Jack Steinbring, sites EaLa-01, 02, 03 (Whitemouth Falls Site, Porth Site, Bjorkland Site) comprised of multi-component campsites and burial mounds indicate that the area was frequented as much as 5,000 years ago. (Pettipas 2015; Buchner 1982b).

6.8.1.5.2.1.2 Historic Sites

One provincially recognized historic site, the Pinawa Dam Provincial Heritage Park, is located with the 5,000 m of the Winnipeg River. This park is under the management of Manitoba Conservation and Climate. During the construction of the amphitheatre Historic Resources Branch staff conducted some archaeological investigations, and a cultural component related to the dam construction was identified. The site was assigned an archaeological site designation (AECL 2001).

6.8.1.5.2.2 Traditional Land and Resource Use by Indigenous Peoples

The Project is located on Treaty 3 land, while the overall WL site which extends west of the Winnipeg River falls on Treaty 1 land. Communities that form part of these Treaties and Treaty 5 also have historical and current land use ties with the area. Anishinaabe and Ojibway communities with historic traditional territories that have expressed some level of interest in the Project include the Sagkeeng First Nation and Brokenhead Ojibway Nation in Treaty 1; Black River and Hollow Water First Nations in Treaty 5; and Wabaseemoong Independent Nations in Treaty 3 (TRCM n.d.; Ontario Ministry of Aboriginal Affairs 2014).

First Nation community locations in vicinity to the WL site are described below and presented on Figure 6.8.1-2:

- **Sagkeeng First Nation**, an Anishinaabe community, is the closest Indigenous Nation to the WL site. Sagkeeng reserve land is located 52 km directly downriver from the WL site and includes land parcels on either side of the Winnipeg River.
- **Brokenhead Ojibway Nation** is located near the southern basin of Lake Winnipeg, occupies three reserves: 44 km northwest, 55 km northwest and 73 km southwest of the WL site. Brokenhead is primarily surrounded by the RM of St. Clements.
- **Black River First Nation** is an Ojibway community located along the eastern shoreline of Lake Winnipeg at the confluence of the Black and O'Hanly Rivers. The Black River reserve land is 75 km north of the WL site.
- **Hollow Water First Nation**, an Anishinaabe community, is located along the eastern shore of Lake Winnipeg approximately, 113 km north of the WL site.
- **Wabaseemoong Independent Nations** is comprised of four communities, Whitedog First Nation, serving as the main reserve parcel; One Man Lake; Swan Lake and Agency 30 (shared with 12 other First Nations). Occupy four reserves: 80 km east, 85 km east, 95 km east and 140 km southeast of the WL site.

The Project is also located in the homeland of the Red River Métis, as represented by the Manitoba Métis Federation. Figure 6.8.1-3 shows mapped recognized areas for Métis natural resource harvesting in Manitoba and Figure 6.8.1-4 shows the expanded areas bordering the recognized Métis harvesting area.

While Statistics Canada enumerated self-identified Métis residents in many communities in proximity to the Project, Métis communities that historically emerged in the region include:

- **Bas de la Rivière –**Situated on both shores of the Winnipeg River and established in 1732, the community served as a wintering post and trading depot. Fishing and agriculture were particularly important in the area. Originally a North West Company outpost, the post lost its importance as a provisioning and transportation hub following amalgamation with the Hudson's Bay Company in 1821. It became known as Fort Alexander and then eventually Pine Falls.
- **Berens River –** an initial trading post was built at the mouth of the river in 1814 and was a thriving Métis community until fishing was banned on Lake Winnipeg in 1970 as a result of mercury contamination.
- **Fort Alexander –** built by the Hudson's Bay Company on the Winnipeg River to counter the North West Company's Fort Bas de la Rivière, this post also had ties to the Métis in the area (Barkwell 2016).

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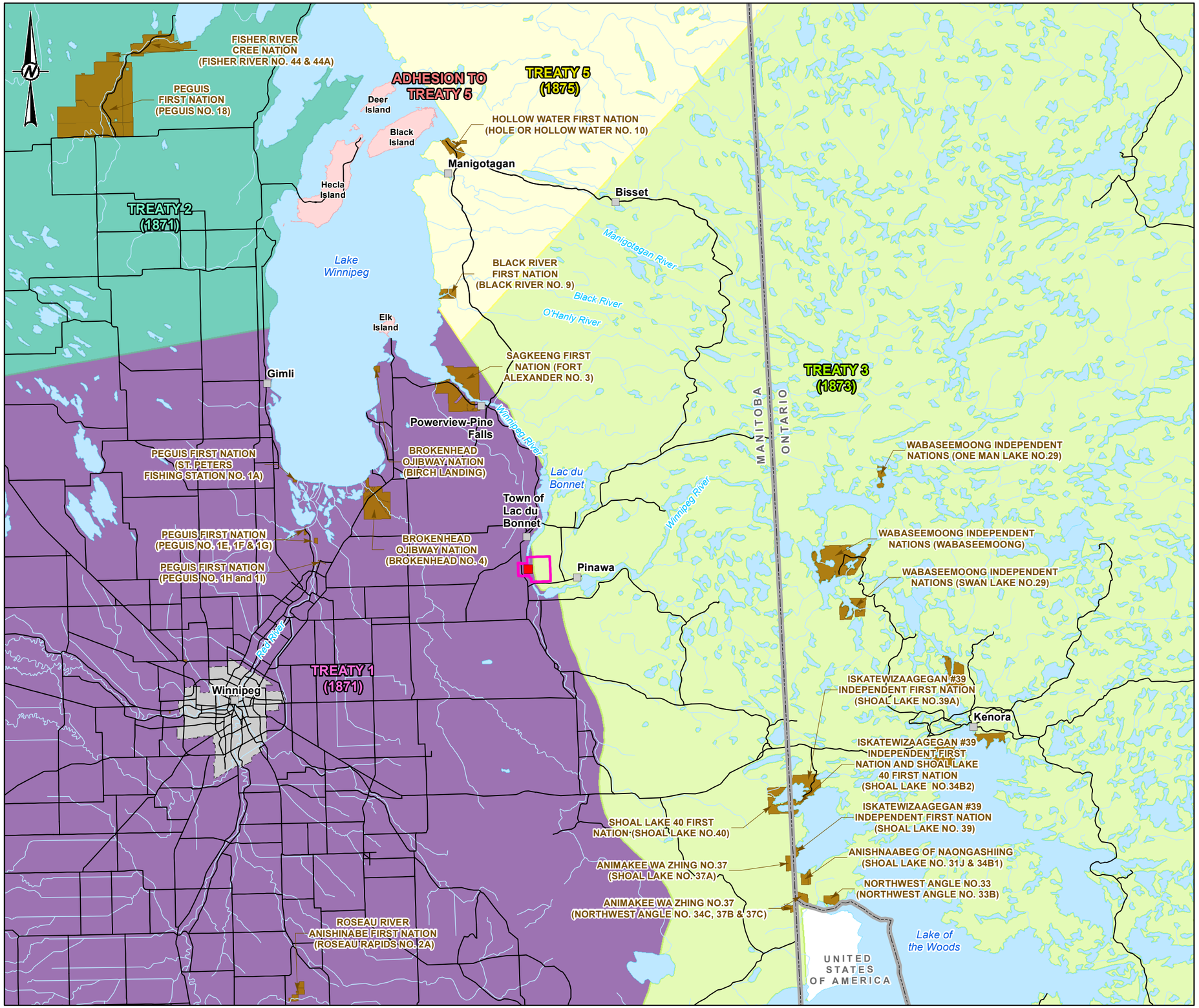

LEGEND

- WR-1 BUILDING (SITE STUDY AREA)
- WHITESHELL LABORATORIES SITE

BASE FEATURES

- CITY/TOWN
- PROVINCIAL BOUNDARY
- MAJOR ROAD
- WATERCOURSE
- WATERBODY

TREATY BOUNDARIES

- TREATY 1 (1871)
- TREATY 2 (1871)
- TREATY 3 (1873)
- TREATY 5 (1875)
- ADHESION TREATY 5

0 20 40 60

1:1,000,000 KILOMETRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY PROVIDED BY CNL (2016-11-22)
3. METIS HARVESTING AREAS - BIG GAME HUNTING AREAS DEVELOPED BY MANITOBA WILDLIFE MANAGEMENT AREAS, PROVINCE OF MANITOBA
4. TREATY BOUNDARIES - HISTORIC FIRST NATIONS TREATIES IN CANADA DELEVOPED BY GLOBAL FOREST WATCH, WORLD RESOURCES INSTITUTE, 2000
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT

CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT

EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE

TREATY AREAS

CONSULTANT

WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/PR/RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
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Path: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0016_EIS_Sec_6.8\20145046-0016-HL-0003_Figure 6_8_1-2_Treaty Areas and Metis Harvesting Area.mxd

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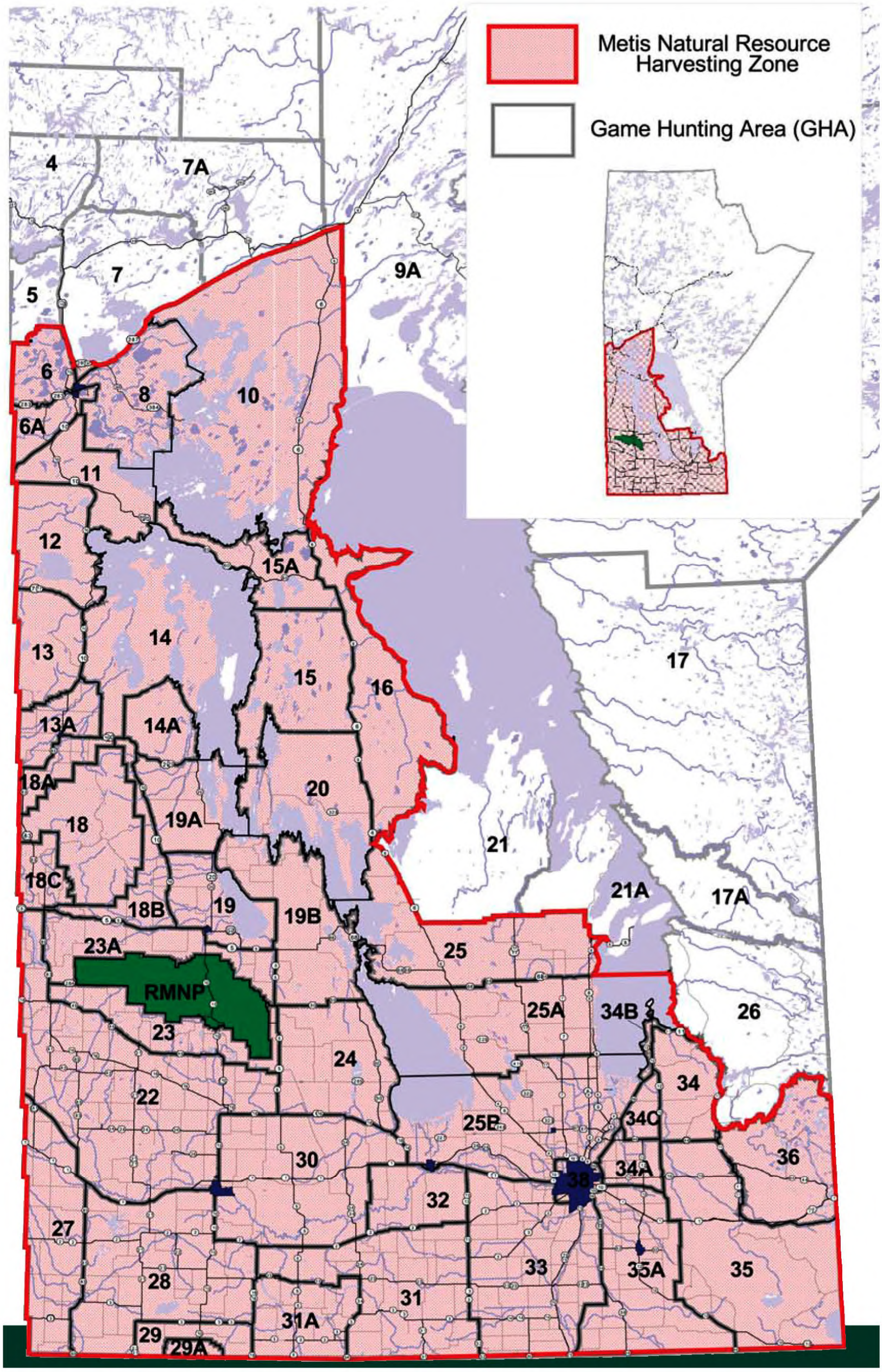
PATH: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0016_EIS_Sec_6.8\20145046-0016-HL-0004_Figure 6_8_1-3 Recognized Areas for Metis Natural Resource Harvesting.mxd PRINTED ON: 2022-12-06 AT: 9:28:23 PM



NOTE(S)

REFERENCE(S)

1. INFORMATION OBTAINED FROM HTTP://WWW.MMF.MB.CA/DOCS/RECOGNIZED_AREAS_FOR_HARVESTING_MAP.PDF

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	SO
PREPARED	SO/RRD
REVIEWED	KL
APPROVED	MM

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
RECOGNIZED AREAS FOR MÉTIS NATURAL RESOURCE HARVESTING

PROJECT NO.	CONTROL	REV.	FIGURE
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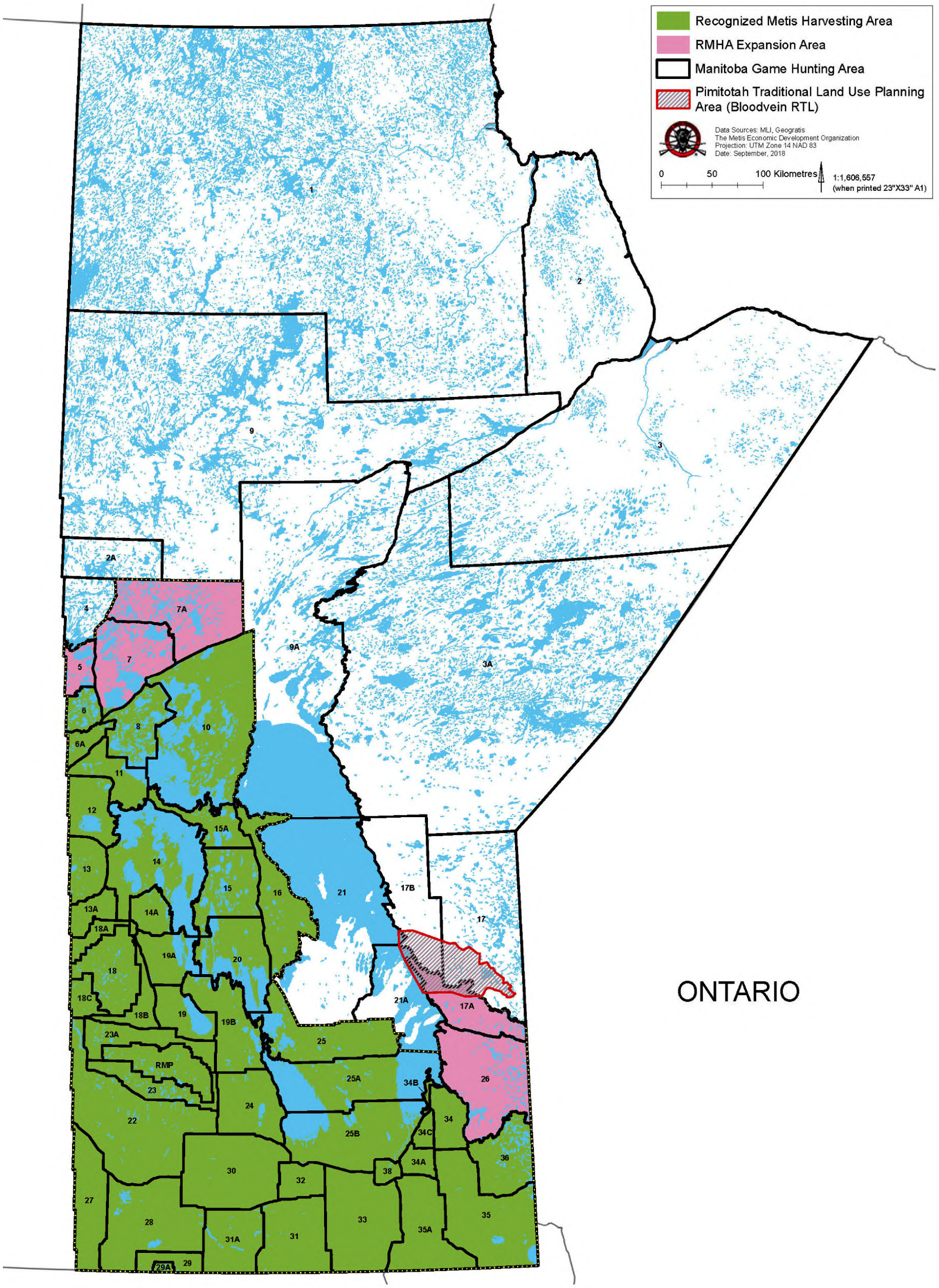
PATH: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0016_EIS_Sec_6.8\20145046-0016-HL-0005_Figure 6_8_1-4 Expansion of the Recognized Metis Harvesting Area.mxd PRINTED ON: 2022-12-06 AT: 9:28:28 PM



NOTE(S)

REFERENCE(S)
1. INFORMATION OBTAINED FROM MLI, GEOGRATIS
THE METIS ECONOMIC DEVELOPMENT ORGANIZATION:
HTTP://WWW.MMF.MB.CA/DOCS/HARVESTING/2018RESOLUTION_RMHAEXPANSION_26SEPT18.PDF

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	SO
PREPARED	SO/RRD
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APPROVED	MM

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
EXPANSION OF THE RECOGNIZED MÉTIS HARVESTING AREA

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0016	2	6.8.1-4

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6.8.1.5.2.2.1 Historical and Present Day Traditional Land Use

This section of the EIS describes historical and present-day traditional land and resource use by First Nations and the Red River Métis. The First Nations within the area have resided at or near their respective reserve parcels since time immemorial (Sagkeeng Anicinabe n.d.). In the nineteenth century, First Nations living near Fort Alexander, present day Sagkeeng First Nation, were nomadic and would make frequent trips north to the Hudson's Bay post to trade and obtain food supplies (Sagkeeng First Nation 2000). The Winnipeg River has historically provided a network of travel routes for local communities (Petch 2005). Present day traditional land and resource use activities, including trapping and wild rice harvesting, continue to supplement the diet and income of local First Nation and Métis communities in the RSA. Wild rice harvesting was originally for domestic purposes but eventually became a commercial economy (Manitoba Hydro and Golder Associates Ltd. 2012).

To fully understand present-day traditional land use activities by Indigenous peoples, it is key to understand the historical and external factors that have affected traditional land and resource use activities including the *Indian Act*, the creation of the reserve system, and residential schools. These factors, among other policies and programs, have continued to alienate Indigenous peoples from their traditional territories and hinder the full expression of their cultures.

Sagkeeng First Nation

Sagkeeng First Nation's reserve is located where the Winnipeg River empties into Lake Winnipeg and their traditional territory encompasses land within Treaty 1 along with land north and west of the Winnipeg River, falling within four Treaty areas (Sagkeeng First Nation 2015). Sagkeeng First Nation is currently in Treaty Land Entitlement specific claims discussions with the Government of Canada (Sagkeeng Anicinabe n.d.), including lands outside the Treaty 1 boundary (Firelight Research Inc. and Sagkeeng Anicinabe 2018). According to the completed Land Use and Occupancy Study, Treaty 1 was signed by Sagkeeng's Anicinabe ancestors on August 3, 1871, at Lower Fort Garry. This resulted in the establishment of the reserve and the Fort Alexander Band, which later was renamed as Sagkeeng Anicinabe (Firelight Research Inc. and Sagkeeng Anicinabe 2018).

The land and waterways have historically been an important part of the economic well-being and transportation system for the Sagkeeng First Nation. "A strongly held conviction among members is that the lands and waterways are the sustaining factors for all life. To members, the land and waters are indivisible and anything that is done to either will have far reaching effects for all life" (Sagkeeng First Nation 2015). In early spring and late fall, fishing was preferred near Catfish Creek and at Point au Mitasse on Lake Winnipeg (Sagkeeng First Nation 2000). Travel in the fall was typically to the Lac du Bonnet area, where the Pinawa Channel meets the Winnipeg River, to harvest wild rice (Sagkeeng First Nation 2000). Family units had preferred hunting areas which included areas close to Fort Alexander and spanned north to Black River First Nation and over 200 km southeast to Dalles and Big Island First Nations in Ontario (Sagkeeng First Nation 2000). Previous studies have confirmed that Sagkeeng First Nation participates in traditional activities of harvesting wild rice, sturgeon fishing, gathering plants and medicines and berry picking in the vicinity of the WL (AECL 2001). Members of Sagkeeng First Nation continue to have a fundamental attachment to the physical, biological, and spiritual environment, lands and waterways, as a way of life (Sagkeeng First Nation 2015). Sagkeeng First Nation currently uses the Winnipeg River as its source for water supply to the community (J.R. Cousin Consultants Ltd. n.d.).

A traditional knowledge and land use study titled, *Sagkeeng Anicinabe Land Use and Occupancy Study Specific to Canadian Nuclear Laboratories' Proposed In Situ Decommissioning of the WR-1 Reactor at Whiteshell Laboratories* (Sagkeeng Land Use and Occupancy Study; Firelight Research Inc. and Sagkeeng Anicinabe 2018) was prepared specifically for the proposed Project. The land use study involved interviews with 33 Sagkeeng

members and identification of 519 site-specific use values within 25 km of the WL site (Table 6.8.1.5-1). Site-specific data were mapped according to five categories of values. These included: Habitation values (including temporary, occasional, seasonal and permanent camps and cabins); Cultural and Spiritual values (including burial sites, ceremonial areas and community gathering areas); Subsistence values (including harvest and kill sites, plant collection areas and trapping areas); Environmental Feature values (including specific, highly-valued habitat for moose, elk and deer); and Transportation values (including trails, water routes and navigation sites).

Values were generally labelled according to four categories: Water; Medicine, Berries and Other Food Plants; Hunting and Trapping; and, Anicinabe Pimatiziwin. The Water category focused primarily on catch sites for numerous fish species such as: sturgeon, suckers, goldeye, sunfish, carp, whitefish, pickerel (walleye), pike and catfish spawning areas. Water sites can also include wild rice harvest sites and drinking water sites. It should also be noted that Water is important as it was historically the key travel corridor and is still a major way in which harvesters access areas. The Medicine, Berries and Other Food Plants category included areas for harvesting medicinal plants and food products such as blueberries, plums, raspberries, strawberries, gooseberries, chokecherries, pin cherries, saskatoon berries, low bush cranberries. The Hunting and Trapping category included known harvest and processing sites for animal species such as moose, white-tailed deer, beaver, muskrat, otter, rabbit, prairie chickens, squirrel, weasel, fox and also important wildlife sites such as mineral licks.

The study (Firelight Research Inc. and Sagkeeng Anicinabe, 2018) also organizes some values according to the category, “Anicinabe Pimatiziwin”. Anicinabe Pimatiziwin values are those that have a broader social, historical and spiritual significance and include: sacred places and gathering sites used by Sagkeeng members and their ancestors for ceremonial purposes and the transmission of traditional knowledge; camping sites, including those used as a base for fishing and hunting activities; trails and water routes, some of which have been used for multiple generations; and findings of archaeological materials.

Table 6.8.1.5-1: Site-Specific Values Identified by Sagkeeng First Nation

Sagkeeng-identified Valued Components	Within 250 m of the Project		Within 5 km of the Project[a, b]		Within 25 km of the Project[a, b]	
	Reported values (#)	Reported values (%)	Reported values (#)	Reported values (%)	Reported values (#)	Reported values (%)
Water Resources	4	12%	5	9%	172	33%
Medicines, Berries and Other Food Plants	7	21%	13	23%	101	19%
Hunting and Trapping	5	15%	14	25%	61	12%
Anicinabe Pimatiziwin	18	53%	24	43%	185	36%
TOTAL[c]	**34**	**100%**	**56**	**100%**	**519**	**100%**

Source: Firelight Research Inc. and Sagkeeng Anicinabe 2018
a) Values are cumulative; values within 250 m of the Project footprint are included in the values 25 km from the Project.
b) The study area used in the assessment and used by Sagkeeng First Nation in the traditional land use study are different.
c) Totals may not add up to 100 due to rounding.

The types of sites documented within the LSA include (Firelight Research Inc. and Sagkeeng Anicinabe 2018):

- Water Resources: catch sites for species including sturgeon, suckers, and catfish; a sturgeon spawning area;
- Medicines, Berries, and Other Food Plants: areas used for picking blueberries and plums; harvesting areas for medicinal plants;
- Hunting and Trapping: kills sites for white-tailed deer and moose, game processing sites; and
- Anicinabe Pimatiziwin: sacred places and gathering sites for ceremonial purposes and the transmission of traditional knowledge; camping sites including base camps for fishing, hunting, and harvesting; trails and water routes; sites where archaeological materials were found; a burial site; a site where a Sagkeeng member used to lived.

Additional sites documented within 25 km of the WL site include (Firelight Research Inc. and Sagkeeng Anicinabe 2018):

- Water Resources: catch sites for species including sturgeon, suckers, pickerel, goldeye, sunfish, whitefish, perch, carp, pike, bass and catfish; sturgeon spawning areas; fish processing sites; high-value wild rice harvesting areas; and water collection/drinking sites;
- Medicines, Berries, and Other Food Plants: areas used for picking blueberries, raspberries, strawberries, pin cherries, saskatoon berries, low-bush cranberries, gooseberries, chokecherries, and plums and harvesting areas for medicinal plants;
- Hunting and Trapping: trapping areas for beaver, muskrat, otter, rabbit, squirrel, and weasel; kill sites for moose, white-tailed deer, and fox; a mineral lick; and game processing sites; and
- Anicinabe Pimatiziwin values including: sacred places and gathering sites for ceremonial purposes and the transmission of traditional knowledge; a burial site dating back several thousand years; a place where a Sagkeeng First Nation member once lived; an old Sagkeeng village site; camping sites including base camps for fishing, hunting, and harvesting; teaching areas where Sagkeeng First Nation members learned to harvest plants and wildlife; trails and water routes, some of which have been used for multiple generations; sites where archaeological materials were found.

The study noted that:

> *"The site-specific data show that the Project is situated in an area that is highly-valued for fishing, harvesting wild rice, medicines, berries and other food plants, hunting wild game, trapping fur-bearing animals, as well as for participating in important cultural activities such as ceremonies, as well as sharing knowledge with younger Sagkeeng generations. Qualitative interview data clearly reveal the study areas as central to Sagkeeng livelihood, cultural identity and connection to the land, waterways and resources, as it is an area that has been used and relied on by Sagkeeng for generations" (p. 3).*

The study notes, and CNL recognizes, that while 33 individuals participated in the Sagkeeng First Nation TKLUOS, there were potentially more with knowledge of the area that did not participate. It should be noted that a couple of participants in the study reported use at the WL site prior to the development of the WL site; the nearly 60 years of fencing off of the site for nuclear research purposes has reduced the number of Sagkeeng First Nation members who have memories of actively using the WL site.

The sites documented in the *Sagkeeng Anicinabe Land Use and Occupancy Study Specific to Canadian Nuclear Laboratories' Proposed In Situ Decommissioning of the WR-1 Reactor at Whiteshell Laboratories* (Firelight Research Inc. and Sagkeeng Anicinabe 2018) include sites that have been used between 1940 and 2017. Use has changed in response to historical events and external pressures. The Sagkeeng First Nation use the term "impacted baseline" throughout the study to describe their current understanding of baseline conditions for the values included in their study. Sagkeeng First Nation members in the impacted baseline sections describe not only fishing, hunting, gathering, and ceremonial activities but also the external factors that prevent them from fully expressing their rights and culture. These external factors include the continuing effects of residential schools, game wardens and conservation officers, non-Indigenous recreational fishers, private property, and industrial activity like hydroelectric dams, mines and forestry. Residential schools replaced the traditional ways of teaching and learning and contributed to a general loss of language and culture. Several members of Sagkeeng First Nation feel a loss of ability to connect with their identity and traditional way of life as a result of these multiple overlapping barriers imposed on them by forces beyond their control:

> *And that [connection to the land] was taken away during the residential school time, they [children] were taken away from their families. (p. 75).*

The discrimination against ceremonies and Indigenous cultures was transmitted through legislation and had negative effects on Sagkeeng First Nation members' ability to perform ceremonies. By being prevented from participating in ceremonies, some members feel that the very practice of ceremonies in the community was diminished.

> *I don't know if there's anybody that knows how to do those [ceremonies] anymore. Because like I said, you know, the Christianity had a lot of impact on a lot of our stuff that we used to do, eh? You know, it was almost like it was—what would you call it? Outlawed? (p. 76).*

Sagkeeng First Nation members are increasingly experiencing difficulties in exercising their Treaty right to fish in the region and at times feel harassed by officials and non-Indigenous recreational fishers:

> *Well, of course, it has an effect on everybody. You know, the craziest thing about that is you go and exercise a Treaty right and the province of Manitoba turns you into a criminal. (p. 40)*

> *…and the fish, like I said, they don't know – we always put our nets out there [Lee River] and we don't go out there now. You know, the recreational fishermen do, but we'd set nets and then they'd come along, you know, drag them up without even letting us know, we'd just go out there and look, "hey, where's our net!?" you know, they say, "you're not supposed to be here." (p. 41).*

Broader industry presence was also identified as having impacts on the SFN's ability to exercise its rights, with two main developments, the Winnipeg River dams and the Pine Falls Paper Company contributing to environmental degradation, water quality, and associated changes to the resources that sustain the community (Narratives 2020) "The impacts have had lasting repercussions on trust and credibility of proponents for existing and future projects" (p. 37).

Sagkeeng First Nation members commented in the *Sagkeeng Anicinabe Land Use and Occupancy Study Specific to Canadian Nuclear Laboratories' Proposed In Situ Decommissioning of the WR-1 Reactor at Whiteshell Laboratories* that industrial development has also changed traditional land use activities by reducing the availability of wildlife for harvesting and access to the land:

So, when it [development] affects the growth of the plant life, then you're not going to have any animals around. It's going to have an effect on them as well. Then they're not so abundant in that area anymore. And I've noticed a lot of that, even today, like—even with the moose ... And where they used to cut [trees], and we used to go into that area, and see where they cut — the animals weren't there. The beaver aren't there, the weasels, the skunks — all those little animals, and even the deer and the moose aren't in those areas, because the trees are not there. And what they used to rub against, to get the ticks off, or you know, to—their fur, whatever, their winter fur, like you know — so that's affecting all of that. It's not only — like I said, it's not only hydro, it's the industries as well, like take the mining industries, you know, that affect all of that. It affects the environment. You know, they don't — they don't realize the impacts that it has on our areas. And not only that but on the livelihood. Like, I was talking to a couple of relatives of mine that are still fishermen, and they're saying that there's no pickerel (p. 60)During the engagement process for the Project and from the Sagkeeng First Nation TKLUOS, Sagkeeng First Nation identified several interests and concerns regarding Traditional Land and Resource Use (further details are provided in Section 4.4 Summary of Issues Raised During Engagement). These issues are not always specifically linked directly to the Project, but rather the overall operation and closure of the WL site; however, due to their overall importance to the community they are noted herein:

- concerns about the long-term effects of the WL site and the Project on water quality and fish:
  - there is a perceived deterioration of fish quality in the Winnipeg River, which may in part be attributed to the paper mill that previously operated in Pinefalls-Powerview but is also directly linked to concerns raised by prior spills from the WL site into the Winnipeg River and the continued presence of radioactive waste in close proximity to the Winnipeg River;
- an interest in fish monitoring at locations in proximity to the community;
- concern about the availability of wild rice and medicinal plants (calamus root, Labrador tea, wild ginger and waterlily roots) that are safe for future use by Sagkeeng First Nation members;
- concerns about the transport of nuclear materials, particularly in the event of an accident and associated contamination within their traditional territory;
- concerns about not currently being meaningfully engaged in the determination of appropriate end land use goals and designations for the WL, and about the increasing temporal scope (longer into the future) of effects on land use at and around the site as a result of transforming it from a temporary radioactive waste storage facility to a permanent radioactive waste disposal facility; and
- in the Sagkeeng First Nation TKLUOS, Sagkeeng First Nation members identified a set of VCs relating to Sagkeeng knowledge and use that may be impacted by the Project. These values included: water resources; medicines, berries and other food plants; hunting and trapping; and Anicinabe Pimatiziwin. CNL confirmed through discussions that these are values of very high importance to Sagkeeng First Nation.

A summary of the specific issues raised by the Sagkeeng First Nation and specific responses by CNL can be found in Appendix 4.0-1 of Section 4.0.

Brokenhead Ojibway Nation

Information about Brokenhead Ojibway Nation traditional land and resource use has come from community websites, consultations and most recently the traditional knowledge and land use study titled *api migizik pii pa gilot – When Eagles Call Traditional Knowledge and Land Use Study for the WR-1 Nuclear Reactor In Situ Decommissioning Project* (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019), completed in November 2019. This study was undertaken for all three of Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation communities and covers a number of topics including the Worldview of the three communities and perspectives on cultural understandings, spirituality and water. Traditional land use including: the ancestral territory; travelling along the River; fishing; harvesting wild rice, berries and other plants; harvesting medicines; hunting, trapping and other harvesting; sacred sites and cultural gathering areas are described. Concerns are reported about how the Traditional Way of Life is Being Lost; the Project; and on recommendations moving forward.

A total of 56 unique individuals from these communities attended one or more events, interviews and/or visits associated with the study including 19 from Brokenhead Ojibway Nation. The mapping of traditional uses also records information from previous traditional knowledge studies that occurred. The three First Nations documented traditional land use over a large area of southeastern Manitoba, east and southeast of the southern basin of Lake Winnipeg. Generally, this is an area that would be bounded by Selkirk in the southwest, Hecla/Grindstone Provincial Park in the northwest and the Manitoba-Ontario border in the east. Traditional use is documented along river systems, recognizing the importance of rivers as travel corridors. The study (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019) also documents the importance of sacred sites, ceremonies and cultural practices and how the 1876 *Indian Act* banned Indigenous gatherings and ceremonies, which continued for many decades. The study (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019) describes how the communities are trying to re-establish cultural traditions. Important cultural sites such as the Bannock Point Petroforms east of the community of Pinawa are also mentioned.

Within the LSA, one site of interest was documented where a member of the Brokenhead Ojibway Nation participated in land clearing for a building, although they did not share additional details (e.g., who or what the building was for). Within the RSA, Brokenhead Ojibway Nation members identified a historic settlement from the eighteenth century along the south shore of Lac du Bonnet between the Winnipeg River and the Lee River and an area used for medicine picking along the Winnipeg River downstream from the McArther Generating Station. Burial and sacred sites were identified near Pine Falls. (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019).

Brokenhead resource harvesters currently use traditional areas north of the Manigotagan River and as far south as the RM of Brokenhead (Brokenhead Ojibway Nation 2015). This traditional use area spans Treaties 1, 3 and 5 (TRCM n.d.). Brokenhead Ojibway Nation resource harvesting activities occur within wildlife management areas, parks and within reserve boundaries. Resource harvesting sites within this area include locations along the Winnipeg and Brokenhead Rivers (Brokenhead Ojibway Nation 2015). Current resource harvesting activities include, but are not limited to, moose hunting and trapping for muskrat and beaver (Brokenhead Ojibway Nation 2015). Brokenhead continues to address outstanding Treaty Land Entitlement specific claims discussions with the Province of Manitoba and Government of Canada. Included in these discussions is the selection of land within the Whiteshell Provincial Park Petroform area located east and south of Pinawa (Brokenhead Ojibway Nation 2015).

In the traditional knowledge and land use study (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019), Brokenhead Ojibway Nation members also mapped traditional land use outside of the RSA, including along the southeastern short of Lake Winnipeg, as well as some use along the Winnipeg River. Brokenhead Ojibway Nation community members described traditional uses in these areas including: plant harvesting, fishing, hunting and trapping. The Winnipeg River itself was identified as an important area of plant harvesting, particularly medicinal plants with wild rice and berries formerly harvested in the Whiteshell Provincial Park area. Some other harvest of pulp/cord wood (commercial harvest) was recorded further east.

The collective study (Black River First Nation, Brokenhead Ojibway Nation, and Hollow Water First Nation 2019) discussed cumulative effects in terms of external factors that have influenced traditional land and resource use activities. Factors mentioned include the highway going through the Brokenhead Ojibway Nation reserve, increased pollution, hydroelectric dams, the Pine Falls Paper Mill, hog farms, and the Whiteshell Laboratories. One Brokenhead Ojibway Nation Elder noted that

> *"hydro development impacts hunting, trapping, and harvesting. The mouth of the river was liveable area before hydro dams" (p. 56) and*
>
> *"the paper mill in Pine Falls – that's a hotspot for cancer. All those people down the river, those people drank that water (p. 56).*

Brokenhead Ojibway Nation identified the following interests and concerns during the engagement process (further details are provided in Appendix 4.0-1 of Section 4.0). These issues are not always specifically linked directly to the Project, but rather the overall operation and closure of the WL site; however due to their overall importance to the community are noted herein:

- Traditional and cultural perspectives are important in relation to the Project.
- Interests regarding future land use in relation to the overall site closure.
- Concerns regarding water quality, particularly as waters flow from the east, from the west, into the Winnipeg River system, and into Lake Winnipeg. The watershed extends to Hudson Bay.
- Concerns about contamination in the Winnipeg River and a distrust in monitoring results and the ability to predict future effects were expressed.
- Concerns about potential effects to wildlife and to human health.

Further to this, in the traditional knowledge and land use study, Brokenhead Ojibway Nation identified the importance of water and concerns about moving nuclear material to the traditional territories of other communities (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019). A summary of the issues raised by the Brokenhead Ojibway Nation and specific responses by CNL can be found in Appendix 4.0-1 of Section 4.0.

Black River First Nation

Information about Black River First Nation traditional land and resource use has come from community websites, consultations and most recently the traditional knowledge and land use study titled *api migizik pii pa gilot – When Eagles Call Traditional Knowledge and Land Use Study for the WR-1 Nuclear Reactor In Situ Decommissioning Project* (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019), completed in November 2019.

A total of 56 unique individuals from these communities attended one or more events, interviews and/or visits associated with the study including 21 from Black River First Nation. The mapping of traditional uses also records information from previous traditional knowledge studies that occurred. The three First Nations documented traditional land use over a large area of southeastern Manitoba, east and southeast of the southern basin of Lake Winnipeg. Generally, this is an area that would be bounded by Selkirk in the southwest, Hecla/Grindstone Provincial Park in the northwest and the Manitoba-Ontario border in the east. Traditional use is documented along river systems, recognizing the importance of rivers as travel corridors.

Within the LSA, Black River First Nation did not document site-specific values. Within the RSA, Black River First Nation noted fishing areas in the Winnipeg River downstream of McArthur Falls and from Powerview-Pine Falls to the mouth of the Winnipeg River. It was noted by a Black River elder that sturgeon fishing would occur on the Winnipeg River by McArthur Falls. Previous traditional knowledge and land use studies also documented other fishing locations upstream from Powerview-Pine Galls and habitation sites near the shores of the Winnipeg River (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019).

The Black River First Nation's traditional lands are primarily located south of the Manigotagan River, west of the Manitoba-Ontario border, and north of the Winnipeg River in Treaties 3 and 5 (Handkamer 2016; TRCM n.d.). Prior to the 1940s, Black River First Nation members participated in cattle ranching along with horses and hay fields, established in proximity to the community, which were important activities for the community (Black River First Nation 2015). In the following years members of Black River maintained an economy based on commercial fishing, logging and cutting cord wood (Black River First Nation 2015). Traditional resource use has historically been and continues to be important to members of Black River First Nation. Resource use activities include hunting, fish, trapping, wild rice harvesting and plant collection both a far a field and near the community (Black River First Nation 2015). Members of Black River have historically used the Black and Winnipeg Rivers most frequently for travel (Handkamer 2016). The Black River served as an access route for resource harvesting in the east, specifically wild rice harvesting and hunting near Nopiming Provincial Park (Handkamer 2016). Black River First Nation is currently pursuing a claim with the federal government regarding the Treaty 5 Disparity Claim concerning per capita reserve land allotment and the lack of free and informed consent to this disparity at the time of the later adhesion to Treaty 5 document (Maurice 2016).

In the traditional knowledge and land use study (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019), Black River First Nation members also mapped land use outside of the RSA, including along and near the Little Black River and throughout the area east of the southern basin of Lake Winnipeg. Black River First Nation community members described traditional uses in this broader area including: fishing, hunting, plant harvesting, trapping, travel routes and wild rice harvesting. Some plant harvesting and fishing was also reported approximately 25 km away from Whiteshell Laboratories in and near Whiteshell Provincial Park.

The collective study (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019) discusses cumulative effects in terms of external factors that have influenced traditional land and resource use activities. Factors mentioned include government restrictions on harvesting, increased pollution, hydroelectric dams, the Pine Falls Paper Mill, hog farms, and the Whiteshell Laboratories. Elders from the Black River First Nation note that traditional fishing practices of First Nations have been steadily restricted despite Treaty promises that they would be allowed to continue harvesting as before. For example, there are constraints placed on sturgeon fishing as it is listed as a species at risk, which historically had both cultural and subsistence importance to First Nations peoples:

> *"One time we got caught catching sturgeon at Sturgeon Point. We weren't allowed to catch that; I don't know why. Yet the First Nation people have a right to fish for their own use. But we got stopped catching sturgeon. Even when we go as far as the Whiteshell. We're not allowed to catch sturgeon there also. You get a big fine. This was just recently. It's still in effect." (p.50).*

Additional historical factors and current issues that members noted prevent the expression of First Nation members' culture include non-Indigenous resource users and regulations.

> *"Many of our traditional areas have been converted to other land uses over time. We've seen people coming up from the south to come and harvest moose and other game. Increasing regulations, such as the need for a firearm possession and acquisition license, and the need to carry a treaty card also create barriers that discourage land use and sharing with youth." (p.53).*

During the engagement process for the Project, Black River First Nation identified several interests and concerns regarding traditional land and resources use (further details are provided in Appendix 4.0-1 of Section 4.0). These issues are not always specifically linked directly to the Project, but rather the overall operation and closure of the WL site; however due to their overall importance to the community are noted herein:

- The petroforms given to the Black River First Nation by Nanabush are present in the general Whiteshell area, approximately 20 km away from the WL site.
- Black River First Nation holds ceremonies in the Whiteshell area during the period of the Harvest Moon.
- Wild rice was identified as a dietary staple.
- Concerns were expressed about water quality and contamination of the Winnipeg River.

Further to this, in the traditional knowledge and land use study the Black River First Nation shared the importance of water, and concerns about moving nuclear material to the traditional territories of other communities (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019). A summary of the issues raised by the Black River First Nation and specific responses by CNL can be found in Appendix 4.0-1 of Section 4.0.

Hollow Water First Nation

Information about Hollow Water First Nation traditional land and resource use has come from community websites, consultations and the traditional knowledge and land use study titled *api migizik pii pa gilot – When Eagles Call Traditional Knowledge and Land Use Study for the WR-1 Nuclear Reactor In Situ Decommissioning Project* (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019), completed in November 2019.

A total of 56 unique individuals from these communities attended one or more events, interviews and/or visits associated with the study including 16 from Hollow Water First Nation. The mapping of traditional uses also records information from previous traditional knowledge studies that occurred. The three First Nations documented traditional land use over a large area of southeastern Manitoba, east and southeast of the southern basin of Lake Winnipeg. Generally, this is an area that would be bounded by Selkirk in the southwest, Hecla/Grindstone Provincial Park in the northwest and the Manitoba-Ontario border in the east. Traditional use is documented along river systems, recognizing the importance of rivers as travel corridors. No sites were documented by Hollow Water First Nation members in the LSA or RSA (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019).

Hollow Water First Nation's traditional lands encompass an area south of the Bloodvein River, west of the Manitoba-Ontario border, and north of the Manigotagan River in Treaties 3 and 5 (TRCM n.d.). Historically Hollow Water First Nation's primary food source and economy was based on wild rice harvesting on the Wanipigow and Rice Rivers along with Clangula Lake and bays on Lake Winnipeg (Thompson and Bushie 2015). The woodlands were used for hunting and trapping in the winter, fishing along the shores of Lake Winnipeg was popular in the spring, and wild rice was harvested on the shallow rivers and lakes in the fall (Reder 2013). Hollow Water First Nation community members currently maintain the historical tradition of gathering on Black Island to harvest blueberries. Economic activities for the community currently include fishing, hunting, trapping and wild rice harvesting. Fishing is considered the most important of these activities as a majority of community residents are directly employed in the Lake Winnipeg fishery (Manitoba Eco-Network 2010). Hollow Water First Nation does not have any outstanding Treaty Land Entitlement claims (SERDC 2016).

The collective study (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019) discusses cumulative effects in terms of external factors that have influence traditional land and resource use activities. Factors mentioned include government restrictions on harvesting, increased pollution, hydroelectric dams, the Pine Falls Paper Mill, hog farms, and the Whiteshell Laboratories. Additional historical factors and current issues that prevent the expression of First Nation members' culture include regulations and industries' impact on the land. One Hollow Water First Nation Elder commented that

> *I was a trapper for 54 years. [The government is now] taking away hunting rights and [industries are] destroying hunting grounds . . . You need to go 300 metres off the road to hunt now. (p.53).*

Changes to hunting and trapping are more ways in which the cumulative effects of development have slowly altered the traditional way of life:

> *We used to have lots of moose a long time ago. Deer. Rabbits. Now we just have a lot of bannock! (p.54).*

In the traditional knowledge and land use study (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019), Hollow Water First Nation members mapped traditional land use east of the south basin of Lake Winnipeg and generally north of Manigotagan River Provincial Park. Uses documented included: trapping (muskrat, beaver, otter fisher, lynx, fox), plant harvesting (berries, wild rice, plums, cranberries, crab apples, wild rice, Labrador tea, sand berries, blackberries, gooseberries, rose hips), hunting (moose, ducks, geese, fowl), fishing (pickerel (walleye), whitefish, sunfish, perch) campsites, travel routes along the Manigotagan River and commercial uses such as commercial timber harvesting. Hollow Water First Nation members did not identify uses along the Winnipeg River System. Hollow Water First Nation identified the following interests and concerns during the engagement process (further details are provided in Appendix 4.0-1 of Section 4.0). These issues are not

always specifically linked directly to the Project, but rather the overall operation and closure of the WL site; however due to their overall importance to the community are noted herein:

- Concerns about contamination of the soil and of the river were expressed.
- Concerns about fish.

Further to this, in the traditional knowledge and land use study Hollow Water First Nation identified the importance of water, and concerns about moving nuclear material to the traditional territories of other communities (Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019). A summary of the issues raised by the Hollow Water First Nation and specific responses by CNL can be found in Appendix 4.0-1 of Section 4.0.

Wabaseemoong Independent Nations

Wabaseemoong Independent Nations traditional land use area is located in Treaty 3 and is about 60 km wide and 120 km long spanning approximately 6,720 km^2 adjacent to the Manitoba – Ontario border, north of the Town of Kenora (WIN n.d.). The southwest boundary of the traditional land use area is established by the White Dog Parkway, approximately 50 km, which extends along Provincial Road 525 from the intersection of Highway 596. The Parkway continues north through White Dog reserve to the terminus at Caribou Falls located at the confluence of the English River system and the Winnipeg River system (WIN n.d.). This Parkway provides access to approximately one third of the Wabaseemoong Independent Nations traditional land use area and allows the only road access to the north (WIN n.d.). Wabaseemoong Independent Nations has historically used and currently utilizes the English and Winnipeg River systems for traditional land and resource use activities (Energy East Project 2016). Water routes from these two systems have provided resource use access to hundreds of kilometres in all directions (WIN n.d.). Previous discussions with Wabaseemoong Independent Nations, have confirmed interest in the area where traditional land and resource use activities regularly occur (AECL 2001).

In 2018, Wabaseemoong Independent Nations submitted a *Traditional Knowledge and Environmental Impact Assessment Report* (WIN 2018) that considered historical land use data and noted that seven modified map biography interviews had been collected at the time the report was submitted in early 2018 with more interviews to be completed in 2019. The spatial scope for the interviews was focused on the Winnipeg River system. The study (WIN 2018) concludes that members use the Winnipeg River system for a range of purposes.

Before interviews were completed for the study (WIN 2018), some Wabaseemoong Independent Nations members commented on their reluctance to participate because of the historical distrust of government and industry:

> *Many of the community members approached to participate in the study were reluctant to share their knowledge due to personal feelings of mistrust directed towards government and industry initiatives in general; a legacy of the flooding of the One Man Lake reserve and the mercury contamination of the local river systems.* (p. 5)

Wabaseemoong Independent Nations identified the following interests and concerns during the engagement process (further details are provided in Appendix 4.0-1 of Section 4.0). These issues are not always specifically linked directly to the Project, but rather the overall operation and closure of the WL site; however due to their overall importance to the community are noted herein:

- Whitedog is approximately 50 km from the site. Many of their members rely on the land. Although they reside upstream, they are located downwind of the Project.

- Concern was expressed about air emissions, and in particular about the earlier operation of the WL site.
- Concern was expressed that animals do not obey the same sorts of boundaries as humans and could come into contact with hazardous materials.
- Concerns were expressed about fish, and how contaminants can accumulate in fish over time.
- Concerns were expressed about water quality – specifically about the release of hazardous and radioactive materials to the Winnipeg River.

A summary of the specific issues raised by the Wabaseemoong First Nation and specific responses by CNL can be found in Appendix 4.0-1 of Section 4.0.

Manitoba Métis Federation

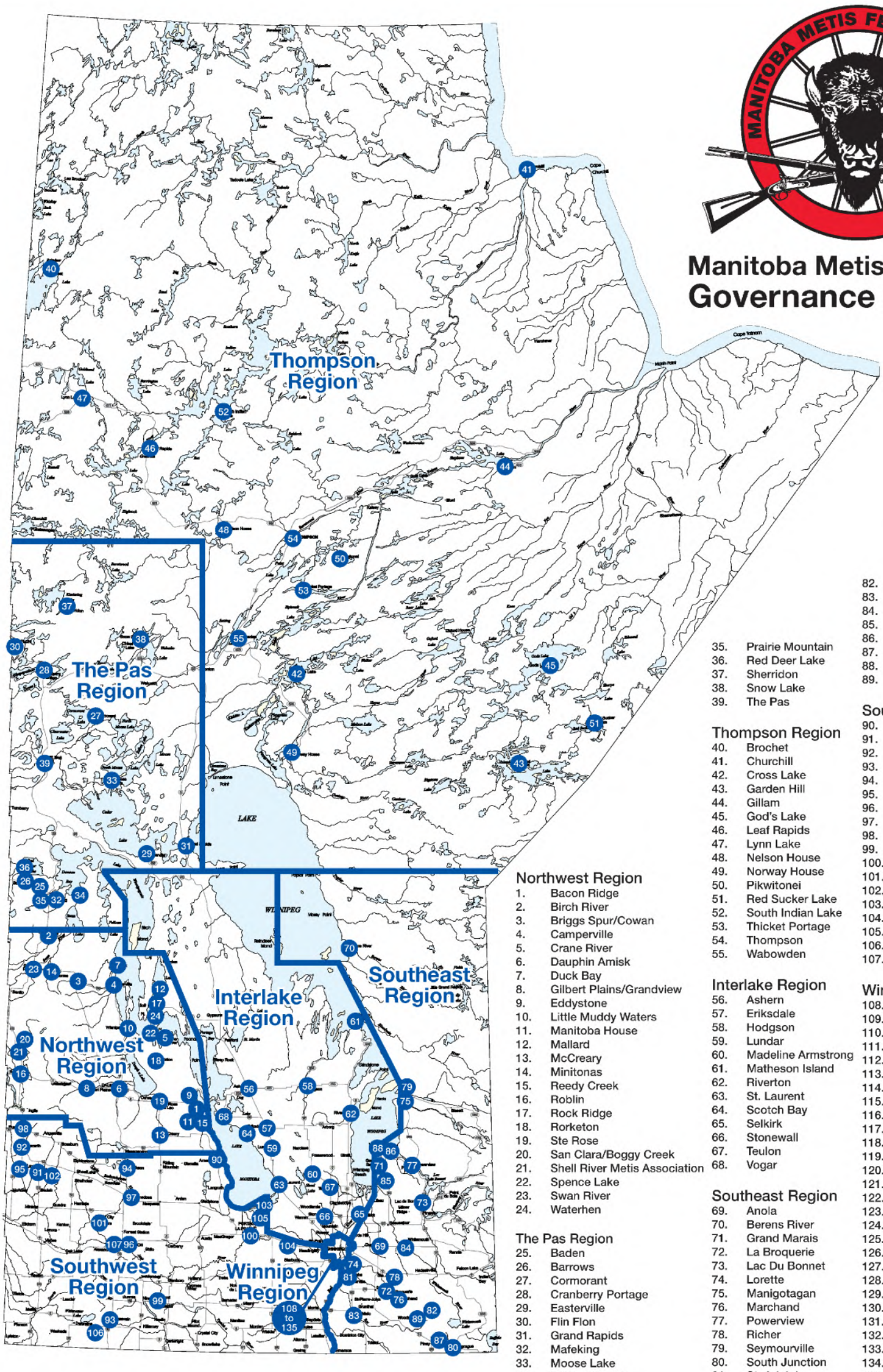
Three Indigenous peoples are constitutionally recognized by the government in Canada, as per s.35 (2) of the *Constitution Act, 1982*. First Nations, Inuit and Métis. The term “Métis” is defined by the Métis National Council (MNC) as: “a person who self-identifies as Métis, is distinct from other Aboriginal peoples, is of historic Métis Nation Ancestry and who is accepted by the Métis Nation.” (MNC 2022). The MNC is a federally recognized national administrative and representative body for the Métis Nation both nationally and internationally since 1983. Five democratically elected provincial organizations exist within Canada and are comprised of regional councils, community councils and Métis locals. The Manitoba Métis Federation is one of these provincial organizations, alongside the Métis Nation of Ontario, Métis Nation Saskatchewan, Métis Nation of Alberta and Métis Nation of British Columbia. The Manitoba Métis Federation is the democratically elected self-government representative of the Manitoba Métis also known as the Red River Métis, an “Aboriginal peoples’ under Section 35 of the *Constitution Act*, 1982 and currently includes the Manitoba Métis Federation Inc., a non-share corporation incorporated pursuant to the laws of Manitoba. Founded in 1967, the Federation has over 650 staff across the province (MMF 2018a).

The Manitoba Métis Federation represents and advance the interests of the Métis people of Manitoba and uses an electoral process where all formal positions are elected by Federation members in each designated Region or Local. Governance includes: a President, Board of Directors, regional associations or “Regions” and community-level "Locals". The President functions as the Federation leader and spokesperson and Chief Executive Officer. This position oversees day-to-day Federation operations and is elected through a province-wide election every four years. A Board of Directors, comprised of 23 democratically elected members, provides guidance, leadership and management toward Federation (and its subsidiaries) policies, objectives and strategic direction. Seven Regions across Manitoba are administered by a vice-president and two executive officers, who are also of the Federation’s Board of Directors, and who administer programs and services independently to their specific geographic area. Each Region comprises various Locals. These are administered by a chairperson, a vice-chairperson and a secretary-treasurer, and have a minimum of nine members which meet at least four times a year. Each Federation member belongs to a Local. Specific Locals determine the timing of election of their respective Local representatives, while regional officers are elected every four years (MMF 2018a).

The governance structure of the Manitoba Métis Federation is provided on Figure 6.8.1-5.

PATH: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0016_EIS_Sec_6.8\20145046-0016-HL-0006_Figure 6_8_1-5 Manitoba Metis Federation Governance Structure.mxd PRINTED ON: 2022-12-06 AT: 9:28:32 PM

Manitoba Metis Federation Governance Structure



Northwest Region
1. Bacon Ridge
2. Birch River
3. Briggs Spur/Cowan
4. Camperville
5. Crane River
6. Dauphin Amisk
7. Duck Bay
8. Gilbert Plains/Grandview
9. Eddystone
10. Little Muddy Waters
11. Manitoba House
12. Mallard
13. McCreary
14. Minitonas
15. Reedy Creek
16. Roblin
17. Rock Ridge
18. Rorketon
19. Ste Rose
20. San Clara/Boggy Creek
21. Shell River Metis Association
22. Spence Lake
23. Swan River
24. Waterhen

The Pas Region
25. Baden
26. Barrows
27. Cormorant
28. Cranberry Portage
29. Easterville
30. Flin Flon
31. Grand Rapids
32. Mafeking
33. Moose Lake
34. Pelican Rapids
35. Prairie Mountain
36. Red Deer Lake
37. Sherridon
38. Snow Lake
39. The Pas

Thompson Region
40. Brochet
41. Churchill
42. Cross Lake
43. Garden Hill
44. Gillam
45. God's Lake
46. Leaf Rapids
47. Lynn Lake
48. Nelson House
49. Norway House
50. Pikwitonei
51. Red Sucker Lake
52. South Indian Lake
53. Thicket Portage
54. Thompson
55. Wabowden

Interlake Region
56. Ashern
57. Eriksdale
58. Hodgson
59. Lundar
60. Madeline Armstrong
61. Matheson Island
62. Riverton
63. St. Laurent
64. Scotch Bay
65. Selkirk
66. Stonewall
67. Teulon
68. Vogar

Southeast Region
69. Anola
70. Berens River
71. Grand Marais
72. La Broquerie
73. Lac Du Bonnet
74. Lorette
75. Manigotagan
76. Marchand
77. Powerview
78. Richer
79. Seymourville
80. South Junction
81. St. Adolphe
82. St. Labre
83. St. Malo
84. Ste Rita
85. Stoney Point
86. Traverse Bay
87. Vassar
88. Victoria Beach
89. Woodridge

Southwest Region
90. Amaranth
91. Assiniboine
92. Binscarth/Ste Madeline Birtle
93. Cherry Creek Metis Council
94. Erickson/Wapiti
95. Fort Ellice
96. Grand Valley
97. Les Metis
98. Pelly Trail/Russell
99. Pembina River
100. Portage
101. Rivers
102. Snake Creek
103. St. Ambroise
104. St. Eustace
105. St. Marks
106. Turtle Mountain
107. Westman

Winnipeg Region
108. Blueberry
109. Bosco
110. Catfish
111. Conseil Elzéar Goulet
112. Dakota
113. Dumont
114. Fontaine
115. Gilbert Park
116. Heritage Proud
117. Infinity
118. Keenleyside
119. Kinew
120. Liberty
121. Metis Elders
122. Michif
123. New Horizons
124. Point Douglas
125. Prairie Buffalo
126. Red River
127. Redboine
128. Riel
129. Seven Oaks
130. South Central
131. Spruce
132. St. Norbert
133. St. Vital North
134. Winnipeg North
135. Winnipeg West

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NOTE(S)

REFERENCE(S)
MMF (MANITOBA MÉTIS FEDERATION INC.)
HTTP://WWW.MMF.MB.CA/DOCS/MMF_FEDERATION_STRUCTURE.PDF

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	SO
PREPARED	SO/RRD
REVIEWED	KL
APPROVED	MM

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
MANITOBA METIS FEDERATION GOVERNANCE STRUCTURE

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0016	2	6.8.1-5

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The Manitoba Métis Community is widely dispersed throughout the province and highly mobile in regard to geographic extent of traditional resource use (Barkwell 2016). In 2012, the Government of Manitoba and the Manitoba Métis Federation signed an Agreement that provides for the recognition of Métis harvesting rights for food and domestic use in mutually agreed to regions of the province and which relies on the Manitoba Métis Federation's *Métis Laws of the Harvest* as the basis for the development of new provincial regulations to govern Métis harvesting (Government of Manitoba et al. 2012). The Agreement generally covered the southern area of Manitoba but also committed the parties to a collaborative process for examining Métis harvesting rights in other regions of the Province. That map is shown on Figure 6.8.1-2.

Recognized Métis Natural Resource Harvesting Areas 36, 34 34B and 25A and Game Hunting Area 26 are situated in the vicinity of the WL site (Manitoba Sustainable Development n.d.f). It should be noted that the WL site on the east side of the Winnipeg River appears to be not in the Recognized Métis Harvesting Area but is in an area labelled as the "Recognized Métis Harvesting Area – Expansion Area" (Figure 6.8.1-4), or provincial Game Hunting Area 26 also known as Manigotagan. Although the WL site is located in an area that the Province of Manitoba has not recognized as a Métis harvesting area (MMF 2018b), CNL acknowledges that the Métis have existing, asserted, and/or harvesting rights in the vicinity of the Project.

According to the Métis Law of the Harvest, Métis harvesters may harvest throughout Recognized Métis Harvesting Area on all unoccupied provincial Crown Lands in Manitoba and occupied provincial Crown lands, including provincial parks, wherever First Nation Members are allowed to harvest; and on any privately owned lands in Manitoba on which that Métis Harvester has been given permission by the owner or occupant, or reserve lands with permission of Band Council (MMF 2013).

According to the Métis Law of the Harvest (MMF 2013), harvest includes hunting, trapping, fishing and gathering for food and domestic use, including sharing, social and ceremonial purposes, of fish, big-game, small game, furbearers, game-bird (upland and migratory), berries, mushrooms, medicinal and other plants including wild rice and firewood or timber. Plant harvesting has been undertaken for food, crafts and medicines and has included birch, cedar, dandelion, milkweed, berries, wood products, roots, nuts and mushrooms. These activities were typically undertaken in the summer months and are known to occur in areas southwest of the Project. During the public and Indigenous engagement process, the Manitoba Métis Federation noted that their citizens' place of residence did not always correlate with their resource use areas, as the population is mobile, and land use tends to be associated with where an individual learned to harvest. As such, their citizens often travel to other locations across the province when undertaking harvesting activities, which reflects the location in which they learned (e.g., where their grandfather taught them).

A traditional knowledge and land use study, titled *Whiteshell Reactor #1 Decommissioning Manitoba Métis Traditional Knowledge, Land Use and Occupancy Study*"(TKLUOS) was prepared by Shared Values Solutions (SVS 2019) for the Manitoba Métis Federation specifically for the proposed Project. A total of ten Métis harvesters were surveyed for the study resulting in the identification of 424 locations of Land Use and Occupancy Values (LUOs). Two study areas were used, the first is a study area that includes 100 m on either side of the Winnipeg River from Seven Sisters Generating Station to the mouth of the Winnipeg River, Lac du Bonnet and the Lee River. The second is a 25 km radial study area around the WR-1. A total of 192 LUOs were mapped within 25 km of the WL site and 75 were within 100 m of the WL site. The LOUs included: access routes; fishing locations; trapping/snaring locations; gathering; commercial guide or land use; Traditional Ecological Knowledge; changes to the environment; hunting; demographic; cultural; and, other land-use (i.e., ice fishing huts). Values were collected temporally by organizing values by the last 10 years; 10 years prior; or both. These uses could occur over the entire individual's life.

The Red River Métis citizens interviewed described land use activities within a 25 km area around the WL site, including access routes, hunting, fishing, trapping, and commercial guiding or other commercial land use locations. In addition, Red River Métis citizens noted sites of cultural significance. One Red River Métis citizen noted that the WL site is excellent deer habitat and that they have seen deer on the riverbank at the site.

Within the LSA, Red River Métis citizens noted areas where they have fished pickerel/walleye, goldeye, and mooneye; gathered firewood; harvested blueberries, cranberries, pin cherries, and saskatoon berries. They also noted a boat launch. No hunting or trapping sites were documented in the LSA. In the RSA, Métis citizens documented numerous fishing spots along the Winnipeg River downstream of the Project. Species fished include sauger, pickerel/walleye, jackfish/northern pike, sturgeon, and perch. Métis citizens also noted areas where they had hunted duck, grouse, and partridge in the RSA. In the RSA, cultural sites documented by Métis citizens include multiple boat launches, an important landscape feature, and a recreational area for tubing (SVS 2019).

The TKLUOS (SVS 2019) provides an overview of the types of traditional knowledge, land use and occupancy values that were collected in the interviews with Métis knowledge holders. This information included the following: current and childhood residences; hunting and trapping sites; fishing locations, including species and temporal scope of fishing activity; gathering of plants for food, medicinal plants and natural materials, including use of gathered materials; commercial fishing, trapping and other land uses for income; culture and heritage resources, sacred sites, archaeological sites, areas of economic importance, other special sites and contemporary gathering places; locations of overnight sites including cabins, other types of structures and camping sites; land and water access routes; Traditional Ecological Knowledge, including locations of fish spawning areas, seasonal mammal habitats and migration routes, bird habitat, wetlands, salt licks, important plant habitat and other significant ecological features; thoughts, perceptions, concerns and unanswered questions about the Project; and, hopes for the future of the Manitoba Métis Community.

The TKLUOS (SVS 2019) noted that:

> "*it can be said with confidence that members of the Manitoba Métis Community rely on and use the lands and waters around the WR-1 site for various cultural and traditional purposes, including actively exercising their s. 35 harvesting and other Aboriginal rights*." (p.2)

The TKLUOS (SVS 2019) goes on to comment that

> "*Despite the noted limitations set out in this report, SVS is of the position that the study provides a reasonable representation of the Manitoba Métis Community patterns of LUO within the study areas.*" (p.24)

A summary of the specific issues raised by the Manitoba Métis Federation and specific responses by CNL can be found in Appendix 4.0-1 of Section 4.0.

6.8.1.5.2.2.2 Winnipeg River

As described in Section 6.4.2 Surface Water Quality, the Winnipeg River is considered to be a medium-sized lowland river (AECL 2001). Its drainage area is approximately 150,000 km^2, originating in Ontario at Lake of the Woods. The Winnipeg River tributaries include the Rainy River (flows into the Lake of the Woods), Black Sturgeon River, English River, Bird River, Lee River, Whiteshell River, Whitemouth River and the Macfarlane River. There are six hydroelectric dams on the river, the closest approximately 7.5 km upstream of the WL site. These dams have extensively modified flow patterns in the river (AECL 2001). Adjacent to the WL site, the river

is approximately 0.3 km wide and 7 m deep, and flows northerly between 436 m^3/s and 1,842 m^3/s to Lake Winnipeg (2010 to 2015 average at Seven Sisters Generating Station; Manitoba Hydro 2016).

Historically, liquid effluent from the Active Liquid Waste Treatment Center was discharged to the Winnipeg River via the process sewer at the sewer outfall located about 8 m offshore in approximately 5 m of water (AECL 2001). The Winnipeg River Task Force (WRTF 1995) looked at potential sources of Winnipeg River water quality degradation near the community of Sagkeeng First Nation. The Task Force found that WL has not had an adverse effect on water quality in the Winnipeg River for downstream communities (AECL 2001). The task force included members from the Sagkeeng First Nation, Environment Canada, Indian and Northern Affairs Canada and Health Canada.

The monthly average of water chemistry for 2011 to 2015 for the intake water at the WL site had concentrations of copper, iron and lead exceeding the Manitoba Water Quality Standards, Objectives, and Guidelines (WQSOG; see Section 6.4.2.5.2.2 Surface Water and Sediment Quality). Phosphorous concentrations in the river also exceed the WQSOG and increased between 2011 and 2015. Recently, the Winnipeg River has been classified as meso-eutrophic (Environment Canada 2015). This indicates that nutrient levels are moderate, which may lead to plant growth and reduced water clarity. Samples collected upstream of the WL site (Pinawa) has consistently had cesium-137 and strontium-90 concentrations below the federal drinking water standard (see Section 6.4.2.5.2.2 Surface Water and Sediment Quality).

During the 2000 sediment investigation, the sediment downstream of the outfall was determined to be erosional, with a clay bottom covered in parts with sand, gravel, cobble and boulders (AECL 2001). The highest measured caesium-137 level in a sediment sample during the 2000 study was 2,610 Becquerels per kilogram (Bq/kg) (AECL 2001). This exceeds the *Nuclear Substance and Radiation Devices Regulation* (SOR/200-207; NSRDR) Clearance Level of 100 Bq/kg for caesium-137. Although the activity level in the sediment at the K03 location is above NSRDR unconditional clearance level, it is well below a human external exposure level of concern 2.8×10^6 Bq/kg. It is also well below the Tier 2 estimated no-effect value (ENEV) for benthic invertebrates' value of 1.5×10^5 Bq/kg. The caesium-137 levels detected in the samples collected during routine monitoring at locations OFL, K03, K05, K14 and K23 from 2010 to 2015 were one to two orders of magnitude lower than the highest 2000 sample (CNL 2020). Caesium-137 levels at all locations except OFL and KO5 were below the NSRDR Clearance Level of 100 Bq/kg. The activity at OFL has historically varied from less than 5 Bq/kg to 75,500 Bq/kg (CNL 2020). Variation of activity is not unexpected for all samples due to the highly localized and spotty nature of the contamination in the river sediments. This variability is the likely reason for the unusually high caesium-137 activity noted in the K05 sample in 2015 (CNL 2020).

As part of the routine monitoring at the WL site, river bottom sediments were collected from twelve locations along the Winnipeg River, ranging from 0.8 km upstream to 13.1 km downstream of the Outfall. In 2015, the gross alpha activity detected in the samples ranged from 214 to 410 Bq/kg (CNL 2020). In five years prior, average minimums and maximums activities ranged from 268±14 to 520±35 Bq/kg. The alpha activity in these samples is due to naturally occurring isotopes such as uranium-238 or thorium-232 and their progeny, as both upstream and downstream samples contain similar levels. All samples are below the NSRDR Clearance Level for naturally occurring uranium-238 and thorium-232 of 1,000 Bq/kg (CNL 2020).

The gross beta activity in sediment ranged from 488 to 781 Bq/kg in 2015 at the twelve sampling locations apart of the routine monitoring (CNL 2020). The previous five years average minimums and maximums ranged from 390±94 to 2,128±1233 Bq/kg. The variability of the average maximum five year range is large due to extremely high concentrations measured in 2012 at K23 of 7,058 Bq/kg. Beta activity includes contributions from naturally

occurring potassium-40 and from caesium-137. The majority of the beta activity for all locations continues to be from naturally occurring potassium-40 (CNL 2020). The NSRDR Clearance Level for potassium-40 is 10,000 Bq/kg.

The Winnipeg River supports a diverse fish community and affords spawning, rearing and foraging habitats. A total of 61 native species are reported for the river (Stewart and Watkinson 2004) and two species at risk are known to be present within the vicinity of the WL site: Lake Sturgeon (*Acipenser fulvescens*) and Carmine Shiner (*Notropis percobromus* [COSEWIC 2019]). Fish occurring within the study reach include species that are primarily resident (present year-round), as well as migratory (passing through). Fish habitat is generally similar throughout the assessment area (Section 6.5.5.2.2 Fish Community).

The Town of Lac du Bonnet and Pinawa draw water from the Winnipeg River System and treat it at their water treatment plants (Province of Manitoba 2004; LGD of Pinawa 2015). Sagkeeng First Nation is the only First Nation in the socio-economic RSA known to draw water from the Winnipeg River for residential purposes (J.R. Cousin Consultants Ltd. n.d.).

6.8.1.6 Project Interactions and Mitigation

6.8.1.6.1 Methods

This section describes the process by which interactions between Project components and activities and traditional land and resource use VCs were identified and evaluated. Potential effect pathways are identified and mitigation developed to eliminate and/or reduce effects is presented. A pathways analysis is then used to focus the assessment on key interactions between the Project and the environment by evaluating the different effect pathways to determine if, after incorporation of mitigation, there is still potential to cause residual effects. Where effects will be adequately mitigated and are not forwarded for further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are described. Primary pathways that may lead to residual effects after incorporation of mitigation are further characterized in subsequent subsections of the assessment. As such, the Project Interactions and Mitigation section helps to focus the remainder of the assessment on those interactions (effects pathways) likely to result in residual adverse effects.

The first part of the analysis was to identify the potential effects pathways for all stages of the Project. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. The next step in the analysis was the development of environmental design features and mitigation practices that could be incorporated into the Project to eliminate and/or reduce effects to traditional land and resource use VCs. Environmental design features included design elements, environmental best practices and management policies and procedures. Environmental design features and mitigation were developed through an iterative process between the engineering and environmental teams, combined with input from project-specific or regional engagement with other interested parties. The design features and/or mitigation activities were selected considering their effectiveness for implementation and maintenance, and their appropriateness within the context of the identified effect pathways.

After incorporation of mitigation, potential pathways were evaluated into the following categories using scientific knowledge, logic, experience with similar developments and the effectiveness of environmental design features and mitigation.

- **No pathway** – pathway is removed by environmental design features or mitigation such that the Project would not be expected to result in a measurable environmental change to measurement indicators identified for traditional land and resource use VCs relative to Base Case values, and therefore would have no residual effects to land and resource use VCs.
- **Secondary pathway** – the pathway could result in a measurable minor change to measurement indicators identified for traditional land and resource use VCs but would have a negligible residual effect on traditional land and resource use VCs relative to Base Case values and is not expected to contribute cumulatively to other Project effects or to the effects of other past, present or reasonably foreseeable developments to cause a significant effect.
- **Primary pathway** – the pathway is likely to result in an environmental change to measurement indicators identified for traditional land and resource use VCs relative to the Base Case that could contribute to residual effects to traditional land and resource use VCs.

Environmental design features and mitigation that have been or could be incorporated into the Project to eliminate and/or reduce adverse effects to traditional land and resource use VCs were considered. Potential pathways that were completely removed due to implementation of environmental design or mitigation were not assessed further. Pathways that were assessed to be secondary and demonstrated to have a negligible residual effect to traditional land and resource use VCs through simple qualitative or semi-quantitative evaluation of the pathway were also not advanced for further assessment.

6.8.1.6.2 Results

Pathways through which all stages of the Project may interact with and result in changes to measurement indicators for traditional land and resource use VCs is provided in Table 6.8.1.6-1.

Table 6.8.1.6-1:Pathways Analysis for Traditional Land and Resource Use Valued Components

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
Overall activities associated with WL site preparation, ISD of WR-1 and decommissioning of above-ground facilities	■ Changes to traditional land use resulting from changes to vegetation, fish and wildlife and their habitats, and surface water quality in the Winnipeg River.	■ The Project is located in an already disturbed area. ■ Temporary supporting infrastructure will be located within the Local Study Area (i.e., previously disturbed and developed area). ■ Erosion and sediment control practices (e.g., silt fences, runoff management) applicable to the region and already in place at the Regional Study Area will be used during decommissioning activities around disturbed areas, where appropriate. ■ Project activity will typically be limited to daytime hours, where possible, and noise will be short-term and sporadic. ■ Decommissioning of the WR-1 Building will be completed in a controlled manner, and no blasting will be required. ■ The planned decommissioning of the WR-1 Building presently involves: ▪ removing the service wings and infilling in these areas with compacted fill; ▪ sealing of open conduits in the building foundation; ▪ grouting the interior portion of the building (containing the remaining components of WR-1) to ground surface elevation and removing the superstructure; and ▪ Installation of reinforced concrete cap. ■ Implementation of CNL's *Environmental Protection* (CNL 2021) and *Management and Monitoring of Emissions* (CNL 2018), which includes operational control monitoring, air verification monitoring and environmental monitoring. ■ As part of CNL's licence with the Canadian Nuclear Safety Commission, environmental monitoring around the WL site is required and will continue for the Project. ■ Follow-up monitoring during the post-closure phase will be completed to verify effects predictions and to provide information for use in adaptive management to address potential unforeseen effects. ■ CNL is committed to involving Indigenous peoples in the follow-up monitoring, including initiatives that considers Indigenous values. This would involve Indigenous peoples during the monitoring stage of the Project to assess potential effects on fish and wildlife resources and changes to vegetation and water quality upon which traditional uses are dependent. It would also involve discussions in post decommissioning monitoring.	Secondary

Table 6.8.1.6-1:Pathways Analysis for Traditional Land and Resource Use Valued Components

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
Overall activities associated with WL site preparation, ISD of WR-1 and decommissioning of above-ground facilities	■ Nuisance factors such as dust and noise may affect the desirability of engaging in traditional land and resources use.	■ Implementation of CNL's *Environmental Protection* (CNL 2021) and *Management and Monitoring of Emissions* (CNL 2018), which includes operational control monitoring, air verification monitoring and environmental monitoring. ■ Implementation of dust management techniques to control dust generated by the Project, consistent with the current Environmental Assessment Follow-up Program. ■ Use of contamination immobilization agents, containment, ventilation and HEPA filters to control generation of airborne emissions during decontamination or removal of contaminated systems or structures. ■ Use of dust suppression methods during building demolition or soil remediation activities to control airborne emissions and dust during building demolition or soil remediation. Methods may include: ▪ wetting techniques during demolition to limit mobility of dust; ▪ wind restrictions during demolition to stop work or apply wetting techniques; and ▪ hydro seeding during backfilling and landscaping to reduce soil erosion. ■ Removal of accumulations of particulates (e.g., dirt) on road as soon as possible. ■ On-site vehicles and equipment engines will meet Tier 3 emission standards, where possible, and be maintained in good working order. ■ Limit idling of vehicles on-site and speed on roads. ■ Use of tarps or 3-sided enclosures for raw material storage. ■ Road watering and chemical dust suppressant when necessary. ■ Decommissioning activity will be limited to daytime hours and noise will be short-term and sporadic. Decommissioning of the WR-1 Building will be completed in a controlled manner, and no blasting will be required. ■ CNL is committed to involving Indigenous Nations during the monitoring stage of the Project.	No linkage

Table 6.8.1.6-1:Pathways Analysis for Traditional Land and Resource Use Valued Components

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
Overall activities associated with WL site preparation, ISD of WR-1 and decommissioning of above-ground facilities (continued)	■ Project activities could affect unidentified or unknown heritage resources.	■ Implementation of the Environmental Assessment Follow-up Program for the Project, which describes the commitment to protection and preservation of cultural and archaeological sites. ■ Per the *Heritage Resources Act C.C.S.M. c. H39.1*, if unanticipated heritage resources are encountered during Project activities, the following will apply: ▪ all Project activity in the immediate vicinity will cease; ▪ the Heritage Resources Branch will be contacted; and ▪ based on the information provided, a mitigation plan will be formulated and implemented in consultation with the Heritage Resources Branch. ■ Project activity at the site can resume only after the Heritage Resources Branch has granted permission. ■ Indigenous organizations will be contacted for input with respect to any actions related to heritage resources.	No Linkage
Preparation for and implementation of institutional control	■ The use of ISD as the decommissioning method for WR-1 will change the proportion of the site that can be released for unrestricted use. ■ The Project may change the suitability of the LSA for traditional land and resource uses.	■ Continued activities through the Community Regeneration Partnership to help the region develop economically. ■ Communication of environmental monitoring results to confirm the safety of the WL site and lands around it. ■ Final ISD designed so that projections of doses to members of the public are well below the established limits for dose to any member of the public. ■ Final ISD design will be done to maximize hazard reduction. ■ Continued collaboration with Indigenous Nations on environmental monitoring activities and communication of results. ■ Implementation of an engagement plan supported by a community advisory committee with Sagkeeng First Nation to help address recommendations from their psychosocial impacts study.	Secondary

Table 6.8.1.6-1:Pathways Analysis for Traditional Land and Resource Use Valued Components

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
Preparation for and implementation of institutional control Closure of the entire WL site	■ Decommissioning and reclamation of the entire WL site, including the Project, may change the future land tenure and uses of the WL site.	■ CNL is committed to involving Indigenous peoples in the follow-up monitoring, including initiatives that considers Indigenous values. ■ CNL will work with Indigenous Nations to ensure that relationships endure, grow and adapt to future activities. As such, CNL will establish an Indigenous Advisory Committee and relationship agreements with each engaged Indigenous Nation, which include liaison positions, and create mechanisms to develop and implement initiatives that will help address each Nation's unique interests and concerns related to the Project and the Whiteshell Laboratories Closure Project. ■ Follow-up monitoring during the post-closure phase will be completed to verify effects predictions and to provide information for use in adaptive management to address potential unforeseen effects. Results will be shared with Indigenous Nations. ■ Continued activities through the Community Regeneration Partnership to help the region develop economically. ■ The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe, and in keeping with the post-closure land use classification and release criteria to achieve the planned end-states. ■ Affected areas will be remediated to meet the WL preliminary soil cleanup and the non-radiological and radiological clearance and release criteria in accordance with the target end state of the associated land-use category. ■ Engagement with Indigenous Peoples on future uses of the WL lands surrounding the WL site. ■ Continued collaboration with the Sagkeeng First Nation on initiatives that support the community's cultural expression and reconnection to the land on site.	Secondary

6.8.1.6.2.1 No Linkage Pathway

The following pathway was assessed as having no measurable environmental change and hence, no linkage to residual effects on traditional land and resource use VCs.

- **Project activities could affect unidentified or unknown heritage resources.**

Although there are currently no archaeological sites located on the WL site, there is a site located approximately 1,700 m south of the WL site (AECL 2001) and the Winnipeg River has been an important travel route throughout history, potentially beginning in the Paleo Indian Period (*ca.* 11,000 to 7,000 years ago). Project activities that could affect cultural and archaeological sites include those activities that could cause ground disturbance of any previously undisturbed area, especially if the undisturbed area is located between the western edge of the WL site's built infrastructure and the Winnipeg River.

The Environmental Assessment Follow-up Program for the WL site describes CNL's commitment to the protection and preservation of cultural and archaeological sites. Decommissioning activities are not expected to include any undisturbed land or areas on the WL site. If an unexpected discovery of a heritage resource is made during Project activities, CNL will, in accordance with the *Heritage Resources Act*, cease activities until the Heritage Resources Branch can be consulted on the need to conduct a Heritage Resource Impact Assessment before resuming decommissioning activities. CNL will also engage interested Indigenous organizations with respect to the identification and management of such heritage resources. With this mitigation in place, this pathway is considered to have no linkage to effects on traditional land and resource use.

- **Nuisance factors such as dust and noise may affect the desirability of engaging in traditional land and resource use.**

During construction, traditional land and resource use will be restricted on the WL site, but will continue to persist in locations adjacent to the WL site. Project activities, including site preparation, WR-1 Building demolition and operation of the batch mixing plant, are expected to increase the level of nuisance factors (dust and noise) in the LSA; however they are not expected to have an effect on an individual's land and resource use experience or on harvested species because of mitigation and management practices put in place for the Project.

Nuisance factors could make traditional land and resource use activity experience on the Winnipeg River to the west of the WL site less enjoyable, but changes are expected to be temporary and people will still be able to access the river upstream and downstream of the WL site to engage in activities. No emissions from Project activities are anticipated to exceed the appropriate standards and guidelines (Table 6.2.1-14). Project activity will typically be limited to daytime hours, where possible, and noise will be short-term and sporadic. Decommissioning of the WR-1 Building will be completed in a controlled manner, and no blasting will be required. The loudest decommissioning activity will likely be noise from a percussion hammer on an excavator, which will be used to break up reinforced concrete walls and floors during demolition. This activity will be limited to the interior of the building envelope, which will serve to reduce the level of noise outside the building, and in the surrounding area. The WL site has also retained heavy tree coverage, which provides a natural noise barrier (AECL 2001).

Due to the restriction on use and access to the WL site, the nature of Project-related noise, the absence of threshold exceedances for emissions and mitigation for minimizing dust, which includes implementation of dust management techniques to control dust generated by the Project, nuisance factors as a result of Project activities are not expected to have an effect on traditional land and resource use in the LSA. This pathway is therefore considered to have no linkage to effects on traditional land and resource use. That being said, CNL is aware that Indigenous organizations have indicated their concerns about potential effects on traditional land and resource use that occurs in close proximity to the WL site. CNL is committed to working closely with each nation to develop and maintain monitoring programs that will allow each nation the ability to gather the data they need to inform their communities in a meaningful way, and to help guide the project into the future.

6.8.1.6.2.2 Secondary Pathways

In some cases, a potential interaction with an assessment endpoint exists but mitigation is expected to cause minor changes to the environment and a negligible effect on traditional land and resource use relative to the existing Base Case. The following are expected to result in negligible effects on traditional land and resource use and will not be examined further in the EIS.

- **Changes to traditional land use resulting from changes to vegetation, fish and wildlife and their habitats, and surface water quality in the Winnipeg River.**

The Project could affect traditional land use through changes to vegetation, fish and wildlife and their habitats, and surface water quality in the Winnipeg River. Changes to these VCs could result from a change in the abundance and distribution of resources, the quality of the resource, and the ability to access the resource including fish, wildlife and vegetation. Any of these changes could subsequently affect the ability and the desire to engage in activities in the LSA.

The footprint of the WR-1 Building is approximately 0.07 ha and is located in an area that has been previously disturbed, where wildlife habitat value is considered to be negligible to low. In addition, temporary supporting infrastructure will be located within the LSA on previously disturbed and developed areas. Therefore, the Project is not expected to result in an incremental loss of wildlife habitat from current conditions at the WL site. Erosion and sediment control practices (e.g., silt fences, runoff management) applicable to the region and already in place at the RSA will be used during decommissioning activities around disturbed areas, where appropriate. This will reduce the potential for effects on adjacent natural areas that provide suitable wildlife habitat. Once decommissioning of the WR-1 Building and ISD of WR-1 are completed and the engineered cover installed, the area will be graded and restored with native vegetation. Once institutional control begins in 2027, there will be monitoring activities, but the Project site will remain otherwise undisturbed.

Disturbance Factors

Project activities, including site preparation, demolition of the WR-1 Building and the development of temporary infrastructure, will increase noise levels and the amount of dust produced in the LSA, which could affect the distribution of wildlife species harvested by resource users. Changes to the distribution of wildlife species could in turn affect traditional land and resource use, as they constitute some of the resources on which these activities are dependent. Due to the nature of the noise produced by Project activities (sporadic, short-term, no blasting), wildlife species that live near the WL site are not expected to experience habitat loss (AECL 2001). Increases in dust are expected to be short-term, reversible, and not exceed the appropriate guidelines and standards. Noise and dust are not expected to result in changes of wildlife distribution that could affect traditional land and resource use. CNL has made a strong commitment to ongoing Indigenous engagement. In this context, CNL will be working closely with Indigenous Nations to share information regarding future decommissioning activities, and ensuring we have strong communication on matters that may have consequences in relation to the practice of Indigenous rights. We are confident that our approach will allow us to address any potential concern.

Airborne Dispersion of Contaminants

The Project may result in airborne contaminants that could deposit to soil and surface water, where they could affect vegetation, wildlife/wildlife habitat, fish/fish habitat and surface water quality. Changes to vegetation, wildlife/wildlife habitat and fish/fish habitat could in turn affect traditional land and resource use, as they constitute some of the resources on which these activities are dependent. The Environmental Risk Assessment (ERA) predicated that there will be no exceedances of the 2.4 mGy/day radiation benchmark for terrestrial and riparian biota on or near the WL site resulting from atmospheric releases (Section 6.7.2.7.1 Application Case – Closure Phase). All predicted doses are well below this level. Therefore, it is unlikely that there would be significant adverse effects on terrestrial populations or communities (including terrestrial plants [e.g., berries] and terrestrial wildlife [e.g., snowshoe hare, white-tailed deer and red fox]) as a result of radionuclide releases from closure activities. In addition, the ERA predicts that the total radiation dose to all human receptors (including harvesters) during closure activities is well below the public dose limit of 1 mSv/a (Section 6.7.1.7.1 Application Case – Closure Phase). Since the dose estimates are a small fraction of the public dose limit, no discernable health effects are anticipated due to exposure of potential critical groups to radioactive releases from the WL site during closure.

Waterborne Dispersion of Contaminants

The Project may result in waterborne dispersion of contaminants that could affect vegetation, wildlife/ wildlife habitat, fish/fish habitat and surface water quality. Waterborne dispersion may occur after the start of institutional control through leakage via the grouting to groundwater. Groundwater may then migrate to surface water at the Winnipeg River, where contaminants could travel downstream and affect vegetation, wildlife/wildlife habitat and fish/fish habitat. Changes to water quality or fish/fish habitat could in turn affect traditional land and resources use, as they constitute some of the resources on which these activities are dependent. The ERA predicts that there will be no exceedances of the 9.6 mGy/day radiation benchmark for the aquatic biota in the Winnipeg River (Section 6.7.2.7.2 Application Case – Post-closure Phase). Similarly, there are no predicted exceedances of the 2.4 mGy/day radiation benchmark for terrestrial and riparian biota on or near the WL site (Section 6.7.2.7.2 Application Case – Post-closure Phase). All predicted doses are well below these levels. For non-radiological contaminants of potential concern, the ERA predicts no exceedances of cadmium, lead, HB-40 and xylene exposure to ecological receptors. Therefore, it is unlikely that there would be significant adverse effects on either aquatic or terrestrial populations or communities as a result of radionuclide releases or the release of non-radiological contaminants from post-closure activities.

There are no anticipated exceedances for the radiation benchmarks for human receptors, including an on-site harvester, a farm north of the WL site on the Winnipeg River, and an on-site farm, a human receptor located on the Whiteshell Reactor Disposal Facility (WRDF; i.e., the end-state of the Project). The on-site farm receptor was assessed because the temporal boundary of the post-closure phase extends past a number of human generations. The total radiation dose for all receptors are below the public dosage limit of 1 mSv/a and the dose constraint for the Project of 0.25 mSv/a for all age groups (Section 6.7.1.7.2 Application Case – Post-closure Phase). Since the dose estimates are a small fraction of the public dose limit, no discernable health effects are anticipated due to exposure of these receptors to radioactive releases from the WL site during the post-closure phase.

The doses to human receptors that could be exposed to the non-radiological contaminants of potential concern in surface water during post-closure were calculated based on total concentration (background plus Project contribution). Incremental hazard quotients were compared to a benchmark hazard quotient of 0.2, which is consistent with Health Canada. The hazard quotients derived for constituents of potential concern were below the protective benchmark for all receptors, with the exception of a toddler harvester, which slightly exceeded the benchmark. If only the project contribution is considered, the HQs are reduced even further, and hazard quotients are well below for all receptors (the Project contribution to the total is 0.0021% for cadmium and 0.00002% for lead). Therefore, no discernable health effects are anticipated due to exposure of potential critical groups from the Project during post-closure.

Summary

Through these pathways, the Project is expected to have a negligible effect on traditional land and resource use according to western scientific analysis. There are not anticipated to be any threshold exceedances in harvested receptors through atmospheric releases and waterborne dispersion of contaminants. In addition, the mitigation proposed to minimize Project effects on surface water quality, the aquatic environment, and the terrestrial environment, are anticipated to eliminate or mitigate any potential adverse effects to the resources on which traditional land and resource use are dependent. These pathways are therefore characterized as secondary.

Based on their worldview and experience, the Indigenous Nations studies reached different conclusions than the western scientific analysis completed for the EIS. As the Black River First Nation, Brokenhead Ojibway Nation, and Hollow Water First Nation (2019) note:

> *"As Anishinaabe Traditional Knowledge holders, we have concerns about the decommissioning of this nuclear reactor that cannot be addressed through science. We want to acknowledge that CNL has given careful scientific consideration to our questions and that CNSC is providing a second scientific opinion on the project." (p. 59)*

In their TKLU Study (Firelight Group Inc and Sagkeeng Anicinabe 2018), SFN members shared that they believed that the Project would affect the resources they harvest. For example:

> *I think [decommissioning the site] will affect the animals and the plant life in there (p. 81); and*
>
> *…because of the radioactive stuff I wouldn't feel comfortable taking stuff in that area. I don't even feel comfortable because knowing that it could actually seep into the river, yeah. And we're downstream from where that site is, a lot of our animal life like I said is not safe (p. 83).*

Métis citizens also believe that the Project could affect the health of fish, birds, and deer over time and in turn affect their health (SVS 2019):

> *If that stuff's going to get in the deer, it's not [just] going to impact the deer, it's going to impact the people eating the deer, right? So by the time we figure that out it's going to be too late (p. 52).*

According to the Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation (2019), the Project could ultimately affect the Winnipeg River:

> *Water is strong. When it rains, it leaves a lot of water on the ground. Lots of it sinks. It is still going to get into the ground no matter what they put on top. Eventually it will go into the river (p. 65).*

The Wabaseemoong Independent Nations in their review of the EIS expressed their believe that the Project will change resources and their availability. In particular they are concerned about the destruction and alteration of habitat, changes in water quality, and modified ecosystem function, and bioaccumulation, which would affect their ability to engage in traditional land use activities (WIN 2018).

Indigenous Nations have indicated their concerns and perceptions about potential effects on wildlife, fish and plants and the resulting effects on traditional land and resource use that occurs close to the WL site. To address the difference between the conclusions of the effects assessment and the TKLU studies, CNL has engaged with Indigenous Nations to understand their perspectives on Project effects and develop opportunities and mechanisms for their ongoing involvement and participation, which are described in more detail in Section 6.8.1.7. The measures proposed in Section 6.8.1.7 to involve Indigenous Nations in a country food monitoring program and risk communication program, environmental monitoring and communication efforts to help demonstrate ongoing protection of the environment. CNL is committed to involving Indigenous peoples during the monitoring stage of the Project to help better understand and alleviate such concerns.

- **The use of ISD as the decommissioning method for WR-1 will change the proportion of the WL site that can be released for unrestricted use.**
- **Decommissioning and reclamation of the entire WL site, including the Project, may change the future land tenure and uses of the WL site.**

The WL site has been operational since the 1960s, with restrictions on public access for safety and security reasons. Exceptions to this include parcels of the WL site on the west side of the Winnipeg River that have been continuously used for agricultural purposes under agreements with AECL. The area to the east of the WL main campus has been left undeveloped and is meant to act as a buffer to the industrial site (LGD of Pinawa 2004). No traditional land and resource uses are permitted on the WL site. Traditional land and resource use activities have persisted adjacent to the site, including uses of the Winnipeg River. It is expected that activities and land use adjacent to the site will be able to continue in the future as the Project will have no effect on land tenure or usage beyond the WL site boundaries.

Future use of the WL site will depend on the ability to release parts of the site with no restriction on use upon completion of the Project. Future uses/zoning have not been determined, but the end-state plan for the WL site is to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-state. The criteria developed will prioritize the environment and safety while incorporating Traditional knowledge if provided. Indigenous Nations priorities will also be included provided they align with environmental and safety priorities. Some lands will have restrictions on the future use so that there are no adverse effects to people and the environment as assessed in the safety assessment and modelling associated with the ISD of infrastructure and facilities, such as WR-1 and the Waste Management Area. These areas will require ongoing controls including institutional control, access restrictions and environmental monitoring. However, the amount of land associated with these areas is negligible relative to the size of the WL site that will have no restrictions on land use. CNL will be engaging Indigenous Nations in a discussion on future uses for the WL site, with site closure planned for early 2027.

The following are the key roles and responsibilities to determine the future use of the WL site:

- AECL owns the site and has responsibility for all assets and liabilities.
- CNL is the contractor responsible to perform the decommissioning and site remediation of the WL site.
- CNL is preparing a Land-Use and End-State Plan defining the end state criteria in collaboration with stakeholders, Indigenous Nations and the public, and will submit it to the CNSC for acceptance.
- CNL informs and engages the public, Indigenous, and other key stakeholders such as the Province of Manitoba.

While the Project will change the proportion of the site with restricted access and future uses, decommissioning is designed with the environment and safety as a priority. Future use will incorporate Traditional knowledge and CNL will work collaboratively with Indigenous Nations so their concerns can be considered and aspirations around the site incorporated. Since the Project will make the WL site safer when compared to baseline conditions and it will increase the amount of land available for future use in the LSA, these pathways are categorized as secondary.

The Project in combination with the decommissioning and reclamation of the WL site is also anticipated by CNL to contribute to positive effects on the environment, which will positively affect traditional land and resource use within the RSA (e.g., less industrial activity that could affect hunting, fishing, trapping and plant and berry gathering). Consequently, cumulative effects from the Project in combination with the decommissioning of the remaining infrastructure and support facilities, and reclamation of the affected areas at the WL site are anticipated to be negligible.

- **The Project may change the suitability of the LSA for traditional land and resource uses.**

The WL site was established in the 1960s with WR-1 becoming operational in 1965. Since that time, there have been nuclear research and more recently, decommissioning activities at the site. The area around the WL site in the LSA is currently used for agricultural activities, wildlife harvesting activities, fishing and private residences. Decommissioning activities at the WL Site do not appear to have altered traditional land and resource use in proximity to the WL site with activities, as such deer hunting and fishing still popular. For example, Métis citizens have used the LSA for traditional land and resource use activities within the past 10 years (SVS 2019). Other land and resource use activities are described in Section 6.8.2. The presence of the encased WR-1 is not expected to cause changes in these existing activities, although a small number of users may consider areas in proximity to the site as less optimal than if the reactor had been removed in its entirety.

The Project will be engineered to demonstrate long-term safety through a combination of site characteristics and engineered design features and to isolate and contain contamination inside the reactor vault and limit releases of hazardous substances, including radiological substances. According to the ERA, thresholds for airborne and waterborne contaminants will not be exceeded as a result of the Project (EcoMetrix 2021). Therefore, there is no need to change land use category of the land released for unrestricted use or of the land in the LSA around the WL site; however, the presence of an encapsulated reactor and associated perceptions may make engaging in activities in the LSA less desirable for some users.

While the western scientific analysis concludes that for most environmental disciplines, there are no residual effects predicted, and where there are residual effects (i.e., Section 6.7 Human and Ecological Health), they are not predicted to be significant, Indigenous Nations have reached other conclusions in their Project-specific studies. The Black River First Nation, Brokenhead Ojibway Nation, and Hollow Water First Nation (2019) acknowledge the differing lenses for analysis.

> *We want to acknowledge that CNL has given careful scientific consideration to our questions and that CNSC is providing a second opinion on the project. However, experience shows that even good science has been wrong in the past…We are people of the land, not nuclear scientists, and it is important that we share the concerns we see through our worldview.* (p. 59)

In the studies, the Indigenous Nations express their uncertainty regarding the Project's durability and longevity (Firelight Group Inc. and Sagkeeng Anicinabe 2018; SVS 2018; Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation 2019; WIN 2018). Some members note that the uncertainty could result in a change in their resource use patterns. As one Sagkeeng First Nation member commented (Firelight Group Inc. and Sagkeeng Anicinabe 2018)

> *I don't think I would feel comfortable to be fishing near the area itself (p. 83).*

An Red River Métis citizen shared their uncertainty (SVS 2018):

> *I think there's a lot of unknowns. For me, there's a lot of unknowns, and most of it is, I'm worried about water quality and for the fish, and for migrating birds, drinking water too. And whether or not, I'm not sure if the decommissioning will put more pollution into the water, or if it's kind there already and we're stuck with it no matter what happens. (p. 51)*

Sagkeeng First Nation has expressed concerns regarding gaps in the assessment of effects to traditional land and resource use and the processes followed to arrive at conclusions. This included questions around how Indigenous people were engaged in the assessment process, from the identification of pathways, the assessment of effects on traditional land and resource use, and verification of CNL's conclusions. Sagkeeng First Nation would prefer to

see changes to traditional land use behaviours arising from fear and stigma assessed as a primary pathway. Fundamental to the concerns is the use of a "damaged baseline" in which Indigenous peoples have been alienated from the site and its surroundings for the past 60 years, meaning that the assessment will inevitably arrive at a conclusion of no significant adverse effect.

To support continued understanding and dialogue around the suitability for use of the WL site and the lands around it for traditional land and resource use purposes, and to address the difference between the conclusions of the effects assessment and the TKLU studies, CNL will support robust communication of environmental monitoring results to confirm the safety of the WL to and help address concerns about future uses. To date, CNL has engaged with Indigenous Nations to understand their perspectives on Project effects and develop opportunities and mechanisms for their ongoing involvement and participation, which are described in more detail in Section 6.8.1.7. For example, beginning in 2019, the Manitoba Métis Federation had an Environmental Monitor observing CNL's environmental monitoring program, and other Indigenous Nations have been extended an invitation to do the same. The measures proposed in Section 6.8.1.7 to involve Indigenous Nations in a country food monitoring program and risk communication program, environmental monitoring and communication efforts to help demonstrate ongoing protection of the environment. CNL is committed to involving Indigenous peoples during the monitoring stage of the Project to help better understand and alleviate such concerns.

CNL will continue to use a public website and other media mechanisms to share information and receive feedback from local communities and Indigenous peoples through the duration of the Project. Future communication mechanisms to keep local communities and Indigenous peoples informed will be determined as necessary, and in consultation with them. Collaboration and information sharing with Indigenous Nations will be important to ensuring mitigation is effective. Overall, with mitigation and engagement in place, Project effects on traditional land and resource use are expected to be negligible. These pathways are therefore characterized as secondary.

6.8.1.6.2.3 Primary Pathways

There are no interactions with primary linkages to effects to the traditional land and resource use VC. While Indigenous Nations in their TKLU studies reached different conclusions related to the Project's effects to traditional land and resource use, CNL's ongoing commitments to collaborating with Indigenous Nations on mitigation and monitoring, are expected to keep all pathways secondary, which means there may be a minor detectable change to measurement indicators but they are expected to be negligible relative to the Base Case.

6.8.1.7 Monitoring and Follow-up

As there are no primary pathways for traditional land and resource use VCs, monitoring is not anticipated for traditional land and resource use. However, CNL will implement an Environmental Assessment Follow-up Program for the Project that will be integrated with the existing Environmental Assessment Follow-up Program for the WL site. The Environmental Assessment Follow-up Program for the Project will include sufficient information on the type, quantity and quality of information required to reliably verify effects predicted by the environmental assessment and confirm the effectiveness of mitigations. Wherever possible, existing programs will be adapted to meet the objectives of the Environmental Assessment Follow-Up Program for the Project.

Monitoring for environmental pathways (i.e., for air quality, water quality and groundwater quality) will be implemented to verify effects predictions for traditional land and resource use. It is noted that data generated by the monitoring program will be evaluated on an ongoing basis within an adaptive management framework. Within this framework, modifications to the program may be appropriate to confirm data continue to fulfill program objectives. For example, should a contaminant of potential concern reach concentrations outside the range

predicted in the EIS or Decommissioning Safety Assessment Report, the frequency of sampling may be increased and additional locations may be sampled to investigate the source of the increased concentrations. Conversely, cessation of a monitoring activity might be appropriate once it has been shown that an effect has stabilized or has been reduced to a level where it is no longer considered significant with respect to regulatory requirements or community concerns. Any proposals for modifications to the monitoring program and the rationale for the modifications will be communicated to the Canadian Nuclear Safety Commission prior to implementation. Additional information on the Environmental Assessment Follow-up Program for the Project can be found in Section 11.0 Summary of Monitoring and Follow-up Programs.

During Project engagement activities, the First Nations and the Manitoba Métis Federation expressed concerns about the potential long-term effects of the Project on the environment, including different conclusions about Project effects. They indicated that the health of the environment, species relied on for fishing and harvesting, and the risk to people in the area of the WL site are of great concern. They also expressed an interest in being actively involved in the development and implementation of an ongoing monitoring program.

To address the differing conclusions and uncertainty, CNL is committed to involving the First Nations and the Red River Métis in monitoring and to engaging with them over the long-term to address ongoing concerns. This section outlines commitments and suggestions made by CNL to the Black River First Nation and Hollow Water First Nation, the Manitoba Métis Federation, and Sagkeeng First Nation on the topic of environmental monitoring, including next steps. CNL intends to continue to work with the First Nations and Métis peoples to increase mutual knowledge and awareness of environmental monitoring activities at the Whiteshell Laboratories, including the use of Indigenous Environmental Monitors in monitoring activities.

For Black River First Nation and Hollow Water First Nation, CNL has proposed hosting a community workshop to discuss CNL's environmental protection program and look for ways to include species of interest to Indigenous Nations into CNL's environmental protection program. CNL will work with the community to develop a plain language summary report for CNL's annual environmental monitoring reports, explaining the results and main conclusions, and share this document with all the Indigenous Nations. In addition, CNL has committed to supporting the Indigenous Nations participation in environmental monitoring. While not specific to environmental monitoring, CNL has committed to funding Black River First Nation and Hollow Water First Nation's engagement proposal, which may include participation in environmental monitoring activities. CNL has also committed to engage with Black River First Nation and Hollow Water First Nation to discuss future land use for the WL site.

CNL is committed to working with the Manitoba Métis Federation on their long-term interests such as environmental monitoring by sharing monitoring results, seeking input on our current environmental protection program, implementing improvement based on feedback received from Manitoba Métis Federation, and discussing potential remediation as necessary. CNL hosted a technical workshop with Manitoba Métis Federation and their consultants, Shared Value Solutions Ltd, to further explore and address the issue of ground water monitoring. CNL regularly invites Indigenous Nations to observe and participate in CNL's environmental monitoring activities. CNL will provide a plain language summary report to support CNL's annual environmental monitoring reports. CNL has also committed to engage with Manitoba Métis Federation to discuss future land use for the WL site.

The Sagkeeng First Nation is located downstream from the WL site and therefore has a different relationship to the Project, which is reflected in CNL's commitments. CNL has extended an invitation to the community for participation in environmental monitoring on the WL site. CNL has committed to the collaborative development of a Community Environmental Monitoring Program with Sagkeeng First Nation. In addition, CNL regularly invites Indigenous Nations to observe and participate in CNL's ongoing environmental monitoring activities. CNL will

provide a plain language summary report that summarizes CNL's annual environmental monitoring reports. Further to this, CNL is committed to the following:

- CNL has committed funding to support SFN's Indigenous Liaison for two years;
- CNL has committed to provide monthly engagement summaries to Sagkeeng First Nation to enhance community understanding;
- CNL has committed to hosting workshops and webinars, as suggested by Sagkeeng First Nation's Liaison, to share information about the safety of in-situ disposal as it relates to people and the environment;
- CNL has committed to engage with Sagkeeng First Nation to discuss future land use for the WL site; and
- CNL has expressed interest in exploring initiatives that will support SFN's reconnection to the land on the WL site through ceremony or other cultural activities, as well as through the International Centre of Indigenous Knowledge and Wellness at Turtle Lodge.

6.8.1.8 Conclusions

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). The traditional land and resource use VCs chosen for the Project to reflect identified concerns, professional judgement and/or standard practice in environmental assessment are Cultural and Archaeological Sites, Traditional Land and Resource Use by Indigenous Peoples and the Winnipeg River.

The Project could affect traditional land use through effects to vegetation, fish and wildlife and their habitats, and surface water quality in the Winnipeg River. Changes to these VCs could result from a change in the abundance and distribution of resources, the quality of the resource, and the ability to access resources including fish, wildlife and vegetation. Any of these changes could subsequently affect the ability and the desire to engage in activities in the LSA. There are not anticipated to be any threshold exceedances in harvested receptors through atmospheric releases and waterborne dispersion of contaminants. In addition, the mitigation proposed to minimize Project effects on surface water quality, the aquatic environment, the terrestrial environment, human health and ecological health are anticipated to eliminate or mitigate any potential adverse effects to the resources on which traditional land and resource use are dependent. While CNL is confident in these results, it will continue engaging with Indigenous Nations on mitigation and monitoring.

The WL site has been operational since the 1960s, with restrictions on public access for safety and security reasons. Exceptions to this include parcels of the WL site on the west side of the Winnipeg River that have been continuously used for agricultural purposes under agreements with AECL. No traditional land and resources uses are permitted on the WL site. Traditional land and resource use activities have persisted adjacent to the site, including uses of the Winnipeg River. It is expected that all activities and land uses adjacent to the site will be able to continue in the future as the Project will have no effect on land tenure or usage beyond the WL site boundaries.

In collaboration with Indigenous Nations and the public, CNL is committed to meaningful and ongoing engagement on the WL site remediation and clean-up activities. Although a small proportion of the WL site will have restrictions on use because of the Project, it is still anticipated that the majority of the site will be safe and appropriate for unrestricted use. Overall, decommissioning of the WL site will result in an increase in the amount available for future use in the LSA. This may include transfer of the land to other parties following engagement with stakeholders, Indigenous Peoples and the public. Future uses/zoning have not been determined, but the end-state plan for the WL site is to return lands disturbed by site activities to a condition that is physically stable, safe and in

keeping with the post-closure land use classification and release criteria to achieve the planned end-state. Consequently, the Project is expected to have a negligible effect on traditional land and resource use VCs.

CNL will implement a WR-1 Environmental Assessment Follow-up Program to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. In addition, to mitigate perceptions related to the suitability for use of the WL site and the lands around it, CNL will support robust communication of environmental monitoring results to confirm the safety of the WL site and help address concerns about future uses. CNL will continue to engage with local communities, municipalities and Indigenous peoples.

6.8.2 Other Land and Resource Use

The assessment of other land and resource use includes consideration of non-Indigenous commercial, municipal, and federal land and resource use activities in proximity to the Project. These activities include agriculture, forestry, mineral claims and leases, water use, and outdoor recreation and tourism, sport fishing, outfitting, hunting, trapping, and other winter activities.

6.8.2.1 Scope of the Assessment

The assessment on other land and resource use follows the overall environmental assessment approach and methods described in Section 6.1 Environmental Assessment Approach. The assessment is completed in the following steps.

- **Step 1 – Identify Valued Components (VCs) and define the spatial boundaries, temporal boundaries and assessment cases** (refer to Sections 6.8.2.3 Valued Components and Section 6.8.2.4 Assessment Boundaries) for the assessment of other land and resource use. The VCs, the assessment endpoints and measurement indicators used to assess the Project related changes to other land and resource use; the spatial and temporal boundaries at which the assessment occurred; and the assessment cases considered.
- **Step 2 – Describe the existing conditions** (refer to Section 6.8.2.5 Description of the Environment). Existing conditions in the local and regional areas are described, including the combined effects of previous and existing developments (Base Case). The existing environment represents historical and current land and resource use.
- **Step 3 – Evaluate Project interactions and mitigation** (refer to Section 6.8.2.6 Project Interactions and Mitigation). Project components and/or activities with the potential to affect other land and resource use are identified and mitigation options are presented to limit or avoid effects. A pathways analysis is then used to focus on key interactions between the Project and the environment and determine if mitigation can limit or eliminate the predicted residual effects. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. Where effects are adequately mitigated and are not forwarded for further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are described. Primary pathways that may lead to residual effects to other land and resource use after incorporating mitigation are carried forward to Step 4 for further analysis and residual effects characterization.

- **Step 4 – Present the methods and results of the residual effects analysis**. This step was not required as no primary pathways were identified in the other land and resource use assessment.
- **Step 5 – Describe the level of certainty and management of uncertainty.** This step was not required as no primary pathways were identified in the other land and resource use assessment.
- **Step 6 – Classify and determine the significance of the predicted residual effects**. This step was not required as no primary pathways were identified in the other land and resource use assessment.
- **Step 7 – Identifying monitoring and follow-up** (refer to Section 6.8.2.7 Monitoring and Follow-up) required to confirm effects predictions and address uncertainty.
- **Step 8 – Present a consolidated summary of conclusions and outcomes of the assessment** (refer to Section 6.8.2.8 Conclusions) on other land and resource use.

6.8.2.2 Public Engagement Feedback – Key Interests and Concerns

Key interests and concerns raised by stakeholders/general public related to other land and resource use and the steps CNL took to incorporate it into ongoing engagement on the EIS are summarized in Table 6.8.2.2-1. Other general public interests and concerns are documented in Section 5 Public Engagement.

Interests and concerns raised by Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations during engagement related to the Indigenous land and resource use assessment are summarized in Section 6.8.1, Table 6.8.1.2-1.

Table 6.8.2.2-1: Summary of Key Interests and Concerns Raised by the Public During Engagement Activities Related to the Other Land and Resource Use Assessment

Interest and Concern	Inclusion Status	Additional Information and Rationale
Future Land Use - Requested more information on the plans for the WR-1 site after ISD is completed.	Already included in the environmental assessment. A commitment by CNL to determine the future use of the WL site, including collaboration with local stakeholders has been added to Section 6.8.6.2.2 Secondary Pathways.	CNL is working in collaboration with AECL and will be engaging local communities to discuss and consider options for the future use of the Whiteshell Laboratories site. Changes to land use restrictions associated with the WL site end state as a result of the Project are described in Section 6.8.2.6.2.2 Secondary Pathways.

Table 6.8.2.2-1: Summary of Key Interests and Concerns Raised by the Public During Engagement Activities Related to the Other Land and Resource Use Assessment

Interest and Concern	Inclusion Status	Additional Information and Rationale
Impact on the Winnipeg River	Already included in the environmental assessment.	The continued protection of the Winnipeg River is a key focus of the EIS. Although the assessments indicated that there will be no negative effects on the Winnipeg River or its sediment and aquatic organisms as confirmed in EIS Sections 6.4.1 Hydrology, 6.4.2 Surface Water Quality and 6.5 Aquatic Environment, CNL is planning to include the WRDF in the existing environmental monitoring program. The list of monitoring activities proposed to verify the effects predictions from the Project is provided in Section 11 Summary of Monitoring and Follow-up Programs.
Environmental Monitoring - Information was sought on how the in situ design incorporates ongoing environmental monitoring.	Already included in the environmental assessment.	CNL will implement an Environmental Assessment Follow-up Program for the Project that will be integrated with the existing Environmental Assessment Follow-up Program for the WL site (see Section 6.8.2.7 Monitoring and Follow-up and Section 11 Summary of Monitoring and Follow-up Programs).

6.8.2.3 Valued Components

Valued components refer to socio economic and environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). The other land and resource use VCs chosen for the Project to reflect identified concerns, professional judgement and/or standard practice in environmental assessment are Land Tenure, Outdoor Recreation and Tourism, and the Winnipeg River. The rationale for selecting these VCs is discussed in Table 6.8.2.3-1.

Table 6.8.2.3-1:Valued Components for the Other Land and Resource Use Assessment

Valued Component	Rationale for Selection
Land Tenure	Land tenure considers the uses, allocations and ownership of lands in proximity to the Project, including the Whiteshell Laboratories (WL) site itself. The change in decommissioning for the Whiteshell Reactor 1 (WR-1) Building will decrease the proportion of the WL site available for future land tenure by private or public entities. The use of in situ disposal may also change the perceived suitability of land use surrounding the WL site. The land tenure VC is of known importance to Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations as identified through Traditional Knowledge and Land Use Studies, engagement with CNL, and verification discussions.
Outdoor Recreation and Tourism	The WL site is located in an area with several provincial parks, including the Whiteshell Provincial Park, that offer a variety of outdoor recreation opportunities while also being located near towns and Rural Municipalities (RMs) that rely on cottagers and tourism to contribute to their local economies.
Winnipeg River	The public identified the importance of the Winnipeg River. A number of communities depend on the river for drinking water, recreation and food. The river flows into the Lake Winnipeg, one of the largest lakes in the world. The eastern shore of the lake is included in a United Nations World Heritage Site proposal (Manitoba Wildlands 2008). This watershed is valued for many reasons by many people and groups.

Assessment endpoints are qualitative expressions used to assess the significance of residual effects on VCs and represent the key properties of the VC that should be protected for future generations. The assessments of each VC will incorporate community knowledge where available. Measurement indicators represent properties of the environment and VCs that, when changed, could result in or contribute to an effect on a VC. Measurement indicators can be used to monitor the success of mitigation and management programs. The assessment endpoints and measurement indicators associated with the other land and resource assessment are outlined in Table 6.8.2.3-2.

Table 6.8.2.3-2:Assessment Endpoints and Measurement Indicators for the Other Land and Resource Use Assessment

Valued Component	Assessment Endpoints	Measurement Indicators
Land Tenure	Capacity for continued land use	■ Availability of portions of WL site for alternative future uses. ■ Ability to maintain current land uses/tenures in proximity to the Project.
Outdoor Recreation and Tourism	Continued opportunity for outdoor recreation and tourism activities such as hunting, fishing and trapping.	■ Relative abundance and distribution of fish species. ■ Relative abundance and distribution of wildlife species. ■ Changes to fish and wildlife habitat. ■ Relative abundance and distribution of vegetation and fish and wildlife habitat. ■ Continued opportunity for recreational land use. ■ Perceived suitability of area for outdoor recreation and tourism activities.

Table 6.8.2.3-2: Assessment Endpoints and Measurement Indicators for the Other Land and Resource Use Assessment

Valued Component	Assessment Endpoints	Measurement Indicators
Winnipeg River	Maintenance of self-sustaining and ecologically effective fish populations that are available for fishing.	■ Changes to ambient levels of surface water parameters ■ Relative abundance and distribution of fish species. ■ Changes to fish habitat. ■ Relative abundance and distribution of fish habitat.

6.8.2.4 Assessment Boundaries

6.8.2.4.1 Spatial Boundaries

The spatial boundaries selected for the other land and resource use assessment were chosen because they permit description of Base Case conditions in sufficient detail to enable potential project-VC interactions and effects to be identified, understood, and assessed, including understanding and assessing the contribution of the Project to cumulative effects. These boundaries were developed in consideration of known land and resource use around the WL site and the study areas of other disciplines (e.g., Terrestrial Environment; Human Health) that may have an effect on other land and resource use. The spatial boundaries selected for the other land and resource use assessment are presented on Figure 6.8.1-1.

6.8.2.4.2 Temporal Boundaries

The temporal boundary of the assessment includes effects observed under existing conditions, the timeframe during which Project activities are actively occurring and the duration of predicted residual effects. The duration of an effect is defined as the amount of time between the start and end of a Project activity or stressor (which is related to the Project phases) plus the time required for the residual effect to be reversed. In some cases, a residual effect may be irreversible within the temporal boundaries of the Project if the effects were predicted to last so far into the future that they could not be predicted with any level of certainty (e.g., residual effect lasts for thousands of years). The following phases were identified for the Project:

- **Closure Phase:** Preparation and implementation of in situ disposal (ISD), which includes preparation for ISD, grouting of below-grade structures and systems, removal of above-grade WR-1 structures and systems, installation of the concrete cap and engineered cover, and environmental controls and final site restoration. These activities last from 2022 to 2027.

- **Post-closure Phase:** The post closure phase has two discrete periods: institutional control and post institutional control. Institutional control is estimated to last 100 years during which long-term monitoring and maintenance activities will continue to demonstrate WRDF performance is in compliance with the safety case assumptions and performance modelling. The 100 year timeframe is not related to the design life of the WRDF barriers. The 100-year active monitoring period was selected to ensure that sufficient opportunity is provided to verify the WRDF is performing as expected. Additionally, beyond 100 years, there is less confidence that institutional controls, like access restrictions, can be relied upon. Although the duration of institutional control is estimated at 100 years, it is recognized that it will continue until the CNSC, or the appropriate authority at the time, agrees it is no longer needed.

  Post-institutional control occurs after year 2127 and continues indefinitely. The post-closure phase will continue indefinitely; however, the timeframe defined for assessment of potential effects as part of the normal evolution of the Project is 10,000 years. This time period encompasses the phase in which peak effects are anticipated.

6.8.2.4.3 Assessment Cases

The assessment on other land and resource use has three assessment cases.

- **Base Case**: This scenario represents existing conditions and characterizes combined effects from previous and existing developments and activities. The Base Case reflects the effects of existing disturbances, such as forestry, transportation, agricultural, mining and residential and recreational development. Current effects from the existing WL facilities and operations, for example, are considered part of the Base Case. In addition, effects from the decommissioning and reclamation activities already completed at the WL site are also considered as part of the Base Case.
- **Application Case**: The Application Case represents predictions of the effects that may results from the Project combined with the existing effects of the Base Case.
- **Reasonably Foreseeable Developments (RFD) Case**: This scenario represents the effects of the Base Case combined with the predicted incremental effects from the Project, as well as effects from other RFDs within the RSA that are currently under application review or that have officially entered a regulatory application process. There are no RFDs expected in the RSA other than the continued decommissioning of the remaining facilities at the WL site, as described in the Comprehensive Study Report (AECL 2001). Cumulative effects from the Project in combination with the decommissioning of the remaining infrastructure and support facilities, and reclamation of the affected areas at the WL site (see Table 6.8.2.4-1) are presented as part of this assessment.

Table 6.8.2.4-1: Reasonably Foreseeable Developments considered in the Other Land and Resource Use Assessment

Type of Project	Location	Description	Timeframe	Overlap with Valued Components
Infrastructure Decommissioning	WL	Decommissioning of remaining infrastructure on the WL site (includes ISD of some low-level waste trenches).	2016 to 2027	Yes – there is both spatial and temporal overlap of effects with the Project
Environmental Remediation	WL	Remediation of affected lands, with the exception of the low-level waste trenches.	2016 to 2027	Yes – there is both spatial and temporal overlap of effects with the Project

6.8.2.5 Description of the Environment

This section describes the setting and characterization for other land and resource use as relevant for the assessment of the Project. It describes the existing conditions against which potential changes from the Project are compared and evaluated.

6.8.2.5.1 Methods

The characterization of the existing environment for other land and resource use reflects review of both primary and secondary data sources. Data collection began with a review of existing literature and databases from a variety of public sources. Where sufficient detail was not available from secondary data sources to describe the existing environment, primary data collection was undertaken in the form of key person interviews.

6.8.2.5.1.1 Literature Review

The review of literature and databases included the following sources:

- federal, provincial and municipal government reports and data;
- documents produced for other environmental assessment processes (e.g., environmental impact statements, regulatory submissions);
- academic literature (dissertations, cultural chronologies);
- archival research;
- the Whiteshell Laboratories Decommissioning Project: Comprehensive Study Report (AECL 2001);
- the Environmental Assessment and Follow-up Program for Whiteshell Laboratories (CNL 2002); and
- online sources (e.g., community websites, online business profiles).

6.8.2.5.1.2 Key Person Interview Program

A limited Key Person interview (KPI) Program was undertaken to address gaps that could not be readily filled by secondary sources and to gain an understanding of other land and resource use surrounding the WL site. Interviews were conducted with four individuals primarily from Manitoba Sustainable Development (now Manitoba Environment, Climate and Parks). Interview guides for the KPIs were developed to address the subject areas discussed in this section of the environmental assessment.

6.8.2.5.1.3 Public Engagement

Information shared by the public was also used to inform both the base case and application case. Where applicable within this section, interests and information gained through the engagement program relevant to other land and resource use has been highlighted. Further detail on the outcomes of engagement processes can be found in Section 5 Public Engagement.

6.8.2.5.2 Results

This section describes land tenure and use in proximity of the WL site, including parcels on both sides of the Winnipeg River. Land interests in the area include wildlife management and protected areas, trapping and outfitting concessions, mineral and quarry reserves, agricultural lands and forestry.

6.8.2.5.2.1 Whiteshell Laboratories Site

The Project is located within the WL site, which is situated in the northwest corner of the LGD of Pinawa and borders the RM of Lac du Bonnet to the north, east and west. The LGD of Pinawa was established in 1962 as the WL site (LGD of Pinawa 2004). The WL site was established in the early 1960s to facilitate research and development of higher temperature versions of the Canada Deuterium Uranium (CANDU) reactor. The WL site included WR-1, an organic cooled reactor, which became operational in 1965 (AECL 2001). In the early 1970s, the organic cooled reactor program was eliminated, and full focus was concentrated on the heavy water-cooled CANDU reactor system. In 1985, WR-1 was permanently shut down (CNL 2016).

The site occupies 4,375 ha of land that was either privately owned or Crown land before the establishment of Whiteshell Laboratories. Currently, Atomic Energy of Canada Limited (AECL), a federal government crown corporation, holds the title to the WL site lands. Access to these areas generally has restriction on use for security and safety. The WL site occupies the following different land use designations in the LGD of Pinawa (2004).

- **AG – General Agriculture:** AECL land on the western side of the Winnipeg River is used for agriculture, which is considered a minor land use in the LGD of Pinawa. The purpose of the designation is to protect existing agricultural developments and to protect environmentally sensitive areas from the potential effects of agricultural practices.
- **MH – Heavy Industrial:** AECL land including the WL main campus, waste management area and landfill are used for industrial use. The purpose of this designation is to encourage industrial development while limiting potential land use conflicts and potential adverse environmental effects.
- **RC – Recreational/Commercial:** The southeast corner of the WL site is zoned as recreational/commercial. In the future, this classification may allow access for residents of Pinawa to spaces for passive recreational uses.
- **NA - Natural Area:** The majority of the WL site located on the east side of the Winnipeg River, is designated as natural areas, the purpose of which is to protects areas from development. In the future, this classification may allow access for residents of Pinawa to spaces for passive recreational uses.

6.8.2.5.2.1.1 Wildlife Management and Protected Areas

The WL site is located near the following management and protected areas (Figure 6.8.1-1).

- **Pinawa Dam Provincial Park:** Located on Provincial Route 520 approximately 10 km northeast of the WL site. The park commemorates Manitoba's first year-round hydroelectric generating station. The park is 193 ha in size. The park is a day-use recreation area. It contains picnic areas, a picnic shelter, trails and interpretive facilities. In the winter, a snowmobile trail runs through the park (MCWS 2012a).
- **Whitemouth Falls Provincial Park:** Located approximately 6 km southeast of the WL site and is 483 ha in size. The park is at the confluence of the Whitemouth and Winnipeg rivers. The portion of the park south of the Winnipeg River is a day-use recreation area, while the area north of the Winnipeg River is to protect great gray owl habitat (MCWS 2012b).
- **Whiteshell Provincial Park** is directly east of the WL site and is 276,400 ha in size. Pinawa is located within the park boundaries. The park is intended to be a key recreational area in the Canadian Shield, provide cottaging opportunities, provide an accessible wilderness zone, accommodate resource harvesting and maintain a diverse sport fishery. The park offers swimming, boating, biking, golf, hiking, cross country skiing and snowmobiling. There are a range of accommodations located in the park, including several campgrounds (Department of Natural Resources 1983).
- **Pinawa Provincial Park** is located south of Provincial Route 211 on the east short of the Winnipeg River. It is less than 1 ha in size. The park is intended to provide a point of access to the Winnipeg River for boating and fishing and day-use opportunities (MCWS 2012c).
- **Lewis Bog Ecological Reserve** is located in Agassiz Provincial Forest southwest of the WL site. It was recently expanded from 570 ha to 5,240 ha. The reserve supports several types of bogs and forests. Rare orchid species and rare wildlife species have been seen in the reserve. The expansion is expected to help reduce the risk to the area and the rare species it supports from the effects of nearby commercial peat harvesting and agricultural activities. (Manitoba Sustainable Development n.d.a).
- **Lee River Wildlife Management Area** is located east of the Town of Lac du Bonnet off Provincial Route 520 and north of the WL site, and is 1,187 ha in size. It features a variety of grouse, white-tailed deer and moose. Coyotes, wolves and foxes use the area for denning and it is within a breeding and migration corridor for northern forest owls (Manitoba Sustainable Development n.d.b.).

6.8.2.5.2.1.2 Agricultural Lands

Land to the north and west of the WL site have been zoned by the RM of Lac du Bonnet for agricultural purposes. This agricultural zoning designation is intended to provide a buffer around the Town of Lac du Bonnet. The zoning designations allow a full range of agricultural activities; however, only existing livestock operations can be expanded (RM of Lac du Bonnet 2019). Other areas west of the Winnipeg River have been designated for mixed use, including residential and rural uses. Rural residential zones are low-density residential developments that use on-site waste management facilities, while residential areas allow for single-family and multi-family dwellings. There is conditional allowance of commercial resorts in these zones (RM of Lac du Bonnet 2019).

On the west side of the Winnipeg River, AECL permits agricultural use within the WL site lands. This land is in the LGD of Pinawa and comprises the majority of agricultural property in the LGD (LGD of Pinawa 2004).

6.8.2.5.2.1.3 Forestry

To the south and west of the WL site, in the RM of Lac du Bonnet is the Agassiz Provincial Forest. Provincial forests were established as a source of sustainable timber supply (Manitoba Conservation n.d.). The Agassiz Provincial Forest is approximately 795 km^2 in size. It is also used for peat moss extraction and snowmobile trails.

Forestry has historically been important to the region, but there has traditionally been little forestry activity near the WL site (AECL 2001). Since the Comprehensive Study Report (AECL 2001) was filed, the forestry industry has decreased. Tembec, which owned and operated the Pine Falls Mill in Powerview-Pine Falls, stopped production there in 2009 and permanently closed the facility in 2010; Tembec later sold the site (Pulp-Paper World 2011). Overall, the forestry industry in Manitoba has shrunk due to a variety of factors, including the collapse of the US housing market in 2006 and the closure of multiple mills in the province (MCWS 2012c).

6.8.2.5.2.1.4 Mineral Claims and Leases

There are quarry permits to the northeast and southwest of the WL site and several quarry withdrawals in the area, including near the northeast boundary of the WL site. There are no other mineral claims or leases in proximity of the WL site (Manitoba Growth, Enterprise and Trade n.d.).

6.8.2.5.2.1.5 Water Use

There are multiple municipal water rights licences and an irrigation water rights licence for the Winnipeg River in the RSA. The municipal water rights licences are held by the Town of Lac du Bonnet and Pinawa, along with various water co-ops and a residential development (Manitoba Sustainable Development 2017). The WL site also draws water from the Winnipeg River. Water from the Winnipeg River is likely also used for domestic purposes as there are residences along the shore, but water withdrawals of less the 25,000 L/d do not generally require licensing.

6.8.2.5.2.2 Outdoor Recreation and Tourism

The WL site is in eastern Manitoba west of the Whiteshell Provincial Park on the Winnipeg River. The region is popular for cottagers and campers as it is the gateway for access to a number of Provincial Parks, including Old Pinawa Dam Provincial Park, Nopiming Provincial Park and the Whiteshell Provincial Park. The area around the WL site, including Pinawa, along with the Town and RM of Lac du Bonnet are important areas for outdoor recreation and related cottaging and tourism in southern Manitoba. Section 6.9.5.2.3 Employment and Income discusses the economic effect of cottaging and tourism for Pinawa and the Town and RM of Lac du Bonnet, which is an important economic driver for all three municipalities.

Pinawa is located adjacent to the boundary of the Whiteshell Provincial Park and offers many outdoor activities to year-round and seasonal cottage residents including sailing, canoeing, fishing, hiking, swimming, golfing, snowmobiling and cross-country skiing (LGD of Pinawa 2019a). Whiteshell Provincial Park is a four-season park that boasts rushing rivers, clear deep lakes and sandy beaches. There are numerous self-guided hiking trails, canoe routes, campgrounds, picnic areas, among other amenities (Manitoba Sustainable Development n.d.c). Pinawa also has a number of tourist attractions that draw visitors to the area including the Pinawa Heritage Sundial, the Pinawa Suspension Bridge, and Pinawa's section of the Great Trail (also known as the Trans Canada Trail), which includes the Pinawa Channel Heritage Walk, the Ironwood Trail and the Alice Chambers Trail which is internationally recognized as Manitoba's Pine to Prairie Birding Trail (LGD of Pinawa 2019b). The Pinawa Dam Provincial Park, showcasing concrete ruins, highlights the first hydroelectric power dam in Manitoba including interpretive signage, self-guiding interpretive brochures, an amphitheatre, the Heritage Walk Picnic Shelter, picnic

facilities, Centennial Spillway Trail and bridge access to an interpretive nature trail (Pinawa Community Development Corporation 2019).

Pinawa has a local beach, two launching ramps for powerboats and watercraft, a boat marina and canoe rentals. The Pinawa Channel, between the diversion dam and the suspension bridge, is popular for tubing and provides exceptional canoeing and kayaking through to the Pinawa Dam Provincial Park. The Pinawa Rowing and Sailing Club are located near the marina and offer lessons, equipment for members and accommodation for non-motorized watercraft (Pinawa Community Development Corporation 2019).

The Winnipeg River, including the stretch from the WL site downstream to the Town of Lac du Bonnet is lined with residential developments, which include year-round and seasonal residences. The other waterways in the RM of Lac du Bonnet, including Lac du Bonnet and the Lee River also attract seasonal residents who want to remain relatively close to a population centre and still enjoy a rural lifestyle. During the KPI Program, it was noted that many people who decide to eventually move to either the Town or RM of Lac du Bonnet originally spent their summers in the area (KPI Program 2016).

There are three marinas on the Winnipeg River in the RM of Lac du Bonnet. The LaVerendrye Boat Launch at the north end of the Town of Lac du Bonnet on Provincial Road 502, one on the east side of Provincial Route 313 and the Winnipeg River Bridge and the board launch at Roadside Park, which is off Highway 11 north, 15 km away from the Town of Lac du Bonnet.

6.8.2.5.2.2.1 Sport Fishing

Sport fishing is popular in the region due to the number of waterways, which include the Winnipeg River and the Lee River. Major species include walleye, northern pike, sturgeon, smallmouth bass, mooneye, sauger and channel catfish. These species are common in the region and are known to have stable populations (KPI Program 2016). The WL site is located in the Southern Division, which includes all of southern Manitoba. The fishing season is generally closed from the beginning of April through to mid-May annually and typically opens on Saturday before the long weekend. Catch limits vary by species and for some species also vary by fish size. Lake sturgeon also occur in the Winnipeg River near the WL site and favour the outfall of the WL site, because lake sturgeon is a protected species, it must be released if caught (AECL 2001).

Fishing locations on the Winnipeg River vary by the species desired by an angler. Popular locations include the Town Pier in Lac du Bonnet, the Winnipeg River Bridge and the dike along Highway 11, “Pickerel Point” (located upstream of the town of Lac du Bonnet where there is a constriction in the river) and near the McArthur Falls generating station (KPI Program 2016). It is also possible to ice fish around Lac du Bonnet (Town and RM of Lac du Bonnet 2019a).

Individuals interested in fishing on the Winnipeg River near the Town of Lac du Bonnet are able to do so in their own boats or there are outfitters who offer guiding services on the Winnipeg River. Fishing guides in the area are popular with American and Manitoban tourists, and the species pursued are dependent on the interests of the fishers.

Fishing for sustenance or traditional purposes is considered in Section 6.8.1.5.2.2.1 Historical and Present Day Traditional Land Use.

6.8.2.5.2.2.2 Outfitting

Outfitters are located in and around Pinawa, the Town of Lac du Bonnet, Point Du Bois and Eriksdale. These outfitters provide black bear, whitetail deer, wolf and waterfowl hunts, while others offer local trophy fishing trips and fly-in fishing expeditions to Atikaki, Nopiming and Whiteshell Provincial Parks (Hoards Hunting Camps 1999-2019; Jackson's Lodge and Outposts 2019; Trail End Camp and Outfitters 2019; Agassiz Outfitters 2019; Eagle Nest Lodge 2019; Big Track Outfitters 2019). Outfitting activities tend to be geared towards a client's interests and will vary accordingly (KPI Program 2016).

6.8.2.5.2.2.3 Hunting

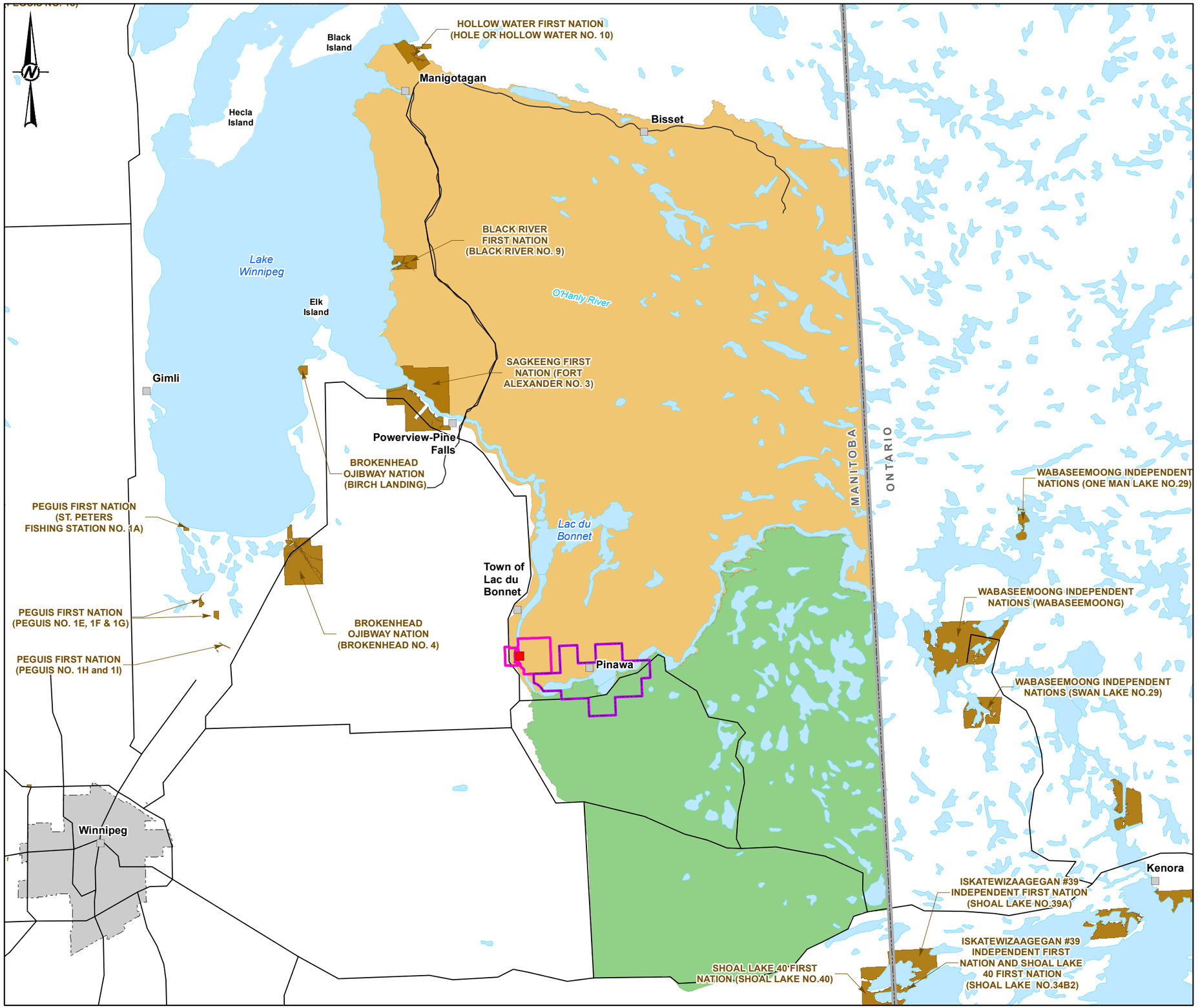
The WL site is located in Game Hunting Area (GHA) 26 (Figure 6.8.2-1). White-tailed deer hunting in the area around the WL site, especially northwest of the Project, is popular (KPI Program 2016). General rifle hunting season for white-tailed deer in GHA 26 is open November 14 through to December 18 with the bag limit of one buck (antlered) deer per licence per year. Deer muzzleloader and deer general rifle seasons have been extended in GHA 26 and 36, an area directly south of GHA 26 along the Manitoba-Ontario border (Manitoba Sustainable Development 2018). This season extension has been implemented to reduce white-tailed deer numbers; additionally GHA 26 is one of the few areas to offer a second and third purchase of deer licences for Manitoba residents who are Canadian citizens. The effort to reduce white-tailed deer numbers is driven by the brain worm and liver fluke parasites carried by white-tailed deer that negatively affect the struggling moose population (Manitoba Sustainable Development 2018).

Upland game birds and migratory waterfowl are also hunted, with a population of rough grouse and sharp-tailed grouse noted in proximity to the site. Grouse season is open between early September through to mid-December, with a daily bag limit of six, and possession limit of 12. Migratory bird seasons vary by species, but are typically open between September 1 and November 30, with daily limits for eight ducks, coots and dark geese and possession limits of 24. Snow geese have a daily limit of 50, and no possession limited. (Manitoba Sustainable Development 2018).

Moose populations in the southeast region of the province are known to be rapidly declining due to disease and overhunting. In an effort to allow moose population levels to recover, cancellation of all licensed moose hunting seasons are in effect for 13 of the GHAs across the province, including GHA 26. A partial area closure for all licensed hunters and rights-based hunters, including Indigenous peoples, has been implemented north of the Black River to the northern boundary of GHA 26. In addition to prohibiting hunting, Manitoba Sustainable Development (now Manitoba Environment, Climate and Parks) is researching and implementing other programs to aid in moose population recovery. One of two wildlife biologists hired by the Province to implement moose recovery programs is located in the Town of Lac du Bonnet. Other programs established to aid in moose population recovery include extension of the white-tailed deer hunting season and wolf trapping season, increasing staff dedicated to enforcement, establishing moose management committees, and engagement with Indigenous peoples (Manitoba Sustainable Development 2018).

Black bear hunting in GHA 26 is limited to Manitoba residents who are Canadian citizens and opens April 25 to June 19 with a bag limit of one adult black bear. Females with cubs may not be taken and Manitoba Sustainable Development (now Manitoba Environment, Climate and Parks) puts forth detailed description on how to identify female black bears in their annual Hunting Guide (Manitoba Sustainable Development 2018).

A gravel pit located just northeast of the LSA is a popular staging point for resource use activities (Manitoba Sustainable Development 2018). Hunting within the WL site is prohibited due to safety concerns.



LEGEND

- WR-1 BUILDING (SITE STUDY AREA)
- WHITESHELL LABORATORIES SITE

BASE FEATURES

- CITY/TOWN
- PROVINCIAL BOUNDARY
- MAJOR ROAD
- WATERCOURSE
- WATERBODY
- FIRST NATION RESERVE
- REGISTERED TRAPLINE NO. 23

BIG GAME HUNTING AREA

- AREA NO. 26
- AREA NO. 36

0 20 40

1:700,000 KILOMETRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY PROVIDED BY CNL (2016-11-22)
3. BIG GAME HUNTING AREAS - DEVELOPED BY MANITOBA WILDLIFE MANAGEMENT AREAS, PROVINCE OF MANITOBA
4. REGISTERED TRAPLINE NO. 23 - PROVIDED BY THE MANITOBA LAND INITIATIVE, 2017
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
GAME HUNTING AREAS AND REGISTERED TRAPLINES

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/PR/RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
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6.8.2.5.2.2.4 Trapping

There are no registered traplines (RTL) in the WL site. Registered trapline 23 runs along the southern border of the site (Figure 6.8.2-1). The holder of RTL 23 is active and traps a variety of species, including marten, red fox, otter, fisher weasel, muskrat and mink. There are no other RTLs that share a boundary with the WL site. The majority of RTLs are east of the WL site in the Whiteshell Provincial Park.

6.8.2.5.2.2.4.1 Winter Activities

Outdoor winter activities in Pinawa include skating, snowmobiling, ice fishing, bird watching, snowshoeing, skiing and hiking. Whiteshell Cross Country Ski Club maintains over 40 km of ski trails and 24 km of the Great Trail throughout the winter. SnoMan (Snowmobilers of Manitoba) actively maintains trails all through Pinawa and the Town and RM of Lac Du Bonnet (Town and RM of Lac du Bonnet 2019b).

6.8.2.5.2.3 Winnipeg River

As described in Section 6.4.2 Surface Water Quality, the Winnipeg River is considered to be a medium-sized lowland river (AECL 2001). Its drainage area is approximately 150,000 km^2, originating in Ontario at Lake of the Woods. The Winnipeg River tributaries include the Rainy River (flows into the Lake of the Woods), Black Sturgeon River, English River, Bird River, Lee River, Whiteshell River, Whitemouth River and the Macfarlane River. There are six hydroelectric dams on the river, the closest approximately 7.5 km upstream of the WL site. These dams have extensively modified flow patterns in the river (AECL 2001). Adjacent to the WL site, the river is approximately 0.3 km wide and 7 m deep and flows northerly between 436 m^3/s and 1,842 m^3/s to Lake Winnipeg (2010 to 2015 average at Seven Sisters Generating Station; Manitoba Hydro 2016).

Historically, liquid effluent from the Active Liquid Waste Treatment Centre was discharged to the Winnipeg River via the process sewer at the sewer outfall located about 8 m offshore in approximately 5 m of water (AECL 2001). The Winnipeg River Task Force (WRTF 1995) looked at potential sources of Winnipeg River water quality degradation near the community of Sagkeeng. The Task Force found that WL has not had an adverse effect on water quality in the Winnipeg River for downstream communities (AECL 2001). The task force included members from the Sagkeeng First Nation, Environment Canada, Indian and Northern Affairs Canada and Health Canada.

The monthly average of water chemistry for 2011 to 2019 for the intake water at the WL site had concentrations of copper, iron and lead exceeding the Manitoba Water Quality Standards, Objectives, and Guidelines (WQSOG; see Section 6.4.2.5.2.2 Surface Water and Sediment Quality). Copper and lead also exceeded the Canadian Council of Ministers of the Environment Water Quality Guidelines (CCME WQG; Table 6.4.2-5 and Figure 6.4.2-3), although concentrations have decreased starting in 2016, and lead concentrations have been under the WQSOG and CCME WQG since 2017. Concentrations of mercury exceeded the WQSOG in 2016 but not in any other years. Phosphorous concentrations in the river also exceeded the WQSOG between 2014 and 2017 but have since decreased to below guideline levels. The intake water quality is considered to be uninfluenced by the WL site because it is located upstream of discharges from the WL site. Recently, the Winnipeg River has been classified as meso-eutrophic (at Pointe du Bois; ECCC 2015). This indicates that nutrient levels are moderate, which may lead to plant growth and reduced water clarity.

During the 2000 sediment investigation, the sediment downstream of the outfall was determined to be erosional, with a clay bottom covered in parts with sand, gravel, cobble and boulders (AECL 2001). The highest measured caesium-137 level in a sediment sample during the 2000 study was 2,610 Becquerels per kilogram (Bq/kg) (AECL 2001). This exceeds the *Nuclear Substance and Radiation Devices Regulation* (SOR/200-207; NSRDR) Clearance Level of 100 Bq/kg for caesium-137. Although the activity level in the sediment at the K03 location is above NSRDR unconditional clearance level, it is well below a human external exposure level of concern 2.8×10^6 Bq/kg. It is also well below the Tier 2 estimated no-effect value (ENEV) for benthic invertebrates' value of 1.5×10^5 Bq/kg. The caesium-137 levels detected in the samples collected during routine monitoring at locations OFL, K03, K05, K14 and K23 from 2010 to 2015 were one to two orders of magnitude lower than the highest 2000 sample (CNL 2020). Caesium-137 levels at all locations except OFL and KO5 were below the NSRDR Clearance Level of 100 Bq/kg. The activity at OFL has historically varied from less than 5 Bq/kg to 75,500 Bq/kg (CNL 2020). Variation of activity is not unexpected for all samples due to the highly localized and spotty nature of the contamination in the river sediments. This variability is the likely reason for the unusually high caesium-137 activity noted in the K05 sample in 2015 (CNL 2020).

As part of the routine monitoring at the WL site, river bottom sediments were collected from twelve locations along the Winnipeg River, ranging from 0.8 km upstream to 13.1 km downstream of the Outfall. In 2019, the gross alpha activity detected in the samples ranged from 167 to 633 Bq/kg (CNL 2020). In five years prior, average minimums and maximums activities ranged from 214±173 to 534±255 Bq/kg. The alpha activity in these samples is due to naturally occurring isotopes such as uranium-238 or thorium-232 and their progeny, as both upstream and downstream samples contain similar levels. All samples are below the NSRDR Clearance Level for naturally occurring uranium-238 and thorium-232 of 1,000 Bq/kg (CNL 2020).

The gross beta activity in sediment ranged from 333 to 1,133 Bq/kg in 2019 at the twelve sampling locations (CNL 2020). The previous five years average minimums and maximums ranged from 283±119 to 1,504±206 Bq/kg. The gross beta activities measured in 2019 for most sediment samples are higher than averages for the previous five years, with no trends observed. Beta activity includes contributions from naturally occurring potassium-40 and from caesium-137. Aliquots of samples collected in 2019 were submitted for strontium-90 analysis, and results indicated that strontium-90 makes an insignificant contribution to radioactivity in sediments. The majority of the beta activity for all locations continues to be from naturally occurring potassium-40 (CNL 2020). The NSRDR Clearance Level for potassium-40 is 10,000 Bq/kg.

The Winnipeg River supports a diverse fish community and affords spawning, rearing and foraging habitats. A total of 61 native species are reported for the river (Stewart and Watkinson 2004) and two species at risk are known to be present within the vicinity of the WL site: Lake Sturgeon (*Acipenser fulvescens*) and Carmine Shiner (*Notropis percobromus* [COSEWIC 2019]). Fish occurring within the study reach include species that are primarily resident (present year-round), as well as migratory (passing through). Fish habitat is generally similar throughout the assessment area.

The Town of Lac du Bonnet and Pinawa draw water from the Winnipeg River System and treat it at their water treatment plants (Province of Manitoba 2004; LGD of Pinawa 2015). Sagkeeng First Nation is the only First Nation in the socio-economic RSA known to draw water from the Winnipeg River for residential purposes (J.R. Cousin Consultants Ltd. n.d.).

6.8.2.6 Project Interactions and Mitigation

6.8.2.6.1 Methods

This section describes the process by which interactions between Project components and activities and other land and resource use VCs were identified and evaluated. Potential effect pathways are identified and mitigation developed to eliminate and/or reduce effects is presented. A pathways analysis is then used to focus the assessment on key interactions between the Project and the environment by evaluating the different effect pathways to determine if, after incorporation of mitigation, there is still potential to cause residual effects. Where effects will be adequately mitigated and are not forwarded for further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are described. Primary pathways that may lead to residual effects after incorporation of mitigation are further characterized in subsequent subsections of the assessment. As such, the Project Interactions and Mitigation section helps to focus the remainder of the assessment on those interactions (effects pathways) likely to result in residual adverse effects.

The first part of the analysis was to identify the potential effects pathways for all stages of the Project. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. The next step in the analysis was the development of environmental design features and mitigation practices that could be incorporated into the Project to eliminate and/or reduce effects to other land and resource use VCs. Environmental design features included design elements, environmental best practices and management policies and procedures. Environmental design features and mitigation were developed through an iterative process between the engineering and environmental teams, combined with input from project-specific or regional engagement with other interested parties. The design features and/or mitigation activities were selected considering their effectiveness for implementation and maintenance, and their appropriateness within the context of the identified effect pathways.

After incorporation of mitigation, potential pathways were evaluated into the following categories using scientific knowledge, logic, experience with similar developments and the effectiveness of environmental design features and mitigation.

- **No pathway** – pathway is removed by environmental design features or mitigation such that the Project would not be expected to result in a measurable environmental change to measurement indicators identified for other land and resource use VCs relative to Base Case values, and therefore would have no residual effects to land and resource use VCs.
- **Secondary pathway** – the pathway could result in a measurable minor change to measurement indicators identified for other land and resource use VCs but would have a negligible residual effect on other land and resource use VCs relative to Base Case values and is not expected to contribute cumulatively to other Project effects or to the effects of other past, present or reasonably foreseeable developments to cause a significant effect.
- **Primary pathway** – the pathway is likely to result in an environmental change to measurement indicators identified for other land and resource use VCs relative to the Base Case that could contribute to residual effects to other land and resource use VCs.

Environmental design features and mitigation that have been or could be incorporated into the Project to eliminate and/or reduce adverse effects to other land and resource use VCs were considered. Potential pathways that were completely removed due to implementation of environmental design or mitigation were not assessed further. Pathways that were assessed to be secondary and demonstrated to have a negligible residual effect to other land and resource use VCs through simple qualitative or semi-quantitative evaluation of the pathway were also not advanced for further assessment.

6.8.2.6.2 Results

Pathways through which all stages of the Project may interact with and result in changes to measurement indicators for other land and resource use VCs is provided in Table 6.8.2.6-1.

Table 6.8.2.6-1:Pathways Analysis for Other Land and Resource Use Valued Components

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment

Overall activities associated with WL site preparation, ISD of WR-1 and decommissioning of above-ground facilities	■ Changes to outdoor recreational activities and tourism resulting from changes to vegetation, fish and wildlife and their habitats, and surface water quality in the Winnipeg River.	■ The Project is located in an already disturbed area.
		■ Temporary supporting infrastructure will be located within the Local Study Area (i.e., previously disturbed and developed area).
		■ Erosion and sediment control practices (e.g., silt fences, runoff management) applicable to the region and already in place at the Regional Study Area will be used during decommissioning activities around disturbed areas, where appropriate.
		■ Project activity will typically be limited to daytime hours, where possible, and noise will be short-term and sporadic.
		■ Decommissioning of the WR-1 Building will be completed in a controlled manner, and no blasting will be required.
		■ The planned decommissioning of the WR-1 Building presently involves:
		  ▪ removing the service wings and infilling in these areas with compacted fill;
		  ▪ sealing of open conduits in the building foundation;
		  ▪ grouting the interior portion of the building (containing the remaining components of WR-1) to ground surface elevation and removing the superstructure; and
		  ▪ Installation of reinforced concrete cap.
		■ Implementation of CNL's *Environmental Protection* (CNL 2021) and *Management and Monitoring of Emissions* (CNL 2018), which includes operational control monitoring, air verification monitoring and environmental monitoring.
		■ As part of CNL's licence with the Canadian Nuclear Safety Commission, environmental monitoring around the WL site is required and will continue for the Project.
		■ Follow-up monitoring during the post-closure phase will be completed to verify effects predictions and to provide information for use in adaptive management to address potential unforeseen effects.
			Secondary

Table 6.8.2.6-1:Pathways Analysis for Other Land and Resource Use Valued Components

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
Overall activities associated with WL site preparation, ISD of WR-1 and decommissioning of above-ground facilities	■ Nuisance factors such as dust and noise may affect the desirability of engaging in outdoor recreational or tourism activities.	■ Access to the WL site will have restrictions on resources use. ■ Implementation of CNL's *Environmental Protection* (CNL 2021) and *Management and Monitoring of Emissions* (CNL 2018), which includes operational control monitoring, air verification monitoring and environmental monitoring. ■ Implementation of dust management techniques to control dust generated by the Project, consistent with the current Environmental Assessment Follow-up Program. ■ Use of contamination immobilization agents, containment, ventilation and HEPA filters to control generation of airborne emissions during decontamination or removal of contaminated systems or structures. ■ Use of dust suppression methods during building demolition or soil remediation activities to control airborne emissions and nuisance dust during building demolition or soil remediation. Methods may include: ▪ wetting techniques during demolition to limit mobility of dust; ▪ wind restrictions during demolition to stop work or apply wetting techniques; and ▪ hydro seeding during backfilling and landscaping to reduce soil erosion. ■ Removal of accumulations of particulates (e.g., dirt) on road as soon as possible. ■ On-site vehicles and equipment engines will meet Tier 3 emission standards, where possible, and be maintained in good working order. ■ Limit idling of vehicles on-site and speed on roads. ■ Use of tarps or 3-sided enclosures for raw material storage. ■ Road watering and chemical dust suppressant when necessary. ■ Decommissioning activity will be limited to daytime hours and noise will be short-term and sporadic. Decommissioning of the WR-1 Building will be completed in a controlled manner, and no blasting will be required.	No linkage

Table 6.8.2.6-1:Pathways Analysis for Other Land and Resource Use Valued Components

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
Preparation for and implementation of institutional control	■ The use of ISD as the decommissioning method for WR-1 will change the proportion of the site that can be released for unrestricted use by a small percentage. ■ The Project may change the suitability of the Project footprint for outdoor recreation and tourism.	■ Continued activities through the Community Regeneration Partnership to help the region develop economically. ■ Communication of environmental monitoring results to confirm the safety of the WL site and lands around it. ■ Final ISD designed so that projections of doses to members of the public are well below the established limits for dose to any member of the public. ■ Final ISD design will be done to maximize hazard reduction.	Secondary
Preparation for and implementation of institutional control	■ Changes to access restrictions associated with the WL site end-state as a result of the Project may result in changes to future land tenure and uses of the site itself.	■ Communication of environmental monitoring results to confirm the safety of the WL site and lands around it. ■ Continued activities through the Community Regeneration Partnership to help the region develop economically.	Secondary
Closure of the entire WL site	■ Decommissioning and reclamation of the entire WL site, including the Project, may change the future land tenure and uses of the WL site.	■ The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe, and in keeping with the post-closure land use classification and release criteria to achieve the planned end-states. ■ Affected areas will be remediated to meet the WL preliminary soil cleanup and the non-radiological and radiological clearance and release criteria in accordance with the target end state of the associated land-use category.	Secondary

6.8.2.6.2.1 No Linkage Pathway

The following pathway was assessed as having no measurable environmental change and hence, no linkage to residual effects on other land and resource use VCs.

■ **Nuisance factors such as dust and noise may affect outdoor recreational or tourism experiences.**

During construction of the WRDF, there will be restrictions on the use of the WL site, although land and resource use will continue to persist in locations adjacent to the WL site. Project activities, including site preparation, WR-1 Building demolition and operation of the batch mixing plant, are expected to increase the level of nuisance factors (dust and noise) in the LSA; however, they are not expected to have a substantial effect on an individual's land and resource use experience or on harvested species because of mitigation and management practices put in place for the Project.

Nuisance factors could make other land and resource use activity experience on the Winnipeg River to the west of the WL site less enjoyable but changes are expected to be temporary and people will still be able to access the river upstream and downstream of the WL site to engage in activities. No emissions from Project activities are anticipated to exceed the appropriate standards and guidelines (Table 6.2.1-14). Project activity will typically be

limited to daytime hours, where possible, and noise will be short-term and sporadic. Decommissioning of the WR-1 Building will be completed in a controlled manner, and no blasting will be required. The loudest decommissioning activity will likely be noise from a percussion hammer on an excavator, which will be used to break up reinforced concrete walls and floors during demolition. This activity will be limited to the interior of the building envelope, which will serve to reduce the level of noise outside the building, and in the surrounding area. The WL site has also retained heavy tree coverage, which provides a natural noise barrier (AECL 2001).

Due to the restriction on use and access to the WL site, the nature of Project-related noise, the absence of threshold exceedances for emissions and mitigation for minimizing dust, which includes implementation of dust management techniques to control dust generated by the Project, nuisance factors as a result of Project activities are not expected to have an effect on recreation and tourism activities in the LSA. This pathway is therefore considered to have no linkage to effects on other land and resource use.

6.8.2.6.2.2 Secondary Pathways

In some cases, a potential interaction with an assessment endpoint exists but mitigation is expected to cause minor changes to the environment and a negligible effect on other land and resource use relative to the existing Base Case. The following are expected to result in negligible effects on other land and resource use and will not be examined further in the EIS.

- **Changes to outdoor recreational activities and tourism resulting from changes to vegetation, fish and wildlife and their habitats, and surface water quality in the Winnipeg River.**

The Project could affect outdoor recreation and tourism activities, and traditional land use through changes to vegetation, fish and wildlife and their habitats, and surface water quality in the Winnipeg River. Changes to these VCs could result from a change in the abundance and distribution of resources, the quality of the resource, and the ability to access the resource including fish, wildlife and vegetation. Any of these changes could subsequently affect the ability and the desire to engage in activities in the LSA.

The footprint of the WR-1 Building is approximately 0.07 ha and is located in an area that has been previously disturbed, where wildlife habitat value is considered to be negligible to low. In addition, temporary supporting infrastructure will be located within the LSA on previously disturbed and developed areas. Therefore, the Project is not expected to result in an incremental loss of wildlife habitat from current conditions at the WL site. Erosion and sediment control practices (e.g., silt fences, runoff management) applicable to the region and already in place at the RSA will be used during decommissioning activities around disturbed areas, where appropriate. This will reduce the potential for effects on adjacent natural areas that provide suitable wildlife habitat. Once decommissioning of the WR-1 Building and ISD of WR-1 are completed and the engineered cover installed, the area will be graded and restored with native vegetation. Once institutional control begins in 2027, there will be monitoring activities, but the Project site will remain otherwise undisturbed.

Nuisance Factors

Project activities, including site preparation, demolition of the WR-1 Building and the development of temporary infrastructure, will increase noise levels and the amount of dust produced in the LSA, which could affect the distribution of wildlife species harvested by resource users. Changes to the distribution of wildlife species could in turn affect outdoor recreation and tourism activities, as they constitute some of the resources on which these activities are dependent. Due to the nature of the noise produced by Project activities (sporadic, short-term, no blasting), wildlife species that live near the WL site are not expected to experience habitat loss (AECL 2001). Increases in dust are expected to be short-term, reversible, and not exceed the appropriate guidelines and

standards. Noise and dust are not expected to result in changes of wildlife distribution that could affect other land and resource use.

Airborne Dispersion of Contaminants

The Project may result in airborne contaminants that could deposit to soil and surface water, where they could affect vegetation, wildlife/wildlife habitat, fish/fish habitat and surface water quality. Changes to vegetation, wildlife/wildlife habitat and fish/fish habitat could in turn affect outdoor recreation and tourism activities, as they constitute some of the resources on which these activities are dependent. The Environmental Risk Assessment (ERA) predicated that there will be no exceedances of the 2.4 mGy/day radiation benchmark for terrestrial and riparian biota on or near the WL site resulting from atmospheric releases (Section 6.7.2.7.1 Application Case – Closure Phase). All predicted doses are well below this level. Therefore, it is unlikely that there would be significant adverse effects on terrestrial populations or communities (i.e., vegetation and wildlife) as a result of radionuclide releases from closure activities. In addition, the ERA predicts that the total radiation dose to all human receptors during closure activities is well below the public dose limit of 1 mSv/a (Section 6.7.1.7.1 Application Case – Closure Phase). Since the dose estimates are a small fraction of the public dose limit, no discernable health effects are anticipated due to exposure of potential critical groups to radioactive releases from the WL site during closure.

Waterborne Dispersion of Contaminants

The Project may result in waterborne dispersion of contaminants that could affect vegetation, wildlife/ wildlife habitat, fish/fish habitat and surface water quality. Waterborne dispersion may occur after the start of institutional control through leakage via the grouting to groundwater. Groundwater may then migrate to surface water at the Winnipeg River, where contaminants could travel downstream and affect vegetation, wildlife/wildlife habitat and fish/fish habitat. Changes to water quality or fish/fish habitat could in turn affect outdoor recreation and tourism activities and traditional land and resources use, as they constitute some of the resources on which these activities are dependent. The ERA predicts that there will be no exceedances of the 9.6 mGy/day radiation benchmark for the aquatic biota in the Winnipeg River (Section 6.7.2.7.2 Application Case – Post-closure Phase). Similarly, there are no predicted exceedances of the 2.4 mGy/day radiation benchmark for terrestrial and riparian biota on or near the WL site (Section 6.7.2.7.2 Application Case – Post-closure Phase). All predicted doses are well below these levels. For non-radiological contaminants of potential concern, the ERA predicts no exceedances of cadmium, lead, HB-40 and xylene exposure to ecological receptors. Therefore, it is unlikely that there would be significant adverse effects on either aquatic or terrestrial populations or communities as a result of radionuclide releases or the release of non-radiological contaminants from post-closure activities.

There are no anticipated exceedances for the radiation benchmarks for human receptors, including an on-site harvester, a farm north of the WL site on the Winnipeg River, and an on-site farm, a human receptor located on the Whiteshell Reactor Disposal Facility (WRDF; i.e., the end-state of the Project). The on-site farm receptor was assessed because the temporal boundary of the post-closure phase extends past a number of human generations. The total radiation dose for all receptors are below the public dosage limit of 1 mSv/a and the dose constraint for the Project of 0.25 mSv/a for all age groups (Section 6.7.1.7.2 Application Case – Post-closure Phase). Since the dose estimates are a small fraction of the public dose limit, no discernable health effects are anticipated due to exposure of these receptors to radioactive releases from the WL site during the post-closure phase.

The doses to human receptors that could be exposed to the non-radiological contaminants of potential concern in surface water during post-closure were calculated based on total concentration (background plus Project contribution). Incremental hazard quotients were compared to a benchmark hazard quotient of 0.2, which is consistent with Health Canada. The hazard quotients derived for constituents of potential concern were below the

protective benchmark for all receptors, with the exception of a toddler harvester, which slightly exceeded the benchmark. If only the project contribution is considered, the HQs are reduced even further, and hazard quotients are well below for all receptors (the Project contribution to the total is 0.0021% for cadmium and 0.00002% for lead). Therefore, no discernable health effects are anticipated due to exposure of potential critical groups from the Project during post-closure.

Through these pathways, the Project is expected to have a negligible effect on recreation and tourism activities. There are not anticipated to be any threshold exceedances in harvested receptors through atmospheric releases and waterborne dispersion of contaminants. In addition, the mitigation proposed to minimize Project effects on surface water quality, the aquatic environment, the terrestrial environment, human health and ecological health are anticipated to eliminate or mitigate any potential adverse effects to the resources on which recreation and tourism activities are dependent. These pathways are therefore characterized as secondary.

- **The use of ISD as the decommissioning method for WR-1 will change the proportion of the site that will have restrictions on use.**
- **Changes to access restrictions associated with the WL site end state as a result of the Project may result in changes to future land tenure and uses of portions of the site itself.**
- **Decommissioning and reclamation of the entire WL site, including the Project, may change the future land tenure and uses of the WL site.**

The WL site has been operational since the 1960s, with restrictions on public access for safety and security reasons. Exceptions to this include parcels of the WL site on the west side of the Winnipeg River that have been continuously used for agricultural purposes under agreements with AECL. The area to the east of the WL main campus has been left undeveloped and is meant to act as a buffer to the industrial site (LGD of Pinawa 2004). No outdoor recreation and tourism activities are permitted on the WL site. Other land and resource use activities have persisted adjacent to the site, including uses of the Winnipeg River. It is expected that all activities and land use adjacent to the site will be able to continue in the future as the Project will have no effect on land tenure or usage beyond the WL site boundaries.

Future use of the WL site will depend on the ability to release parts of the site with no restriction on use upon completion of the Project. Future uses/zoning have not been determined, but the end-state plan for the WL site is to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-state. The criteria developed will prioritize the environment and safety. Some lands will have restrictions on the future use so that there are no adverse effects to people and the environment as assessed in the safety assessment and modelling associated with the ISD of infrastructure and facilities, such as WR-1 and the Waste Management Area. These areas will require ongoing controls including institutional control, access restrictions and environmental monitoring. However, the amount of land associated with all of these areas is negligible relative to the size of the WL site that will have no restrictions on land use. CNL will be engaging the public, Indigenous Nations, and other key stakeholders in a discussion on future uses for the WL site, with site closure planned for early 2027.

The following are the key roles and responsibilities to determine the future use of the WL site:

- AECL owns the site and has responsibility for all assets and liabilities.
- CNL is the contractor responsible to perform the decommissioning and site remediation of the WL site.

- CNL is preparing a Land-Use and End-State Plan defining the end state criteria in collaboration with stakeholders, Indigenous Nations and the public, and will submit it to the CNSC for acceptance.
- CNL informs and engages the public, Indigenous, and other key stakeholders such as the Province of Manitoba.

Changes in the future uses of the site may affect the Local Government District of Pinawa's desire to develop economic activity at the WL site to offset lost jobs due to closure of the site, including nuclear and non-nuclear developments. As noted in Section 6.9.6 Project Interactions and Mitigation, the previous decommissioning plan for WL, described in the Comprehensive Study Report (AECL 2001), assumed that radioactive wastes would eventually be removed and placed in permanent disposal facilities with the assumption that a national disposal facility for low level radioactive waste would be available by 2025 and a national disposal facility for intermediate-level waste operational by 2050 (CNSC 2002). Under the previous decommissioning plan for WL, described in the Comprehensive Study Report (AECL 2001), a smaller percentage of the site (the Waste Management Area) would have had restrictions on use than with the Project; however, the area with anticipated restrictions on use under the Project is still small when compared with the remainder of the WL site.

While the Project will change the proportion of the site with restricted access and future uses, decommissioning is designed with the environment and safety as a priority. Since the Project will make the WL site safer when compared to baseline conditions and it will increase the amount of land available for future use in the LSA, these pathways are categorized as secondary.

The Project in combination with the decommissioning and reclamation of the WL site is also anticipated to contribute to positive effects on the environment, which will positively affect other land and resource use within the RSA (e.g., less industrial activity that could affect outdoor recreation, hunting, fishing, and trapping). Consequently, cumulative effects from the Project in combination with the decommissioning of the remaining infrastructure and support facilities, and reclamation of the affected areas at the WL site are anticipated to be negligible.

- **The Project may change the suitability of the LSA for outdoor recreation and tourism.**

The WL site was established in the 1960s with WR-1 becoming operational in 1965. Since that time, there have been nuclear research and more recently, decommissioning activities at the site. The area around the WL site in the LSA is currently used for agricultural activities, wildlife harvesting activities, fishing and private residences. This has not altered land and resources use in proximity to the WL site with activities, as such deer hunting, agricultural activities, fishing and other uses of the Winnipeg River still popular. The presence of the encased WR-1 is not expected to cause changes in these existing activities, although a small number of users may consider areas in proximity to the site as less optimal than if the reactor had been removed in its entirety.

The Project will be engineered to demonstrate long-term safety through a combination of site characteristics and engineered design features and to isolate and contain contamination inside the reactor vault and limit releases of hazardous substances, including radiological substances. According to the ERA, thresholds for airborne and waterborne contaminants will not be exceeded as a result of the Project (EcoMetrix 2021). Therefore, there is no need to change land use in land released for unrestricted use or on the land in the LSA around the WL site; however, the presence of an encapsulated reactor and associated perceptions may make engaging in activities in the LSA less desirable for some users.

To support continued understanding and dialogue around the suitability for use of the WL site and the lands around it for other land and resource use purposes, CNL will support robust communication of environmental monitoring results to confirm the safety of the WL to and help address concerns about future uses. Members of the Public Liaison Committee, which focuses on building relationships and creating dialogue between CNL, stakeholder groups, and communities and RMs around the WL site (Section 6.9.7 Monitoring and Follow-up) are currently expected to share outcomes with residents of their respective home communities, and it is anticipated that they will have a substantial role with sharing monitoring results with community members once decommissioning is complete.

CNL will continue to use a public website and other media mechanisms to share information and receive feedback from local communities and Indigenous peoples through the duration of the Project. Future communication mechanisms to keep local communities and Indigenous peoples informed will be determined as necessary, and in consultation with them. Collaboration and information sharing with Indigenous Nations will be important to ensuring mitigation is effective. Overall, with mitigation and engagement in place, Project effects on other land and resource use are expected to be negligible. These pathways are therefore characterized as secondary.

6.8.2.6.2.3 Primary Pathways

There are no interactions with primary linkages to effects to the other land and resource use VCs. Mitigation and monitoring efforts are expected to keep all pathways secondary, which means there may be a measurable change to measurement indicators but they are expected to be minor relative to the Base Case.

6.8.2.7 Monitoring and Follow-up

As there are no primary pathways for other land and resource use VCs, monitoring is not anticipated for other land and resource use. However, CNL will implement an Environmental Assessment Follow-up Program for the Project that will be integrated with the existing Environmental Assessment Follow-up Program for the WL site. The Environmental Assessment Follow-up Program for the Project will include sufficient information on the type, quantity and quality of information required to reliably verify effects predicted by the environmental assessment and confirm the effectiveness of mitigations. Wherever possible, existing programs will be adapted to meet the objectives of the Environmental Assessment Follow-Up Program for the Project.

Monitoring for environmental pathways (i.e., for air quality, water quality and groundwater quality) will be implemented to verify effects predictions for other land and resource use. It is noted that data generated by the monitoring program will be evaluated on an ongoing basis within an adaptive management framework. Within this framework, modifications to the program may be appropriate to confirm data continue to fulfill program objectives. For example, should a contaminant of potential concern reach concentrations outside the range predicted in the EIS or Decommissioning Safety Assessment Report, the frequency of sampling may be increased and additional locations may be sampled to investigate the source of the increased concentrations. Conversely, cessation of a monitoring activity might be appropriate once it has been shown that an effect has stabilized or has been reduced to a level where it is no longer considered significant with respect to regulatory requirements or community concerns. Any proposals for modifications to the monitoring program and the rationale for the modifications will be communicated to the Canadian Nuclear Safety Commission prior to implementation. Additional information on the Environmental Assessment Follow-up Program for the Project can be found in Section 11.0 Summary of Monitoring and Follow-up Programs.

CNL will continue to engage with local communities, municipalities and Indigenous peoples on findings of the environmental assessment and status of the Project.

6.8.2.8 Conclusions

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). The other land and resource use VCs chosen for the Project to reflect identified concerns, professional judgement and/or standard practice in environmental assessment are Land Tenure, Outdoor Recreation, and the Winnipeg River.

The Project could affect outdoor recreation and tourism activities through effects to vegetation, fish and wildlife and their habitats, and surface water quality in the Winnipeg River. Changes to these VCs could result from a change in the abundance and distribution of resources, the quality of the resource, and the ability to access resources including fish, wildlife and vegetation. Any of these changes could subsequently affect the ability and the desire to engage in activities in the LSA. There are not anticipated to be any threshold exceedances in harvested receptors through atmospheric releases and waterborne dispersion of contaminants. In addition, the mitigation proposed to minimize Project effects on surface water quality, the aquatic environment, the terrestrial environment, human health and ecological health are anticipated to eliminate or mitigate any potential adverse effects to the resources on which recreation and tourism activities are dependent.

The WL site has been operational since the 1960s, with restrictions on public access for safety and security reasons. Exceptions to this include parcels of the WL site on the west side of the Winnipeg River that have been continuously used for agricultural purposes under agreements with AECL. No outdoor recreation and tourism activities are permitted on the WL site. Other land and resource use activities have persisted adjacent to the site, including uses of the Winnipeg River. It is expected that all activities and land uses adjacent to the site will be able to continue in the future as the Project will have no effect on land tenure or usage beyond the WL site boundaries.

In collaboration with Indigenous Nations and the public, CNL is committed to meaningful and ongoing engagement on the WL site remediation and clean-up activities. Although a small proportion of the WL site will have restrictions on use because of the Project, it is still anticipated that the majority of the site will be safe and appropriate for unrestricted use. Overall, decommissioning of the WL site will result in an increase in the amount available for future use in the LSA. This may include transfer of the land to other parties following engagement with stakeholders, Indigenous Peoples and the public. Future uses/zoning have not been determined, but the end-state plan for the WL site is to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-state. Consequently, the Project is expected to have a negligible effect on other land and resource use VCs.

CNL will implement a WR-1 Environmental Assessment Follow-up Program to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. In addition, to mitigate perceptions related to the suitability for use of the WL site and the lands around it, CNL will support robust communication of environmental monitoring results to confirm the safety of the WL site and help address concerns about future uses. CNL will continue to engage with local communities, municipalities and Indigenous peoples.

6.9 Socio-economic Environment

This section of the Environmental Impact Statement (EIS) for the Canadian Nuclear Laboratories (CNL) In Situ Decommissioning of WR-1 at the Whiteshell Laboratories Site (the Project) seeks to understand and characterize the potential residual effects of the Project and past, present, and reasonably foreseeable developments on the socio-economic environment. Socio-economics refers to the way social and economic factors influence one another in local communities and households. The socio-economic environment assessment considers potential effects of the Project on the people and communities who are part of the existing socio-economic environment in the immediate vicinity of the Project. Potential residual effects of the Project on land and resource use, including sites of cultural or archaeological significance and traditional land and resource use, are assessed in Section 6.8 Land and Resource Use. Indigenous engagement and input were an important element in the assessment. and details of CNL's engagement with potentially affected Indigenous Nations is provided in Section 4.0. Information is incorporated throughout this assessment.

6.9.1 Scope of the Assessment

The socio-economic assessment follows the overall environmental assessment approach and methods described in Section 6.1 Environmental Assessment Approach. The assessment is completed in the following eight primary steps.

- **Step 1 – Identify Valued Components (VCs) and define the spatial boundaries, temporal boundaries and assessment cases** (refer to Sections 6.9.3 Valued Components and Section 6.9.4 Assessment Boundaries) for the socio-economic assessment. The VCs, assessment endpoints and measurement indicators used to assess Project related changes to socio-economics, are also described.
- **Step 2 – Describe the existing conditions** (refer to Section 6.9.5 Description of the Environment). Existing conditions in the local and regional areas are described, including the combined effects of previous and existing developments (Base Case). The existing environment represents the historical and current socio-community characteristics, including non-tangible features and the "built" environment (e.g., community infrastructure).
- **Step 3 – Evaluate Project interactions and mitigation** (refer to Section 6.9.6 Project Interactions and Mitigation). Project components and/or activities with the potential to affect socio-economics are identified and mitigation options are presented to limit or avoid these effects. A pathways analysis is then used to focus on key interactions between the Project and the environment and determine if mitigation can limit or eliminate the predicted residual effects. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. Where effects are adequately mitigated and are not forwarded for further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are described. Primary pathways that may lead to residual effects to socio-economics after incorporating mitigation are carried forward to Steps 4 for further analysis and residual effects characterization.
- **Step 4 – Present the methods and results of the residual effects analysis.** This step was not required as no primary pathways were identified in the socio-economic assessment.

- **Step 5 – Describe the level of certainty and management of uncertainty.** This step was not required as no primary pathways were identified in the socio-economic assessment.
- **Step 6 – Classify and determine the significance of the predicted residual effects.** This step was not required as no primary pathways were identified in the socio-economic assessment.
- **Step 7 – Identifying monitoring and follow-up** (refer to Section 6.9.7 Monitoring and Follow-up) required to confirm effects predictions and address uncertainty.
- **Step 8 – Present a consolidated summary of conclusions and outcomes of the assessment** (refer to Section 6.9.8 Conclusions) of residual effects on socio-economics.

6.9.2 Indigenous Engagement Feedback – Key Interests and Concerns

Interests and concerns raised by Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations during engagement related to the socio-economic assessment are summarized in Table 6.9.2-1. Other general concerns and questions raised during Indigenous engagement activities are documented in Section 4.0 Indigenous Engagement.

Table 6.9.2-1: Summary of Issues Raised During Engagement Activities Related to the Socio-economic Environment

Interest and Concern	Inclusion Status	Additional information and Rationale
Employment and Business Opportunities: ■ Interest in procurement policies and potential economic participation opportunities with the Project ■ Interest in First Nation and Red River Métis businesses to be involved in the overall closure work ■ Interest in training to enhance skills of community members ■ Interest in seasonal employment and the proportion of the workforce that is Indigenous ■ Compensation for permanent storage of nuclear materials in traditional territories ■ Concern about competitiveness with larger business in the tender process	Already included in the environmental assessment Commitments by CNL have been restated in Section 6.9.6.2 Results and Section 6.9.7 Monitoring and Follow-up	■ Employment and business opportunities from the Project are assessed in Section 6.9.6.2 Results
Waste Transportation and Management: ■ Interest in storage and transportation of radioactive waste off-site	Already included in the environmental assessment	■ Methods for transporting waste off-site are described in Section 3.4.8.4 Transporting Waste Off-Site ■ Transportation of waste off-site are assessed in Section 6.9.6.2 Results

Table 6.9.2-1: Summary of Issues Raised During Engagement Activities Related to the Socio-economic Environment

Interest and Concern	Inclusion Status	Additional information and Rationale
Future Land Use Concern that the Project may limit each Nation's participation in land and resource use activities, which would affect their well-being through the ability to express their culture.	The italicized text in the following pathway has been added to Section 6.9.6.2.2 Secondary Pathways: The presence of long-lived radioactive material as part of ISD may affect community well-being for Indigenous Nations through the changes to the suitability of the site for future uses*, the continued inability to exercise stewardship and governance over land and resource management decisions* Psychosocial aspects are important to SFN, and as such CNL has included them in Section 6.9.6.2.2 Secondary Pathways.	■ CNL has committed to engaging each Nation on the future land use and final clean up criteria of the site and to provide the necessary capacity support to enable each First Nation and the Manitoba Métis Federation to meaningfully participate in this engagement. This commitment has been added to Section 6.9.6.2.2 Secondary Pathways and Section 6.9.7 Monitoring and Follow-up. ■ This pathway has been elevated from a no linkage to a secondary pathway due to the importance to Indigenous Nations
Establishment of the WL site Concern about the collective effects of historical changes to each Nation's cultural practices, land and resource use, and Aboriginal and Treaty rights as a result of the establishment of WL site.	Section 6.9.5.2.1.1 Indigenous Community Perspectives on the Whiteshell Laboratories Site has been added to the assessment A subsection on Indigenous Community Perspectives on Health and Wellness was added to Section 6.9.5.2.6.4 Indigenous Health.	■ CNL confirmed that historical grievances are outside of the scope of this Project; however, these sections have been added to recognize the First Nations' and Manitoba Métis Federation's' perspectives on the establishment of the WL site and perspectives on health and wellness. ■ CNL is working closely with AECL to discuss historical grievances with each Nation.
Concerns about the spatial boundaries used in the assessment not being reflective of those used in traditional land use studies.	Indigenous Nations that were previously included as part of the RSA were revised to be part of the LSA, reflective of the role of traditional land and resources use and its contribution to well-being (Section 6.9.4.1 Spatial Boundaries).	■ CNL expanded the spatial boundaries relative to traditional land and resources use VCs (Section 6.8.1 Traditional Land and Resource Use) to be more reflective of the traditional territories identified through traditional land use studies. As such, updates were also warranted in Section 6.94.1 Spatial Boundaries as the relationship between traditional land and resources use has linkages to well-being.

Table 6.9.2-1: Summary of Issues Raised During Engagement Activities Related to the Socio-economic Environment

Interest and Concern	Inclusion Status	Additional information and Rationale
The absence of Indigenous indicators of well-being.	A subsection on Indigenous Community Perspectives on Health and Wellness was added to Section 6.9.5.2.6.4 Indigenous Health of the assessment.	■ Indigenous health and well-being are included in a dedicated section 6.9.5.2.6.4 Indigenous Health that is discussed in addition to the standardized elements that are used for non-Indigenous Nations. This allows direct comparison of the communities for several factors, and then additional analysis and discussion of those factors that are specific to indigenous people.

6.9.3 Valued Components

Valued components refer to socio-economic and environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). The socio-economic VCs chosen for the Project to reflect identified concerns, professional judgement and/or standard practice in environmental assessment are Employment and Income, Business Opportunities, Government Finances, Community Infrastructure and Services, Community Well-being and Public Safety. The rationale for selecting these VCs is discussed in Table 6.9.3-1.

Table 6.9.3-1: Valued Components for Socio-economic Assessment

Valued Component	Rationale for Selection
Employment and Income	Local communities recognize that the decommissioning of the WL site will result in changes to local employment and income opportunities. There are concerns that the change in approach to decommissioning the WR-1 Building may result in challenges to attracting new businesses to the WL site and creating future employment opportunities. The Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations also identified employment as important through engagement and verification discussions.
Business Opportunities	The proposed changes in decommissioning activities for the WR-1 Building create a different set of opportunities for contractors than the previous decommissioning plan. The Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations also identified business opportunities as important through engagement and verification discussions.
Government Finances	The LGD of Pinawa relies on a grant-in-lieu of taxes from AECL associated with the presence and operation of the WL site. The proposed changes in decommissioning activities may accelerate changes to the grant-in-lieu of taxes, which would change Pinawa's municipal revenue streams.

Table 6.9.3-1: Valued Components for Socio-economic Assessment

Valued Component	Rationale for Selection
Community Infrastructure and Services	A wide range of essential human needs are fulfilled by infrastructure and services in communities. Projects can place additional demands on them and their ability to meet community needs. The Project may also affect how community infrastructure and services are funded in Pinawa as AECL pays the LGD a grant-in-lieu of taxes, which is used to fund infrastructure and services, including the School District of Whiteshell.
Community Well-being	Community well-being is affected by a variety of factors, including consideration of economic well-being, physical well-being, social well-being and the environment. The change in approach to decommissioning the WR-1 Building may restrict access to more of the WL site than previously anticipated and limit its subsequent use for other activities. Indigenous Nations have expressed concern that the Project may limit their participation in land and resource use activities, which would affect their well-being through the ability to express their culture or exercise Aboriginal and Treaty rights. Communities have also expressed concern that attracting a new business/industry to the WL site is important for their continued viability, both in terms of employment/income and in terms of their long-term sustainability.
Public Safety	Public Safety has been a concern for the overall decommissioning of the WL site, which included medium-term storage of radioactive waste and eventual transport of radiological waste to permanent disposal facilities. The Project will reduce the amount of radiological waste being transported to disposal facilities, which will reduce one public safety hazard; however, the shift to in situ disposal will create a new public concern that was also identified by Indigenous peoples as some waste will be stored on the WL site permanently. Public safety related to the transportation of radiological waste off-site is considered in this assessment; while concern related to public exposure from in situ disposal is evaluated in Section 6.7 Human and Ecological Health. Psychosocial impacts are not considered a VC; however, due to the significant importance of this concern, and in the spirit of understanding and cooperation, the EIS discusses the psychosocial impacts of perceptions of the Project in Section 4.0 Indigenous Engagement, as well as mitigations CNL has and will put in place to address concerns related to fear and stigma associated with the site,

LGD = Local Government District; AECL = Atomic Energy Canada Limited.

Assessment endpoints are qualitative expressions used to assess the significance of residual effects on VCs and represent the key properties of the VC that should be protected for future generations. The assessments of each VC have incorporated community and/or traditional knowledge where available. Measurement indicators represent properties of the environment and VCs that, when changed, could result in or contribute to an effect on a VC. Measurement indicators can be used to monitor the success of mitigation and management programs. The assessment endpoints and measurement indicators associated with the socio-economic assessment are outlined in Table 6.9.3-2.

Table 6.9.3-2: Assessment Endpoints and Measurement Indicators for the Socio-economic Assessment

Valued Component	Assessment Endpoints	Measurement Indicators
Employment and Income	Employment opportunities and associated income for residents of communities in the LSA at the WL site during decommissioning, including opportunities for Indigenous peoples.	The measurement indicators consider changes to local employment and income opportunities based on the change in decommissioning strategy for the Project and the ability to create future employment opportunities by attracting new businesses to the WL site.

Table 6.9.3-2: Assessment Endpoints and Measurement Indicators for the Socio-economic Assessment

Valued Component	Assessment Endpoints	Measurement Indicators
Business Opportunities	Contracting opportunities for decommissioning work at the WL site provided to local and regional businesses, including Indigenous businesses.	The measurement indicators consider incremental expenditures for procurement requirements created by the Project and implications to the existing industry and business profile in the local and regional study areas.
Government Finances	■ The grant-in-lieu paid by AECL to the LGD of Pinawa. ■ Changes in the fiscal relationship among AECL, Provincial Government and the LGD of Pinawa.	The measurement indicators consider the continued financial viability of the communities and rural municipalities in proximity to the Project. Particular attention is paid to the LGD of Pinawa and its relationships with the federal government, which pays the grant-in-lieu of taxes, and the provincial government, which provides a reduced level of funding to the school district because of the grant-in-lieu of taxes.
Community Infrastructure and Services	■ Capacity of local and regional transportation infrastructure to accommodate Project-related traffic. ■ Capacity of Pinawa to continue providing the same level of infrastructure and services to residents as a result in potential changes to municipal funding.	■ Traffic volumes and road infrastructure will be considered in relation to employee traffic and waste hauling. ■ The Project is not expected to place stress on other infrastructure and services, but a potential change in the municipal revenue stream because of changes in the grant-in-lieu could alter the level of services offered in the LGD of Pinawa.
Community Well-being	■ Nature of post-decommissioning uses of the WL site, which may change as a result of changes in the original decommissioning plan. ■ Capacity of the Community Regeneration Partnership to create a feasible socio-economic plan for the region to promote continued economic and community development. ■ Economic development opportunities available to the communities and RMs in the LSA. ■ Continued use of the area by First Nation member or Red River Métis citizens for traditional land and resource use activities.	The measurement indicators consider the continued socio-economic sustainability and overall well-being of communities in proximity to the Project, with a particular focus on the LGD of Pinawa due to the community's historical ties with the WL site.
Public Safety	■ Safety related to transportation infrastructure. ■ Safety related to access to the WL site, including the consideration of radiation exposure and non-radiological exposure).	The measurement indicators considered for public safety for the Project are related to potential hazards associated with decommissioning activities including waste hauling and public access to the site during institutional control.

LSA = Local Study Area; LGD = Local Government District; RM = Rural Municipality.

6.9.4 Assessment Boundaries

6.9.4.1 Spatial Boundaries

- **Local Study Area (LSA)** for the socio-economic VCs encompasses the municipalities and rural municipalities most likely to be affected by the Project. The LSA contains the municipalities of the Local Government District (LGD) of Pinawa, the Town of Lac du Bonnet and the Town of Beausejour (Beausejour), as well as the Rural Municipality (RM) of Whitemouth, the RM of Lac du Bonnet and the RM of Brokenhead. The workforce at the WL site since it began operations in the 1960s has traditionally resided in these municipalities and RMs; the largest proportion of the current workforce also resides here. These communities have a historical relationship with the operators of the WL site and currently have a relationship with the operators through the Public Liaison Committee and the Whiteshell Laboratories Community Regeneration Partnership (the Partnership), which is intended to help the communities affected by decommissioning develop a socio-economic plan to promote the viability of the regional economy.

  There are also three First Nations communities included in the LSA located in relative proximity to the Project that have an interest from a socio-economic perspective (i.e., employment and business opportunities as well as negative socio-economic effects from permanent ISD affecting future site suitability). These include:

  - Sagkeeng First Nation (Fort Alexander Indian reserve 3 is approximately 66 km northwest of the WL site).
  - Black River First Nation (Black River Indian reserve 9 is approximately 92 km northwest of the WL site).
  - Brokenhead Ojibway Nation (Brokenhead Indian reserve 4 is approximately 73 km northwest of the WL site). Brokenhead Ojibway Nation has two additional reserves, Birch Landing and Na-Sha-Ke-Penais.

  The Manitoba Métis Federation has Locals throughout their southeast region, including one in Lac du Bonnet which is part of the LSA. Additional Indigenous peoples are identified with respect to land and resource use, which is discussed in Section 6.8 Indigenous Land and Resource Use. As other Indigenous people's express interest in the Project from a socio-economic viewpoint, their inclusion in the effects assessment will be considered.

  Regional Study Area (RSA) is where potential effects are expected to be experienced at a broader scale, including potential economic activities and the use of transportation infrastructure. Economic effects could be a result of participation in Project employment or through contracting opportunities created by the Project. Effects on infrastructure and services would result from the use of transportation infrastructure to the WL site and between the WL site and the Chalk River Laboratories site. To capture the maximum extent of potential effects expected to be experienced, the RSA encompasses the Southeast Region of Manitoba and the City of Winnipeg, which includes population centres with well-developed business communities, residents with labour skills that could be relevant to the Project and transportation infrastructure to be used by the Project. The Southeast Region is Census Divisions 1, 2 and 12, which follow RM boundaries. Approximate geographic landmarks for RSA boundaries are the Manitoba-Ontario border in the east, the Manitoba-US border in the south, the Red River/PTH 75 in the west and the Winnipeg River in the north. The major population centres outside of the municipalities in the LSA are the Towns of Niverville, Powerview-Pine Falls and Ste-Anne; the City of Steinbach and the Village of St-Pierre-Jolys. The Manitoba Métis Federation has Locals throughout the RSA, which falls within their southeast region. The LSA and RSA are shown on Figure 6.9.4-1.

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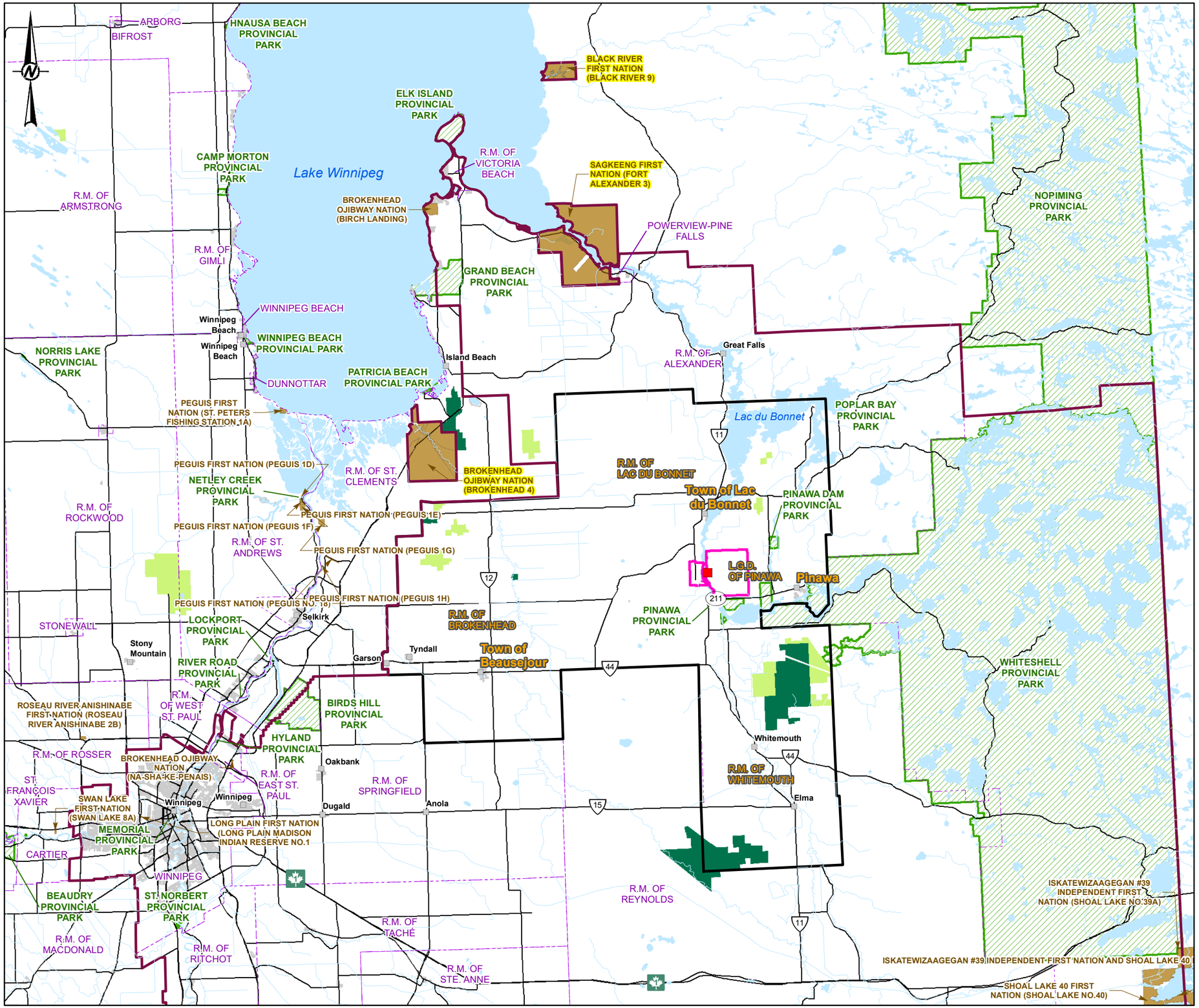


LEGEND

- WR-1 BUILDING (SITE STUDY AREA)
- INDIGENOUS COMMUNITIES OF THE LSA
- MUNICIPAL COMMUNITIES OF THE LSA
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- WHITESHELL LABORATORIES SITE

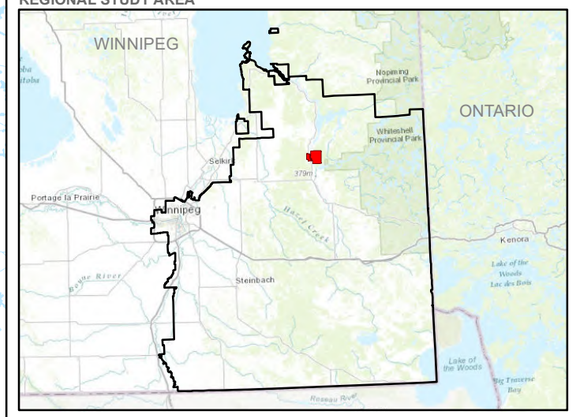
BASE FEATURES

- CITY/TOWN
- MAJOR ROAD
- WATERCOURSE
- WATERBODY
- MUNICIPAL BOUNDARY
- FIRST NATION RESERVE

PROTECTED AREAS

- PROVINCIAL PARK
- ECOLOGICAL RESERVE
- WILDLIFE MANAGEMENT AREA

REGIONAL STUDY AREA



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NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY PROVIDED BY CNL (2016-11-22)
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT

CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT

EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE

SPATIAL BOUNDARIES FOR THE SOCIO-ECONOMIC ASSESSMENT

CONSULTANT

WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
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6.9.4.2 Temporal Boundaries

The temporal boundary of the assessment includes the timeframe during which Project activities are actively occurring and the duration of predicted residual effects. The duration of an effect is defined as the amount of time between the start and end of a Project activity or stressor (which is related to the project phases) plus the time required for the residual effect to be reversed. In some cases, a residual effect may be irreversible within the temporal boundaries of the Project if the effects were predicted to last so far into the future that they could not be predicted with any level of certainty (e.g., residual effect lasts for thousands of years). The following phases were identified for the Project:

- **Closure Phase:** Preparation and implementation of in situ disposal (ISD), which includes preparation for ISD, grouting of below-grade structures and systems, removal of above-grade WR-1 structures and systems, installation of the concrete cap and engineered cover, and environmental controls and final site restoration. These activities last from 2022 to 2027.
- **Post-closure Phase:** The post-closure phase has two discrete periods: institutional control and post-institutional control. Institutional control is estimated to last 100 years during which long-term monitoring and maintenance activities will continue, to demonstrate WRDF performance is in compliance with the safety case assumptions and performance modelling. The 100-year timeframe is not related to the design life of the WRDF barriers. The 100-year active monitoring period was selected to ensure that sufficient opportunity is provided to verify the WRDF is performing as expected. Additionally, beyond 100 years, there is less confidence that institutional controls, like access restrictions, can be relied upon. Although the duration of institutional control is estimated at 100 years, it is recognized that it will continue until the CNSC, or the appropriate authority at the time, agrees it is no longer needed.

  Post-institutional control occurs after year 2127 and continues indefinitely. The post-closure phase will continue indefinitely; however, the timeframe defined for assessment of potential effects as part of the normal evolution of the Project is 10,000 years. This time period encompasses the phase in which peak effects are anticipated.

6.9.4.3 Assessment Cases

The socio-economic assessment considers the following three assessment cases:

- **Base Case:** represents existing conditions and includes effects from previous and existing developments and activities. For the socio-economic assessment, the effects of current and future decommissioning activities for the WL site are included in the Base Case. As described in the Comprehensive Study Report (AECL 2001), the original decommissioning approach for the WL site proposed three phases that would ultimately lead to final decommissioning activities being completed over a 60-year period (i.e., 2061). Since the environmental assessment decision in 2002, the overall approach to decommissioning, in keeping with international best practices, has shifted to an accelerated process with reduced deferment periods with a targeted timeframe for closure of the WL site by 2027.
- First Nations and the Manitoba Métis Federation identified concern about the collective effects of historical changes to each Nation's cultural practices, land and resource use, and Aboriginal and Treaty rights as a result of the establishment of WL site. CNL is working closely with AECL to discuss historical grievances with each Nation.

- **Application Case:** represents predictions of the effects that may result from the Project. As described above, the Base Case already includes effects from the eventual decommissioning of the entire WL site. Consequently, the Application Case for the Project only considers effects from the accelerated process with reduced deferment periods (i.e., accelerated from 2061 to 2027).
- **Reasonably Foreseeable Developments (RFD) Case:** represents the effects of the Base Case combined with the predicted incremental effects from the Project (the Application Case), as well as effects from other RFDs within the RSA that are currently under application review or that have officially entered a regulatory application process. There are no RFDs expected in the RSA (Table 6.9.4-1).

Table 6.9.4-1: Reasonably Foreseeable Developments considered in the Socio-economic Environment Assessment

Type of Project	Location	Description	Timeframe	Overlap with Valued Components
Infrastructure Decommissioning	WL	Decommissioning of remaining infrastructure on the WL site (includes ISD of the low-level waste trenches).	2016 to 2027	No – there is no overlap of effects with the Project (i.e., no new workforce is required for these activities)
Environmental Remediation	WL	Remediation of affected lands, with the exception of the low-level waste trenches.	2016 to 2027	No – there is no overlap of effects with the Project (i.e., no new workforce is required for these activities)

6.9.5 Description of the Environment

This section describes the setting and characterization for socio-economics as relevant for the assessment of the Project. It describes the existing conditions against which potential changes from the Project are compared and evaluated.

6.9.5.1 Methods

The characterization of the existing socio-economic environment reflects review of both primary and secondary data sources. Data collection began with a review of existing literature and databases from a variety of public sources. Where sufficient detail was not available from secondary data sources to describe the existing environment, primary data collection was undertaken in the form of Key Person Interviews.

6.9.5.1.1 Literature Review

The review of literature and databases included the following sources:

- Project-specific Indigenous-community led studies for Sagkeeng First Nation (recognizing these reports contain information relevant to socio-economic assessment, but are not assessments of Sagkeeng First Nation socio-economic impacts);
  - For Sagkeeng First Nation: *Sagkeeng Anicinabe Land Use and Occupancy Study Specific to Canadian Nuclear Laboratories' Proposed In Situ Decommissioning of the WR-1 Reactor at Whiteshell Laboratories* (Firelight Research Inc. and Sagkeeng Anicinabe 2018) and *Sagkeeng Anicinabe Psychosocial Impact Assessment* (Narratives Inc 2020).
- statistical data sources (e.g., Statistics Canada, Indigenous and Northern Affairs Canada);
- federal, provincial and municipal government reports and data;

- health reports and data;
- regional-level documents (i.e., Community Futures Winnipeg River);
- the previous Whiteshell Laboratories Decommissioning Project: Comprehensive Study Report (AECL 2001); and,
- online sources (e.g., community websites, online business profiles).

Data from these sources was used to characterize the existing environment, based upon the most recently available data.

6.9.5.1.1.1 Limitations of Statistics Canada Data

Statistics Canada data should be interpreted with caution because of issues of comparability across years, confidentiality, and data quality. The characterization of the existing socio-economic environment relies on the 2016 and 2006 Census of Population data along with data from the 2011 National Household Survey (NHS). It is noted that in 2011 there was a shift in how the census was administered, with the NHS replacing the long-form census. One of the key differences was a shift from a mandatory to an optional response requirement for citizens. Statistics Canada also suppresses data for confidentiality or data quality.

Statistics Canada collects and reports data based on geographic locations, which means data are tied to the location of the respondent. While this provides insight into geographic communities, when a population, such as the Métis citizens or First Nation members living off-reserve, is disperse, the usefulness of Statistics Canada data is limited in describing the specific populations. Statistics Canada data presented herein focus on the communities (Indigenous and municipal) in the LSA. Further, for Indigenous populations living in municipalities, Statistics Canada reports self-identified Indigenous populations, which means that individuals identifying as Indigenous may not be registered members of a First Nation or a Métis citizen.

6.9.5.1.2 Key Person Interview Program

A limited Key Person Interview Program (KPI Program 2016) was undertaken to address gaps that could not be readily filled by secondary sources to provide perspectives on community interests and concerns in Pinawa, the Town and RM of Lac du Bonnet, Beausejour, the RM of Brokenhead and the RM of Whitemouth. Interview guides for the Key Person Interviews were developed to address the subject areas discussed in this section. One limitation of the KPI Program is the focus on municipalities and RMs in the LSA and RSA. The perspectives of Indigenous Nations were not captured as part of the KPI program, but gathered through various community-led studies (primarily traditional land and occupancy studies) and Project engagement activities.

6.9.5.2 Results

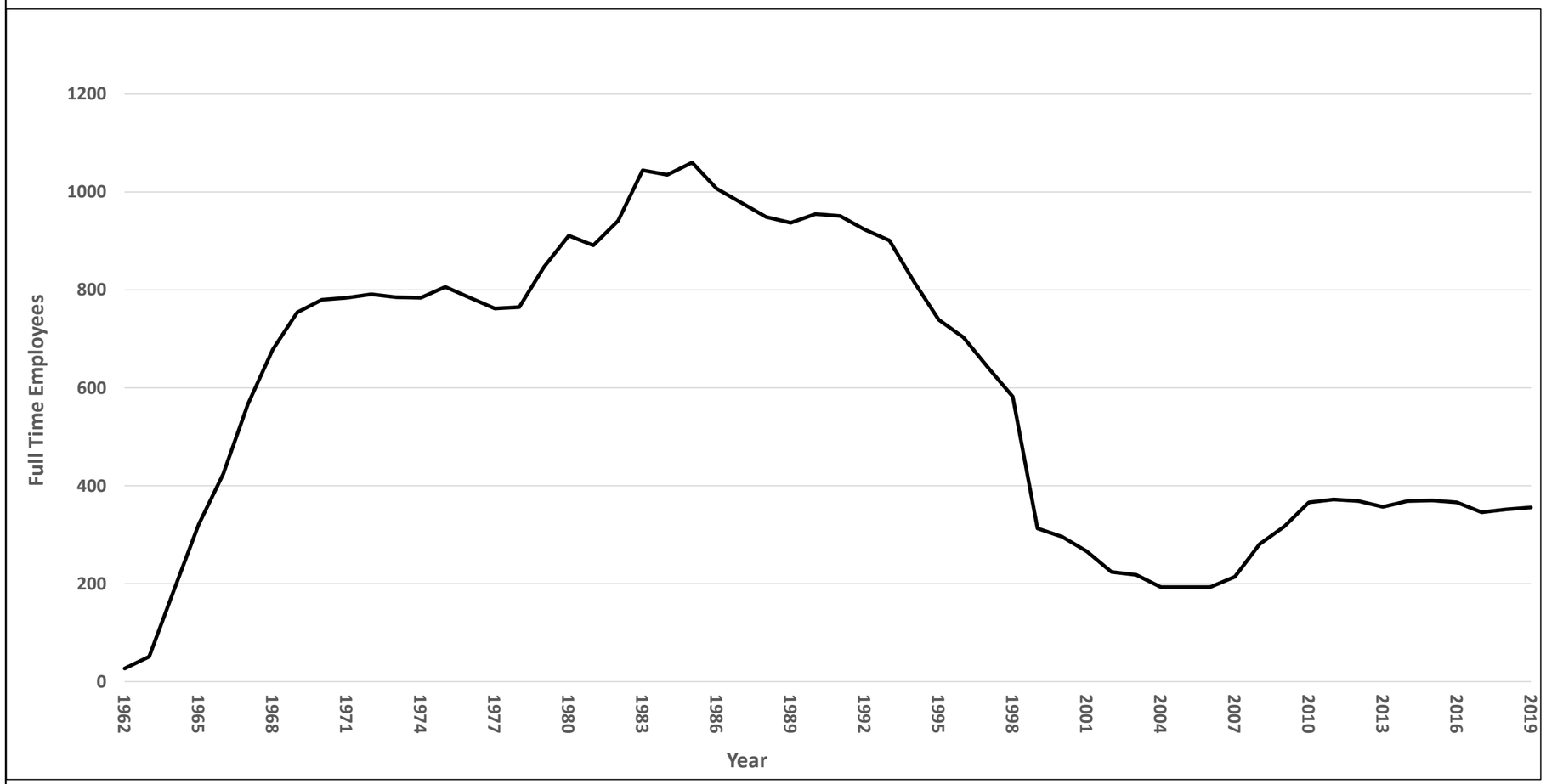
6.9.5.2.1 Historical Background

The WL site was established in the early 1960s by Atomic Energy of Canada Limited (AECL) to facilitate research and development of higher temperature versions of the Canada Deuterium Uranium (CANDU) reactor. Also, at that time, AECL designed and established the local government district of Pinawa. The WL site included WR-1, an organic cooled reactor which became operational in 1965 (AECL 2001). In the early 1970s, the organic cooled reactor program was eliminated, and full focus was concentrated on the heavy water-cooled CANDU reactor system. In 1985, WR-1 was permanently shut down. Over the years many nuclear research, management and safety programs were developed at the WL site which led to its reputation as a diverse centre for research (CNL 2016a; AECL 2001).

As a result of a federal review process that led to the reduction in funding to nuclear research, the Federal Government decided in 1997 to discontinue research programs at the WL site (AECL 2001). The initial efforts to secure a private owner to run the facility were unsuccessful and in 1998 AECL determined the WL site would be closed and decommissioned to meet regulatory requirements. A Comprehensive Study Report for the decommissioning of the WL site was completed in 2001 and the Environmental Assessment decision to approve the project was announced in March of 2002 (CNL 2016b). In 2003, the decommissioning framework for the WL site received approval. This decommissioning framework included a completed Environmental Assessment and the subsequent site decommissioning licence by the Canadian Nuclear Safety Commission (CNSC) (CNL 2016c).

Phase 1 of the WR-1 decommissioning began in 1989 and was completed in 1995. The initial shutdown and Phase 1 decommissioning of WR-1 included, amongst other decommissioning activities, removal of fuel and radioactive material and preparation of WR-1 for a deferment period for the radioactivity levels to decrease through natural decay prior to subsequent decommissioning activities. In 2001, a monitoring program began for WR-1 (AECL 2001; CNL 2016b).

CNL was established on May 30, 2014 as part of the Government of Canada's restructuring of AECL, and preparation for full implementation of a Government-owned, Contractor-operated (GoCo) model. Once CNL was established, AECL applied to the CNSC to transfer the WL site licence to CNL. This licence transfer was approved by the CNSC on October 22, 2014 (CNSC 2014). CNL became a private-sector entity with the transfer of ownership to Canadian National Energy Alliance. CNL currently operates the WL site on behalf of AECL. It has been mandated by AECL to proceed with decommissioning work (CNL 2016a). Change in number of full-time employees at the WL site between 1962 and 2019 is shown in Figure 6.9.5-1.



LEGEND

NOTE(S)

The full-time employment number between 2016-2019 is as of March 31 of each year

REFERENCE(S)

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
FULL-TIME EMPLOYMENT AT THE WL SITE (1962-2019)

CONSULTANT
wsp GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	RRD
REVIEWED	KL
APPROVED	MM

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0017	2	**6.9.5-1**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
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Path: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0017_EIS_Sec_6.9\20145046-0017-ril.L002_Figure 6_9_5-1 Full-time Employment at the WL site (1962-2015)2.mxd

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6.9.5.2.1.1 Indigenous Nations Perspectives on and Observations of the Whiteshell Laboratories Site

The WL site was established in the 1960s without consideration of and consultation with Indigenous Nations in the region, which Sagkeeng First Nation, Black River First Nation, Brokenhead Ojibway Nation, and Hollow Water First Nation noted through engagement. The Sagkeeng First Nation stated concern about the collective effects of historical changes to their cultural practices, land and resource use, and Aboriginal and Treaty rights as a result of the establishment of WL site (Section 4.2.4.1 Sagkeeng First Nation). Black River First Nation, Brokenhead Ojibway Nation, and Hollow Water First Nation were concerned that a large parcel of land could have been removed from treaty land without discussion with Indigenous Nations (Section 4.2.4.3 Black River First Nation, Brokenhead Ojibway Nation, and Hollow Water First Nation). While consultation with Indigenous Nations was not standard practice in the 1960s and the Duty to Consult was not formally established by the Supreme Court of Canada until 2004 (Gonzalez 2020), the WL site in its entirety is understood by CNL as being a source of concern relative to community well-being and cultural expression for Indigenous Nations in the LSA.

Most of the concerns expressed by Indigenous Nations about well-being are tied to a series of historical activities and developments such as hydroelectric dams, large-scale agriculture, the Pine Falls Mill and the WL site (Section 6.8.1.5.2.2 Traditional Land and Resource Use by Indigenous Peoples). These activities and development affected lands used for traditional land and resource use activities through restricted access and other changes to the environment. The Sagkeeng First Nation in the *Sagkeeng Anicinabe's Alternative Means Assessment for the Environmental Assessment of Canadian Nuclear Laboratories' Proposed WR-1 Reactor Decommissioning Project* (Sagkeen Anicinabe and Firelight Research Inc 2020), *Sagkeeng Anicinabe Psychosocial Impact Assessment* (Narratives Inc 2020), and Traditional Knowledge and Land Use (TKLU) Study (Firelight Research Inc. and Sagkeeng Anicinabe 2018) document the changes brought by the WL site on community well-being and the associated land and resource use activities that support it. The Black River First Nation, Brokenhead Ojibway Nation, and Hollow Water First Nation (2019) collectively describe the effects of past industrial development, including the establishment of the WL site on the communities and community well-being.

Section 6.8.1.5.2.2 Traditional Land and Resource Use by Indigenous Peoples describes some of the historical and external factors that have affected land and resource use activities (e.g., the *Indian Act*, residential schools, industrial development). These factors have also contributed the socio-economic environment for Indigenous Nations, including community well-being. The Sagkeeng First Nation, which is downstream from the WL site and whose members have historically used and occupied the WL site prior to it being fenced off, notes that "mental stress, fear, and stigma associated with Whiteshell has already had a significant effect on Sagkeeng people" (Sagkeeng Anicinabe and Firelight Research Inc 2020, p. 35). The presence of the WL site, along with other industrial developments, has led Sagkeeng First Nation members to consider the existing conditions "dirty" and "polluted." For example, one member shared (Narratives Inc. 2020):

> *That was the reason why we left the reserve as well, because my dad started saying that the land and the things were being damaged. Everybody knew about that; that going down the river and close to Lac du Bonnet, you were going to get bad fish. You were going to get deer that sometimes had big pockets of pus or something on the sides. And they'd talk about this, that it was dangerous to get meat and food from over there... And although I didn't understand when I was little, I understand it now, that it had to do with the nuclear [Whiteshell Laboratory Site]. But it also had to do with the dams. And it probably had to do with that mill, too. (p.43)*

The Black River First Nation, Brokenhead Ojibway Nation, and Hollow Water First Nation also document in their TKLU Study (Black River First Nation, Brokenhead Ojibway Nation, and Hollow Water First Nation 2019) that the existing conditions are “sick” and “contaminated.” Observations by community members include:

> *It’s not just about our drinking water. It’s also got to do with our fisherman that fish in the lake. The fish have growths on them. Where does that come from? I can’t rule out this Pinawa site as part of the problem” (p.50)*

And

> *There are clear signs of sickness in animals throughout our Traditional Territory. Moose have brain worms and rot in their meat, so they cannot be eaten. Disease is spread from deer and also because they are eating polluted roots from the river. (p. 53)*

While these observations are related to the physical environment, community members for Black River First Nation, Brokenhead Ojibway Nation, and Hollow Water First Nation shared that their worldview is based on cultural teachings that “tells us how we are to conduct ourselves in relation to other beings on the earth, and how we are to move forward in a positive way” (p. 14). This traditional understanding of the world is “inherently holistic, intergenerational, and spiritual in nature” (p. 14). As a Back River First Nation member shared:

> *Basically, it’s how we live, how we were raised by our parents and grandparents. They respected everything that we had: water, trees, land and the animals too. Everything that they killed, wildlife, nothing was wasted. Everything was shared and used. (p. 14)*

Changes in the environment, including the establishment of the WL site, have affected the health and well-being of community members. One member noted

> *We survived back then with nothing like this [nuclear power]. We were healthier then. Then they had to come along (p. 55)*

6.9.5.2.2 Population

Over the last 15 years the communities within the LSA have generally displayed a population increase, with the exception of the RM of Whitemouth, which has experienced an overall decline. These population increases may be a reflection of people moving out of urban centres, choosing to commute to work while maintaining a rural lifestyle and/or an increase of retirees moving out of city centres or away from family farming in appreciation of rural lifestyle, access to municipal services and easy access to outdoor recreation. Table 6.9.5-1 presents the total population for municipalities and rural municipalities in the RSA from 2001, 2006, 2011 and 2016.

According to Statistics Canada (2001, 2006, 2011a, 2016), the population of Pinawa decreased from 2001 to 2011, while increasing between 2011 and 2016. This initial decline has been linked to the departure of individuals and families associated with layoffs at the WL site, which began in 1998. Meanwhile, retirees have been attracted to the LGD, reportedly because it is considered to be a safe community and health care is readily accessible; however, this has not offset the overall population decline (KPI Program 2016).

The Town of Lac du Bonnet has experienced very little change in population since 2001, however, the Town of Beausejour has experienced a population increase since 2001. In Beausejour, an aging population in the town is partially attributed to the shift from small family farms to industrial farming. As farmers retire, they have tended to sell their farms and move to the town (KPI Program 2016).

Two of the RMs closest to the Project, the RM of Lac du Bonnet and the RM of Brokenhead, have also experienced population growth between 2001 and 2016, while the population in the RM of Whitemouth has decreased since 2001. The RM of Brokenhead has younger demographics than the other municipalities in the LSA. There has been an influx of young families into the villages of Garson and Tyndall. These communities are on Highway 44 between Winnipeg and Beausejour. Many residents of the villages commute to Winnipeg for employment (KPI Program 2016).

Table 6.9.5-1: Total Population for Municipal Communities in the Local Study Area, 2001, 2006, 2011, 2016[a]

Community	2001	2006	2011[b]	2016	Population Change 2001 to 2016[c] (%)
Municipalities					
Local Government District of Pinawa	1,500	1,450	1,444	1,504	0.27%
Town of Lac du Bonnet[d]	1,089	1,009	1,069	1,089	0.00%
Town of Beausejour	2,772	2,823	3,126	3,219	16.13%
Rural Municipalities					
Lac du Bonnet[c]	2,405	2,812	2,930	3,121	29.77%
Brokenhead	3,527	3,940	4,635	5,122	45.22%
Whitemouth	1,617	1,480	1,548	1,557	-3.71%

Source: Statistics Canada (2001, 2006, 2011a, 2012, 2016).

a) Statistics Canada data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5 and in some cases, 10. Columns may not add up due to rounding.

b) Response to the 2011 National Household Survey was voluntary, compared with compulsory response in the other reported years, resulting in some variation in response rate and sample area in smaller communities between years.

c) Population Change 2001-2016 was calculated based on Statistics Canada data.

d) In a review of the 2011 Census, Statistics Canada originally misallocated population and dwellings belonging in the Rural Municipality of Lac du Bonnet to the Town. This is the revised population counts (Statistics Canada 2012).

Indigenous Population

Indigenous populations in the municipalities of the LSA and RSA based on self-identification rates of Census respondents are presented in Table 6.9.5-2. It is noted that Statistics Canada data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5 and in some cases, 10. Some data may also be suppressed for data quality or confidentiality reasons by Statistics Canada. Response to the 2011 National Household Survey was voluntary, compared with compulsory response in the other reported years, resulting in some variation in response rate and sample area in smaller communities between years.

Table 6.9.5-2 shows that reported Indigenous population in Pinawa has increased since 1996; however, the reported 2006 Indigenous population was more than double the reported 2016 population. Beausejour's reported Indigenous population has shown the largest change between 1996 and 2016 with an increase of 385 people. Although this Indigenous population increase was notable for Beausejour, the Town of Lac du Bonnet had a proportionately larger percentage of the total population identified as Indigenous (22.0%) as compared to Beausejour (13.2%) in 2016. The rural municipalities have shown a general increase in Indigenous population since 1996, although Whitemouth's reported Indigenous population remained unchanged from 2011 to 2016.

Table 6.9.5-2: Indigenous Population of Municipal Communities in the Local Study Area, 1996, 2001, 2006, 2011 and 2016

Community	Population	1996	2001	2006	2011	2016
		(# and % Population) [a,b]				
Municipalities						
Local Government District of Pinawa	Total Population	1,672	1,500	1,450	1,444	1,504
	Total Indigenous Identity[c,d]	0 (0%)	N/A[e]	180 (12.4%)	75 (5.2%)	85 (5.7%)
	North American Indian[f]	0 (0%)	N/A	70 (38.9%)	35 (46.7%)	15 (17.6%)
	Métis[g]	10	N/A	110 (61.1%)	20 (26.7%)	70 (82.4%)
	Inuit[h]	0 (0%)	N/A	0 (0%)	0 (0%)	10 (11.8%)
Town of Lac du Bonnet	Total Population	1,070	1,089	1,009	2,930	1,089
	Total Indigenous Identity[c,d]	135 (12.6%)	N/A	160 (15.9%)	N/A	240 (22.0%)
	North American Indian[f]	105 (77.8%)	N/A	30 (18.8%)	N/A	75 (31.3%)
	Métis[g]	30 (22.2%)	N/A	130 (81.3%)	N/A	155 (64.6%)
	Inuit[h]	0 (0%)	N/A	0	N/A	0 (0%)
Town of Beausejour	Total Population	2,712	2,772	2,823	3,126	3,219
	Total Indigenous Identity[c,d]	40 (1.5%)	N/A	185 (6.5%)	295 (9.4%)	425 (13.2%)
	North American Indian[f]	30 (75.0%)	N/A	40 (21.6%)	140 (47.5%)	130 (30.6%)
	Métis[g]	15 (37.5%)	N/A	115 (62.2%)	150 (50.8%)	300 (70.6%)
	Inuit[h]	0 (0%)	N/A	30 (16.2%)	0 (0%)	0 (0%)
Rural Municipalities						
Lac du Bonnet[i]	Total Population	2,280	2,405	2,812	2,671	3,121
	Total Indigenous Identity[c,d]	230 (10.1%)	N/A	380 (13.5%)	320 (12.0%)	430 (13.8%)
	North American Indian[f]	15 (6.5%)	N/A	40 (10.5%)	75 (23.4%)	55 (12.8%)
	Métis[g]	190 (82.6%)	N/A	315 (82.9%)	245 (76.6%)	365 (84.9%)
	Inuit[h]	25 (10.9%)	N/A	10 (2.6%)	0 (0%)	0 (0%)

Table 6.9.5-2: Indigenous Population of Municipal Communities in the Local Study Area, 1996, 2001, 2006, 2011 and 2016

Community	Population	1996	2001	2006	2011	2016
		(# and % Population) [a,b]				
Brokenhead	Total Population	3,495	3,527	3,940	4,635	5,122
	Total Indigenous Identity[c,d]	130 (3.7%)	N/A	310 (7.9%)	N/A	760 (14.8%)
	North American Indian[f]	55 (42.3%)	N/A	85 (27.4%)	N/A	190 (25.0%)
	Métis[g]	70 (53.8%)	N/A	225 72.6%)	N/A	545 (71.7%)
	Inuit[h]	0 (0%)	N/A	0 (0%)	N/A	0 (0%)
Whitemouth	Total Population	1,639	1,617	1,480	1,548	1,557
	Total Indigenous Identity[c,d]	20 (1.2%)	N/A	70 (4.7%)	125 (8.0%)	125 (8.0%)
	North American Indian[f]	10 (50.0%)	N/A	25 (35.7%)	80 (64.0%)	40 (32.0%)
	Métis[g]	15 (75%)	N/A	45 (64.3%)	40 (32.0%)	90 (72.0%)
	Inuit[h]	0 (0%)	N/A	0 (0%)	0 (0%)	0 (0%)

Source: Statistics Canada (1996, 2001, 2006, 2011a, 2012, 2016).

a) Statistics Canada data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5 and in some cases, 10. Columns may not add up due to rounding.

b) Response to the 2011 National Household Survey was voluntary, compared with compulsory response in the other reported years, resulting in some variation in response rate and sample area in smaller communities between years.

c) Total Indigenous identity population is composed of those persons who reported identifying with at least one Indigenous group, that is, North American Indian, Métis or Inuit and/or those who reported being a Treaty Indian or a Registered Indian, as defined by the *Indian Act* of Canada and/or those who reported they were members of an Indian band or First Nation.

d) Percentage of Total Indigenous Identity has been calculated based on Total Population of the community.

e) Not available (N/A) indicates data for this area has been suppressed for data quality or confidentiality reasons.

f) Percentage of North American Indian has been calculated based on Total Indigenous Identity for the community.

g) Percentage of Métis has been calculated based on Total Indigenous Identity for the community.

h) Percentage of Inuit has been calculated based on Total Indigenous Identity for the community.

i) In a review of the 2011 Census, Statistics Canada originally misallocated population and dwellings belonging in the Rural Municipality of Lac du Bonnet to the Town. This is the revised population counts (Statistics Canada 2012).

The Indigenous population of First Nation communities in the LSA as reported through the Census are presented in Table 6.9.5-3. Between 1996 and 2016 the total reported Indigenous population of all three communities grew. The Sagkeeng First Nation grew by approximately 220 people which was an increase of 13% of the total population reported. The Brokenhead Ojibway Nation grew by approximately 180 people an increase of 56%, and the population of Black River First Nation grew by 355 people between 1996 and 2016 representing a reported population increase of over 200%. All three First Nation communities include people that identify as Métis; however, no people identifying as Inuit were recorded in these communities.

Table 6.9.5-3: Indigenous Population of First Nation Communities in the Local Study Area, 1996, 2001, 2006, 2011 and 2016

Community	Population	1996	2001	2006	2011	2016
		(# and% Population)[a]				
Sagkeeng First Nation[b]	Total Population	1,690	1,998	2,121	2,099	1,929
	Total Indigenous Identity[c,d]	1,675 (99.1%)	N/A[e]	2,110 (99.5%)	2,025 (96.5%)	1,895 (98.2%)
	North American Indian[f]	1,650 (98.5%)	N/A	2,080 (98.6%)	2,000 (98.8%)	1,870 (96.9%)
	Métis[g]	15 (0.9%)	N/A	30 (1.4%)	15 (0.7%)	20 (1.1%)
	Inuit[h]	0 (0%)	N/A	0 (0%)	0 (0%)	0 (0%)
Brokenhead Ojibway Nation[i]	Total Population	332	372	467	N/A	516
	Total Indigenous Identity[c,d]	320 (96.4%)	N/A	450 (96.4%)	N/A	500 (96.9%)
	North American Indian[f]	310 (96.9%)	N/A	430 (95.6%)	N/A	465 (93.0%)
	Métis[g]	10 (3.1%)	N/A	20 (4.4%)	N/A	30 (5.8%)
	Inuit[h]	0 (0%)	N/A	0 (0%)	N/A	0 (0%)
Black River First Nation[j]	Total Population	340	389	460	521	698
	Total Indigenous Identity[c,d]	335 (98.5%)	N/A	460 (100%)	525 (100.8%)	690 (98.9%)
	North American Indian[f]	335 (100%)	N/A	455 (98.9%)	520 (99.0%)	690 (100%)
	Métis[g]	0 (0%)	N/A	0 (0%)	10 (1.9%)	0 (0%)
	Inuit[h]	0 (0%)	N/A	0 (0%)	0 (0%)	0 (0%)

Source: Statistics Canada (1996, 2001, 2006, 2011a, 2012, 2016).

a) Statistics Canada data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5 and in some cases, 10. Columns may not add up due to rounding. Response to the 2011 National Household Survey was voluntary, compared with compulsory response in the other reported years, resulting in some variation in response rate and sample area in smaller communities between years.

b) Statistics Canada refers to Sagkeeng First Nation as Fort Alexander 3.

c) Total Indigenous identity population' is composed of those persons who reported identifying with at least one Indigenous group, that is, North American Indian, Métis or Inuit and/or those who reported being a Treaty Indian or a Registered Indian, as defined by the *Indian Act* of Canada and/or those who reported they were members of an Indian band or First Nation.

d) Percentage of Total Indigenous Identity has been calculated based on Total Population of the community.

e) Not available (N/A) indicates data for this area has been suppressed for data quality or confidentiality reasons.

f) Percentage of North American Indian has been calculated based on Total Indigenous Identity for the community.

g) Percentage of Métis has been calculated based on Total Indigenous Identity for the community.

h) Percentage of Inuit has been calculated based on Total Indigenous Identity for the community.

i) Statistics Canada refers to Brokenhead Ojibway Nation as Brokenhead 4.

j) Statistics Canada refers to Black River First Nation as Black River 9.

Population data for Sagkeeng First Nation, Brokenhead Ojibway Nation and Black River First Nation are also available from Indigenous and Northern Affairs Canada (INAC) and Indigenous Services Canada (ISC).[1] Several sources have been cited throughout this section as data collection methods vary by source. Variations in data collection methods can lead to differences among sources with respect to reported population. Actual population levels are expected to be somewhere within the ranges reported. Table 6.9.5-4 presents on- and off-reserve population data according to INAC/ISC. Based on registered population, the membership for the First Nations in the LSA have increased between 1996 and February 2022 on-reserve and off-reserve. The proportion of members living off-reserve has consistently increased for Sagkeeng First Nation over this time frame, while the proportion of Brokenhead Ojibway Nation and Black River First Nation members living off-reserve varied over this time frame, but increased slightly overall. Statistics Canada (2021) notes the increase in First Nation members living off-reserve occurring across Canada and is expected to continue. The reasons for this trend include legislative changes that would enable more people, living mainly off-reserve, to apply for Registered Indian status, and negative net migration of reserves.

Table 6.9.5-4: On- and Off-reserve Population for First Nations in the Local Study Area, 1996 to 2022 (as of February)

First Nation	Population	1996	2001	2006	2011	2016	2022 (February)
Sagkeeng First Nation[a]	Total Number of Members	5,249	6,022	6,640	7,196	7,834	8,295
	Members On reserve	2,971	2,902	3,191	3,280	3,504	3,691
	Members Off reserve[b]	2,277	3,120	3,449	3,916	4,330	4,604
Brokenhead Ojibway Nation	Total Number of Members	1,231	1,426	1,592	1,805	2,037	2,165
	Members On reserve	423	343	549	499	791	675
	Members Off reserve[b]	808	1,083	1,043	1,306	1,246	1,490
Black River First Nation[c]	Total Number of Members	655	799	937	1,162	1,331	1,504
	Members On reserve	472	495	676	867	950	1,023
	Members Off reserve[b]	183	304	261	295	381	481

Source: Indigenous and Northern Affairs Canada 1997, 2002, 2007, and 2012. Indigenous Services Canada (ISC) 2018 and 2022.
a) Indigenous and Northern Affairs Canada and Indigenous Services Canada refers to Sagkeeng First Nation as Fort Alexander First Nation.
b) Off-reserve members include registered members who live on Crown land and on other reserves.
c) Indigenous and Northern Affairs Canada referred to Black River First Nation as Little Black River for years 1996, 2001, 2006, and 2011.

6.9.5.2.3 Employment and Income

6.9.5.2.3.1 CNL Whiteshell Laboratories Employment

Overall employment in the region have been affected by activities at the WL site. The WL site received a decommissioning licence in 2002; however, it has been scaling back employment since the overall peak employment of 1,168 workers in fall 1984. A series of major layoffs occurred in 1998, when the total employment went from 802 employees to 349 (AECL 2001). This number has remained fairly consistent over the past two decades. As of July 31, 2021, there were 321 employees employed on-site, with almost all of them working directly on or supporting decommissioning projects. Positions included engineering, scientific and technical staff; licensed skilled trades; unskilled trades; managers; and administrative and business professionals. Of these

[1] In 2017, INAC was dissolved and replaced by two new departments: Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) and Indigenous Services Canada (ISC).

employees, approximately 6 full-time equivalents work directly on WR-1 and approximately 14 full-time equivalents support the ongoing storage with surveillance of the WR-1.

CNL employed 41 people at WL who self-identify as Indigenous. This represents approximately 13% of the workforce at WL in 2021. Since 2017 this has remained relatively consistent, ranging from 12.94% to 15.33% of the WL workforce.

The decommissioning workforce has been maintained since July 2021 and is expected to increase to approximately 430 staff. The employment is expected to decline to less than 10 employees by 2027. Employment opportunities related to future site monitoring due to the Project have not yet been determined but they are not anticipated to be substantial.

Employment areas for the Project include skilled trades, heavy equipment operators, radiation surveyors and utility workers. When opportunities arise to fill vacant positions or hire local contractors, CNL will attempt to fill positions or hire contractors with local and Indigenous individuals or contractors; however, certain positions may require expertise from beyond the local communities. Canadian Nuclear Laboratories has a goal of developing skilled local talent, including participating in local skill development fairs and expos. More specific to the WL site, CNL maintains a communication protocol with Sagkeeng First Nation and provides job postings to the band office (CNL 2020). CNL is working collaboratively with Sagkeeng First Nation to find meaningful ways to provide economic opportunities.

The majority of CNL employees currently reside in Pinawa (90 employees), Lac du Bonnet (54 employees), and Beausejour (67 employees). There are currently programs in place at the Whiteshell Laboratories to help employees transition to other employment. Programs include access to a certified career coach, training tuition reimbursement and resume preparation.

6.9.5.2.3.2 Employment by Sector

Municipalities and Rural Municipalities

Major employers in the LSA for residents of the municipalities and rural municipalities include the CNL Whiteshell Laboratories; Manitoba Hydro, which has a district office in the Town of Lac du Bonnet, SunGro Horticulture, the Government of Manitoba, which has offices in Beausejour and Lac du Bonnet (Manitoba Conservation) and the Interlake-Eastern Regional Health Authority (RHA; KPI Program 2016). Employment specifics for the CNL Whiteshell Laboratories are provided in greater detail in Section 6.9.5.2.3.2 Employment by Sector.

Participants in the KPI Program also noted the presence and importance of local businesses. In multiple communities, it was noted that local governments are trying to foster an entrepreneurial sensibility in order that residents establish businesses in their home communities. The communities in the LSA have a variety of programs in place to encourage and support the establishment and development of local businesses (KPI Program 2016).

Table 6.9.5-5 outlines employment by key industries for residents of municipalities and the rural municipalities in the LSA for which 2006 and 2016 Census of Population data and 2011[2] National Household Survey data are available, as well as for residents of Manitoba for comparison purposes. Data indicate that for 2006, 2011, and 2016 the key occupational categories for communities in the LSA typically include sales and service occupations; trades, transport, and equipment operators; and education, law and social, and community and government services. Comparatively, the key occupational categories in Manitoba over this time frame were sales and service occupations; trades, transport, and equipment operators; and business, finance, and administration occupations. Pinawa also saw key occupational categories of natural and applied sciences and related occupations for 2006, 2011, and 2016 which increased over this time frame and was higher than the provincial average.

All municipalities and rural municipalities in the LSA saw an increase to its occupations in education, law and social, and community and government services and a decrease to sales and service occupations from 2006 to 2016, including for the province of Manitoba. Occupations in trades, transport, and equipment operators and related occupations varied depending on the municipality and rural municipality, however the majority saw an increase from 2006 to 2016 including for the Town of Lac du Bonnet, Beausejour, the RM of Lac du Bonnet, the RM of Whitemouth, and the province of Manitoba.

[2] Response to the 2011 National Household Survey was voluntary, compared with compulsory response in the other reported years, resulting in some variation in response rate and sample area in smaller communities between years.

Table 6.9.5-5: Employment by Occupation for Municipal Communities in the Local Study Area, 2006, 2011, and 2016[a]

Occupation Classification	Pinawa, Local Government District			Lac du Bonnet, Town			Beausejour, Town		
	2006	2011	2016	2006	2011[b]	2016	2006	2011	2016
	(# and % of Total Occupations)								
Total labour force population aged 15 years and over by occupation – National Occupational Classification (NOC) 2016[e]	565	615	645	460	N/A	420	1,240	1,550	1,635
Occupation – not applicable	0	0	0	10	N/A	10	15	0	10
All occupations	565	615	640	455	N/A	415	1,225	1,540	1,630
Management occupations	45 (8.0%)	50 (8.1%)	55 (8.6%)	20 (4.4%)	N/A	60 (14.5%)	65 (5.3%)	150 (9.7%)	105 (6.4%)
Business; finance and administration occupations	95 (16.8%)	65 (10.6%)	70 (10.9%)	45 (9.9%)	N/A	25 (6.0%)	200 (16.3%)	210 (13.6%)	215 (13.2%)
Natural and applied sciences and related occupations	55 (9.7%)	100 (16.3%)	100 (15.6%)	30 (6.6%)	N/A	40 (9.6%)	85 (6.9%)	130 (8.4%)	85 (5.2%)
Health occupations	35 (6.2%)	35 (5.7%)	65 (10.2%)	20 (4.4%)	N/A	20 (4.8%)	115 (9.4%)	75 (4.9%)	160 (9.8%)
Occupations in education; law and social; community and government services	55 (9.7%)	110 (17.9%)	90 (14.1%)	75 (16.5%)	N/A	75 (18.1%)	95 (7.8%)	290 (18.8%)	250 (15.3%)
Occupations in art; culture; recreation and sport	0 (0.0%)	15 (2.4%)	20 (3.1%)	0 (0.0%)	N/A	20 (4.8%)	10 (0.8%)	40 (2.6%)	10 (0.6%)
Sales and service occupations	165 (29.2%)	80 (13.0%)	145 (22.7%)	150 (33.0%)	N/A	80 (19.3%)	345 (28.2%)	280 (18.2%)	345 (21.2%)
Trades; transport and equipment operators and related occupations	85 (15.0%)	85 (13.8%)	70 (10.9%)	55 (12.1%)	N/A	60 (14.5%)	205 (16.7%)	265 (17.2%)	360 (22.1%)
Natural resources; agriculture and related production occupations	25 (4.4%)	15 (2.4%)	10 (1.6%)	40 (8.8%)	N/A	10 (2.4%)	40 (3.3%)	30 (1.9%)	40 (2.5%)
Occupations in manufacturing and utilities	10 (1.8%)	50 (8.1%)	20 (3.1%)	15 (3.3%)	N/A	20 (4.8%)	70 (5.7%)	65 (4.2%)	60 (3.7%)

Table 6.9.5-5: Employment by Occupation for Municipal Communities in the Local Study Area, 2006, 2011, and 2016[a]

Occupation Classification	Lac du Bonnet, Rural Municipality			Brokenhead, Rural Municipality			Whitemouth, Rural Municipality			Manitoba		
	2006	2011	2016	2006	2011[b]	2016	2006	2011	2016	2006	2011	2016
	(# and % of Total Occupations)											
Total labour force population aged 15 years and over by occupation – NOC 2016[c]	1,495	1,160	1,395	2,180	N/A	2,990	780	865	800	611,285	636,835	662,155
Occupation – not applicable	20	0	15	0	N/A	30	0	0	0	9,130	11,030	12,625
All occupations	1,475	1,155	1,385	2,175	N/A	2,960	775	865	800	602,150	625,810	649,525
Management occupations	120 (8.1%)	110 (9.5%)	160 (11.6%)	110 (5.1%)	N/A	425 (14.4%)	40 (5.2%)	185 (21.4%)	150 (18.8%)	51,355 (8.5%)	69,775 (11.1%)	71,455 (11.0%)
Business; finance and administration occupations	170 (11.5%)	125 (10.8%)	160 (11.6%)	325 (14.9%)	N/A	390 (13.2%)	85 (11.0%)	60 (6.9%)	95 (11.9%)	104,440 (17.3%)	97,840 (15.6%)	96,050 (14.8%)
Natural and applied sciences and related occupations	80 (5.4%)	50 (4.3%)	50 (3.6%)	70 (3.2%)	N/A	110 (3.7%)	30 (3.9%)	0 (0.0%)	10 (1.3%)	29,630 (4.9%)	33,630 (5.4%)	34,135 (5.3%)
Health occupations	65 (4.4%)	25 (2.2%)	115 (8.3%)	125 (5.7%)	N/A	245 (8.3%)	40 (5.2%)	25 (2.9%)	25 (3.1%)	40,455 (6.7%)	46,560 (7.4%)	52,280 (8.0%)
Occupations in education; law and social; community and government services	110 (7.5%)	115 (10%)	130 (9.4%)	120 (5.5%)	N/A	310 (10.5%)	0 (0.0%)	165 (19.1%)	105 (13.1%)	52,890 (8.8%)	82,195 (13.1%)	86,055 (13.2%)
Occupations in art; culture; recreation and sport	10 (0.7%)	0 (0.0%)	10 (0.7%)	35 (1.6%)	N/A	35 (1.2%)	0 (0.0%)	0 (0.0%)	10 (1.3%)	13,955 (2.3%)	13,470 (2.2%)	14,355 (2.2%)
Sales and service occupations	325 (22.0%)	285 (24.7%)	295 (21.3%)	500 (23.0%)	N/A	425 (14.4%)	150 (19.4%)	115 (13.3%)	125 (15.6%)	148,345 (24.6%)	140,965 (22.5%)	144,490 (22.2%)
Trades; transport and equipment operators and related occupations	325 (22.0%)	295 (25.5%)	335 (24.2%)	585 (26.9%)	N/A	780 (26.4%)	160 (20.6%)	210 (24.3%)	195 (24.4%)	90,285 (15.0%)	95,085 (15.2%)	102,660 (15.8%)
Natural resources; agriculture and related production occupations	220 (14.9%)	60 (5.2%)	70 (5.1%)	230 (10.6%)	N/A	105 (3.5%)	215 (27.7%)	80 (9.2%)	70 (8.8%)	38,900 (6.5%)	17,380 (2.8%)	18,400 (2.8%)
Occupations in manufacturing and utilities	50 (3.4%)	75 (6.5%)	65 (4.7%)	65 (3.0%)	N/A	125 (4.2%)	40 (5.2%)	10 (1.2%)	25 (3.1%)	31,900 (5.3%)	28,895 (4.6%)	29,650 (4.6%)

Source: Statistics Canada 2006, 2011a, and 2016.

a) Statistics Canada data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5 and in some cases, 10. Columns may not add up due to rounding. Response to the 2011 National Household Survey was voluntary, compared with compulsory response in the other reported years, resulting in some variation in response rate and sample area in smaller communities between years.

b) Data from the National Household Survey (2011) is suppressed for data quality or confidentiality reasons.

c) Statistics Canada uses the National Occupational Classification (NOC) for Statistics. Occupations are based on the type of job the person holds and the description of his or her duties; it considers the kind of work done by persons aged 15 and over.

CNL has traditionally been an important employer for residents of municipalities in the LSA. CNL employees reside primarily in Pinawa, Beausejour and the Town of Lac du Bonnet. CNL employment has typically been seen as providing high-quality opportunities in terms of both the pay scale and the education requirements associated with many of the jobs (KPI Program 2016).

First Nation Communities

Table 6.9.5-6 outlines employment by key industries for First Nations in the LSA for which 2006 and 2016 Census of Population data and 2011[3] National Household Survey data are available. Data indicate that for 2006, 2011, and 2016 the key occupational categories for Sagkeeng First Nation, Black River First Nation, and Brokenhead Ojibway Nation on-reserve members include sales and services occupations; occupations in education, law and social, community and government services; and trades, transport, and equipment operators and related occupations. Comparatively, the key occupational categories in Manitoba include occupations in sales and service occupations; trades, transport, and equipment operators; and business, finance, and administration.

Sales and service occupations decreased from 2006 to 2016 for on-reserve members of Sagkeeng First Nation, Black River First Nation, and Brokenhead Ojibway Nation, which is the same trend in the province of Manitoba. Where Black River First Nation and Brokenhead Ojibway Nation saw an increase to trades, transport, and equipment operators and related occupations from 2006 to 2016, Sagkeeng First Nation saw a decrease. The province of Manitoba saw an increase to trades, transport, and equipment operators and related occupations from 2006 to 2016. Sagkeeng First Nation and Brokenhead Ojibway Nation on-reserve members saw an increase to occupations in education, law and social, and community and government services from 2006 to 2016 where Black River First Nation had minimal change to this key occupational category. Another notable trend includes a large proportional decrease for natural resources, agriculture, and related production occupations for on-reserve members of each of Sagkeeng First Nation and Black River First Nation from between 2006 and 2011, which was similar for the province as a whole. Brokenhead Ojibway Nation also experienced a substantial proportional decrease for natural resources, agriculture, and related production occupations but since data were suppressed for 2011, it is not known during which census period the decrease occurred.

[3] Response to the 2011 National Household Survey was voluntary, compared with compulsory response in the other reported years, resulting in some variation in response rate and sample area in smaller communities between years.

Table 6.9.5-6: Employment by Occupation for First Nations in the Local Study Area, 2016[a]

Occupation Classification	Sagkeeng First Nation[b]			Black River First Nation[c]			Brokenhead Ojibway Nation[d]			Manitoba		
	2006	2011	2016	2006	2011	2016	2006	2011[e]	2016	2006	2011	2016
	(# and % of Total Occupations)											
Total labour force population aged 15 years and over by occupation – NOC 2016[f]	675	600	380	125	115	200	185	N/A	215	611,285	636,835	662,155
Occupation – not applicable	70	95	35	20	20	25	10	N/A	20	9,130	11,030	12,625
All occupations	610	510	345	105	100	175	180	N/A	195	602,150	625,810	649,525
Management occupations	30 (4.9%)	30 (5.9%)	20 (5.8%)	0 (0.0%)	10 (10.0%)	10 (5.7%)	10 (5.6%)	N/A	10 (5.1%)	51,355 (8.5%)	69,775 (11.1%)	71,455 (11.0%)
Business; finance and administration occupations	35 (5.7%)	45 (8.8%)	25 (7.2%)	10 (9.5%)	10 (10.0%)	20 (11.4%)	20 (11.1%)	N/A	20 (10.3%)	104,440 (17.3%)	97,840 (15.6%)	96,050 (14.8%)
Natural and applied sciences and related occupations	15 (2.5%)	0 (0.0%)	10 (2.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	10 (5.6%)	N/A	0 (0.0%)	29,630 (4.9%)	33,630 (5.4%)	34,135 (5.3%)
Health occupations	30 (4.9%)	30 (5.9%)	20 (5.8%)	10 (9.5%)	0 (0.0%)	10 (5.7%)	10 (5.6%)	N/A	10 (5.1%)	40,455 (6.7%)	46,560 (7.4%)	52,280 (8.0%)
Occupations in education; law and social; community and government services	100 (16.4%)	145 (28.4%)	95 (27.5%)	25 (23.8%)	25 (25.0%)	40 (22.9%)	25 (13.9%)	N/A	50 (25.6%)	52,890 (8.8%)	82,195 (13.1%)	86,055 (13.2%)
Occupations in art; culture; recreation and sport	15 (2.5%)	10 (2.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	10 (5.6%)	N/A	0 (0.0%)	13,955 (2.3%)	13,470 (2.2%)	14,355 (2.2%)
Sales and service occupations	190 (31.1%)	135 (26.5%)	100 (29.0%)	25 (23.8%)	15 (15.0%)	30 (17.1%)	70 (38.9%)	N/A	70 (35.9%)	148,345 (24.6%)	140,965 (22.5%)	144,490 (22.2%)
Trades; transport and equipment operators and related occupations	105 (17.2%)	75 (14.7%)	45 (13.0%)	25 (23.8%)	30 (30.0%)	45 (25.7%)	20 (11.1%)	N/A	35 (17.9%)	90,285 (15.0%)	95,085 (15.2%)	102,660 (15.8%)
Natural resources; agriculture and related production occupations	80 (13.1%)	30 (5.9%)	10 (2.9%)	15 (14.3%)	10 (10.0%)	15 (8.6%)	15 (8.3%)	N/A	0 (0.0%)	38,900 (6.5%)	17,380 (2.8%)	18,400 (2.8%)
Occupations in manufacturing and utilities	10 (1.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	10 (5.6%)	N/A	0 (0.0%)	31,900 (5.3%)	28,895 (4.6%)	29,650 (4.6%)

Source: Statistics Canada 2006, 2011a, and 2016.

a) Statistics Canada data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5 and in some cases, 10. Columns may not add up due to rounding. Response to the 2011 National Household Survey was voluntary, compared with compulsory response in the other reported years, resulting in some variation in response rate and sample area in smaller communities between years.

b) Statistics Canada refers to Sagkeeng First Nation as Fort Alexander 3.

c) Statistics Canada refers to Black River First Nation as Black River 9.

d) Statistics Canada refers to Brokenhead Ojibway Nation as Brokenhead 4.

e) Data from the National Household Survey (2011) is suppressed for data quality or confidentiality reasons.

f) Statistics Canada uses the National Occupational Classification (NOC) for Statistics. Occupations are based on the type of job the person holds and the description of his or her duties; it considers the kind of work done by persons aged 15 and over.

The First Nations in the LSA have local businesses. Sagkeeng First Nation operates the Sagkeeng Superstore (not affiliated with Loblaws Corporation) and a Tim Hortons. Sagkeeng First Nation has also suggested that it may have members and businesses that could aid with decommissioning activities (e.g., trucking, excavation) (reference needed). Brokenhead Ojibway Nation owns Wavers, a gas station and confectionary, and Chief Jim Bear currently sits on the Board of Directors for the South Beach Casino, which benefits all First Nations communities in Manitoba (Brokenhead Ojibway Nation 2014). Black River First Nation has a window plant, water treatment facility, truss plant, health centre, Head Start Program and a general store/gas bar (Black River First Nation 2009).

Mining

The Tanco Mine, located 60 km east of the Town of Lac du Bonnet, produces cesium, tantalum and spodumene. A decrease in Tanco Mine operation in 2016 was primarily the result of reduced demand for spodumene (KPI Program 2016). The True North Gold Mine (formerly the Rice Lake Gold Mine), owned and operated by Klondex Mines Ltd., is located approximately 250 km northeast of Winnipeg near the Town of Bissett and approximately 100 km northeast of Pinawa. Klondex Mines Ltd. filed a technical report and pre-feasibility study for the True North Gold Mine and has generally been pleased with the amount of ore extracted from reprocessing tailings (Klondex Mines Ltd 2016a,b). The site held employment sessions around the Town of Lac du Bonnet in 2016 (KPI Program 2016). The mine has since changed ownership to 1911 Gold. There are also quarry licences in the area and quarries were noted as providing employment to residents of the LSA (KPI Program 2016).

Tourism

Although tourism is not the primary economic driver in the region, seasonal recreational uses and cottaging remain important sources of revenues for all the municipalities and RMs in the LSA. The Whiteshell Provincial Park runs along the eastern boundary of the municipalities in the LSA and provides a steady draw of outdoor enthusiasts to the area. More specifically, the economies of the Town and RM of Lac du Bonnet rely on revenue from tourism as the RM is a prime area for summer cottaging and the population increases substantially in the summer. Retail and services in the Town of Lac du Bonnet benefit from this annual influx. There are plans to improve the town as a tourist destination. The bridge on Provincial Route 313 needs repairs and the community has successfully lobbied the Province of Manitoba to raise the height of the bridge so that a wider variety of boats can pass through the river underneath. The major rehabilitation work on the bridge was completed in November of 2019 (Government of Manitoba 2019). This upgrade will help the town to develop a new harbour, which is expected to attract an increased quantity and diversity of marine user groups, including seasonal boaters (KPI Program 2016).

The economies of Pinawa and Beausejour do not rely as heavily on tourism. Pinawa does not have sufficient accommodations to support a tourist industry. Its location also hampers its ability to take advantage of tourism dollars as it is located at the end of the highway, with no through traffic. Beausejour has other economic drivers that reduce the importance of tourism and cottaging relative to other communities in the LSA (KPI Program 2016).

The communities are part of the Eastman Tourism Region, which includes Birds Hill Provincial Park, Cooks Creek Heritage Museum, Grand Beach Provincial Park, Mennonite Heritage Village, South Beach Casino and Resort and the Whiteshell Provincial Park. In 2014, 20% of Manitoba's visitors (about 2,223,000 people) traveled to and through the region and spent $138.4 million in the region. Tourism resulted in an estimated $29 million in direct tax revenues (Tourism Manitoba 2016).

Agriculture

Agriculture in the LSA has been evolving. Smaller-scale family-owned farms had previously been characteristic of agricultural operations, especially in the RM of Brokenhead. These smaller operations have given way to larger agricultural firms with a more corporate organization (Community Futures Winnipeg River 2016). In the RMs of Whitemouth and Brokenhead, Sun Gro Horticulture is one of the main employers. The RM of Brokenhead is home to rich agricultural lands, with the production of wheat, canola, alfalfa, barley and oats comprising the majority of crops. Agriculture creates important seasonal employment (KPI Program 2016).

6.9.5.2.3.3 Labour Force

Municipalities and Rural Municipalities

Table 6.9.5-7 presents the 2006, 2011, and 2016 labour force characteristics for residents of municipalities and RMs in the LSA for which there are data available. Labour force characteristics include participation, employment, and unemployment rates. The participation rate is the percentage of the population eligible to participate in the labour force (i.e., individuals aged 15 years and over). Less than half of the eligible population in Pinawa participated in the labour force for 2006, 2011, and 2016 representing the lowest rate of all municipalities compared. The Town of Lac du Bonnet had a similar participation rate to Pinawa in 2016. The participation rates in Beausejour and the RM of Lac du Bonnet were higher than Pinawa yet lower than the Manitoba provincial rate over this time frame. The RM of Brokenhead and the RM of Whitemouth had participation rates similar to or greater than the provincial rate for 2006, 2011, and 2016.

For 2006, 2011, and 2016 Pinawa, the Town of Lac du Bonnet, Beausejour, and the RM of Lac du Bonnet had employment rates lower than the provincial average. The RM of Whitemouth and the RM of Brokenhead had employment rates greater than the provincial average for 2006, 2011, and 2016.

Pinawa (8.5%) and the Town of Lac du Bonnet (14.1%) had unemployment rates greater than the provincial average (6.7%) in 2016, while Beausejour's unemployment rate matched the provincial rate (6.7%). The RM of Lac du Bonnet (6.4%), the RM of Brokenhead (5.4%), and the RM of Whitemouth (1.9%) had unemployment rates lower than the provincial average (6.7%) in 2016.

Table 6.9.5-7: Labour Force Characteristics for Municipal Communities in the Local Study Area, 2006, 2011, and 2016

Community	Labour Force Characteristics[a]	2006	2011	2016
Pinawa, Local Government District	Total population 15 years and over by labour force activity	1,235	1,360	1,320
	In the labour force	565	615	645
	Employed	545	600	590
	Unemployed	20	10	55
	Not in the labour force	670	745	675
	Participation rate	45.7%	45.2%	48.9%
	Employment rate	44.1%	44.1%	44.7%
	Unemployment rate	3.5%	1.6%	8.5%
Lac du Bonnet, Town[b]	Total population 15 years and over by labour force activity	830	N/A	880
	In the labour force	460	N/A	425
	Employed	425	N/A	360
	Unemployed	35	N/A	60
	Not in the labour force	365	N/A	460
	Participation rate	55.4%	N/A	48.3%
	Employment rate	51.2%	N/A	40.9%
	Unemployment rate	7.6%	N/A	14.1%
Beausejour, Town	Total population 15 years and over by labour force activity	2,255	2,455	2,690
	In the labour force	1,240	1,550	1,635
	Employed	1,175	1,470	1,525
	Unemployed	65	80	110
	Not in the labour force	1,015	910	1,055
	Participation rate	55.0%	63.1%	60.8%
	Employment rate	52.1%	59.9%	56.7%
	Unemployment rate	5.2%	5.2%	6.7%

Table 6.9.5-7: Labour Force Characteristics for Municipal Communities in the Local Study Area, 2006, 2011, and 2016

Community	Labour Force Characteristics[a]	2006	2011	2016
Lac du Bonnet, Rural Municipality	Total population 15 years and over by labour force activity	2,415	2,120	2,460
	In the labour force	1,495	1,160	1,400
	Employed	1,410	995	1,310
	Unemployed	90	165	90
	Not in the labour force	925	960	1,060
	Participation rate	61.9%	54.7%	56.9%
	Employment rate	58.4%	46.9%	53.3%
	Unemployment rate	6.0%	14.2%	6.4%
Brokenhead, Rural Municipality[b]	Total population 15 years and over by labour force activity	3,195	N/A	4,090
	In the labour force	2,180	N/A	2,985
	Employed	2,105	N/A	2,830
	Unemployed	80	N/A	160
	Not in the labour force	1,010	N/A	1,105
	Participation rate	68.2%	N/A	73.0%
	Employment rate	65.9%	N/A	69.2%
	Unemployment rate	3.7%	N/A	5.4%
Whitemouth, Rural Municipality	Total population 15 years and over by labour force activity	1,180	1,195	1,205
	In the labour force	780	865	800
	Employed	755	820	785
	Unemployed	20	40	15
	Not in the labour force	400	330	405
	Participation rate	66.1%	72.4%	66.4%
	Employment rate	64.0%	68.6%	65.1%
	Unemployment rate	2.6%	4.6%	1.9%
Manitoba	Total population 15 years and over by labour force activity	908,450	946,945	1,001,305
	In the labour force	611,280	636,835	662,155
	Employed	577,710	597,290	617,465
	Unemployed	33,570	39,550	44,690
	Not in the labour force	297,170	310,105	339,155
	Participation rate	67.3%	67.3%	66.1%
	Employment rate	63.6%	63.1%	61.7%
	Unemployment rate	5.5%	6.2%	6.7%

Source: Statistics Canada 2006, 2011a, and 2016.

a) Statistics Canada data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5 and in some cases, 10. Columns may not add up due to rounding. Response to the 2011 National Household Survey was voluntary, compared with compulsory response in the other reported years, resulting in some variation in response rate and sample area in smaller communities between years.

b) Data for the National Household Survey (2011) has been suppressed for data quality or confidentiality reasons.

First Nation Communities

Table 6.9.5-8 presents the 2006, 2011, and 2016 labour force characteristics for First Nations in the LSA for which data are available. Over this time frame, less than half the eligible on-reserve population for Sagkeeng First Nation (46.7% in 2011 and 29.6% in 2016) and Black River First Nation (47.2% in 2006, 41.4% in 2011, and 47.6% in 2016) participated in the labour force with the participation rate remaining fairly steady on-reserve for Black River First Nation and decreasing substantially for on-reserve members of Sagkeeng First Nation. Brokenhead Ojibway Nation had participation rates greater than Sagkeeng First Nation and Black River First Nation, but not greater than the provincial average. Sagkeeng First Nation, Black River First Nation, and Brokenhead Ojibway Nation had employment rates that declined for 2006, 2011, and 2016 and were lower than the provincial average. The province of Manitoba's employment rate was unchanged over this time frame.

The unemployment rate on-reserve for Sagkeeng First Nation (22.2% in 2006, 25.8% in 2011 and 23.4% in 2016), Black River First Nation (24.0% in 2006, 20.8% in 2011, and 40.0% in 2016), and Brokenhead Ojibway Nation (16.2% in 2006 and 20.9% in 2016) is higher than for Manitoba as a whole (5.5% in 2006, 6.2% in 2011, and 6.7% in 2016).

Table 6.9.5-8: Labour Force Characteristics for First Nations in the Local Study Area, 2006, 2011, and 2016

First Nation	Labour Force Characteristics[a]	2006	2011	2016
Sagkeeng First Nation[b]	Total population 15 years and over by labour force activity	1,325	1,285	1,300
	In the labour force	675	600	385
	Employed	520	445	295
	Unemployed	150	155	90
	Not in the labour force	650	685	915
	Participation rate	50.9%	46.7%	29.6%
	Employment rate	39.2%	34.6%	22.7%
	Unemployment rate	22.2%	25.8%	23.4%
Black River First Nation[c]	Total population 15 years and over by labour force activity	265	290	420
	In the labour force	125	120	200
	Employed	95	90	120
	Unemployed	30	25	80
	Not in the labour force	145	170	220
	Participation rate	47.2%	41.4%	47.6%
	Employment rate	35.8%	31.0%	28.6%
	Unemployment rate	24.0%	20.8%	40.0%
Brokenhead Ojibway Nation[d,e]	Total population 15 years and over by labour force activity	310	N/A	375
	In the labour force	185	N/A	215
	Employed	160	N/A	170
	Unemployed	30	N/A	45
	Not in the labour force	125	N/A	165
	Participation rate	59.7%	N/A	57.3%
	Employment rate	51.6%	N/A	45.3%
	Unemployment rate	16.2%	N/A	20.9%

Table 6.9.5-8: Labour Force Characteristics for First Nations in the Local Study Area, 2006, 2011, and 2016

First Nation	Labour Force Characteristics[a]	2006	2011	2016
Manitoba	Total population 15 years and over by labour force activity	908,450	946,945	1,001,305
	In the labour force	611,280	636,835	662,155
	Employed	577,710	597,290	617,465
	Unemployed	33,570	39,550	44,690
	Not in the labour force	297,170	310,105	339,155
	Participation rate	67.3%	67.3%	66.1%
	Employment rate	63.6%	63.1%	61.7%
	Unemployment rate	5.5%	6.2%	6.7%

Source: Statistics Canada 2006, 2011a, and 2016.

a) Statistics Canada data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5 and in some cases, 10. Columns may not add up due to rounding. Response to the 2011 National Household Survey was voluntary, compared with compulsory response in the other reported years, resulting in some variation in response rate and sample area in smaller communities between years.

b) Statistics Canada refers to Sagkeeng First Nation as Fort Alexander 3.

c) Statistics Canada refers to Black River First Nation as Black River 9.

d) Statistics Canada refers to Brokenhead Ojibway Nation as Brokenhead 4.

e) Data for the National Household Survey (2011) has been suppressed for data quality or confidentiality reasons.

6.9.5.2.3.4 Income

Municipalities and Rural Municipalities

Table 6.9.5-9 presents personal income for the residents of municipalities and RMs in the LSA for 2005, 2010, and 2015 for which data are available. Residents of Pinawa and the RM of Lac du Bonnet had the highest average personal income after taxes in 2005, 2010, and 2015 compared to the LSA, and was similar to or slightly higher than the Manitoba provincial average over this time frame. Pinawa had average personal income after tax of $25,528 in 2005, $35,194 in 2010, and $37,220 in 2015 (this represents a growth of 45.8% from 2005 to 2015). The RM of Lac du Bonnet had average personal income after tax of $25,250 in 2005, $29,725 in 2010, and $37,303 in 2015 (this represents a growth of 47.7% from 2005 to 2015). The RM of Whitemouth had the lowest average personal income after taxes in the LSA in 2005 ($22,030), 2010 ($25,354), and 2015 ($31,504). The provincial average personal income after tax was $25,978 in 2005, $30,702 in 2010, and $35,957 in 2015 (this represents a growth of 38.4% from 2005 to 2015).

The majority of residents in all municipalities had personal incomes (total individuals 15 years and older with income) between $10,000 and $50,000 for 2005, 2010, and 2015. This is also true for the province where the majority of individuals 15 years of age and older with income also had personal incomes between $10,000 and $50,000 for 2005, 2010, and 2015.

Table 6.9.5-9: Personal Income for Municipal Communities in the Local Study Area, 2005, 2010, and 2015[a]

Community	Income Group	2005	2010	2015
Pinawa, Local Government District	Total number of individuals 15 years of age and older with income	1,165	1,325	1,275
	Average personal income after taxes ($)	$25,528	$35,194	$37,220
	Under $10,000	240	170	160
	$10,000-$19,999	205	240	185
	$20,000-$29,999	250	165	175
	$30,000-$39,999	255	265	170
	$40,000-$49,999	135	165	215
	$50,000-$59,999	80[b]	75	135
	$60,000 and over		240	235
Lac du Bonnet, Town[c]	Total number of individuals 15 years of age and older with income	815	N/A	870
	Average personal income after taxes ($)	$22,348	N/A	$34,854
	Under $10,000	170	N/A	95
	$10,000-$19,999	270	N/A	195
	$20,000-$29,999	155	N/A	175
	$30,000-$39,999	125	N/A	140
	$40,000-$49,999	55	N/A	90
	$50,000-$59,999	35[b]	N/A	50
	$60,000 and over		N/A	125
Beausejour, Town	Total number of individuals 15 years of age and older with income	2,220	2,405	2,555
	Average personal income after taxes ($)	$23,646	$30,610	$34,236
	Under $10,000	455	355	295
	$10,000-$19,999	675	545	470
	$20,000-$29,999	415	490	500
	$30,000-$39,999	330	390	425
	$40,000-$49,999	175	175	350
	$50,000-$59,999	165	170	205
	$60,000 and over		255	310

Table 6.9.5-9: Personal Income for Municipal Communities in the Local Study Area, 2005, 2010, and 2015[a]

Community	Income Group	2005	2010	2015
Lac du Bonnet, Rural Municipality	Total number of individuals 15 years of age and older with income	2,260	2,070	2,415
	Average personal income after taxes ($)	$25,250	$29,725	$37,303
	Under $10,000	450	315	250
	$10,000-$19,999	515	450	410
	$20,000-$29,999	510	445	455
	$30,000-$39,999	335	315	380
	$40,000-$49,999	225	300	310
	$50,000-$59,999	215[b]	85	205
	$60,000 and over		150	410
Brokenhead, Rural Municipality[c]	Total number of individuals 15 years of age and older with income	3,060	N/A	3,985
	Average personal income after taxes ($)	$24,725	N/A	$35,611
	Under $10,000	620	N/A	495
	$10,000-$19,999	700	N/A	620
	$20,000-$29,999	695	N/A	655
	$30,000-$39,999	495	N/A	665
	$40,000-$49,999	345	N/A	555
	$50,000-$59,999	200[b]	N/A	415
	$60,000 and over		N/A	570
Whitemouth, Rural Municipality	Total number of individuals 15 years of age and older with income	1,080	1,180	1,175
	Average personal income after taxes ($)	$22,030	$25,354	$31,504
	Under $10,000	245	260	155
	$10,000-$19,999	365	240	240
	$20,000-$29,999	270	245	260
	$30,000-$39,999	115	185	200
	$40,000-$49,999	25	105	135
	$50,000-$59,999	65[b]	100	80
	$60,000 and over		40	105
Manitoba	Total number of individuals 15 years of age and older with income	865,315	900,915	954,205
	Average personal income after taxes ($)	$25,978	$30,702	$35,957
	Under $10,000	180,735	166,870	142,035
	$10,000-$19,999	216,095	179,470	161,865
	$20,000-$29,999	183,430	166,025	165,880
	$30,000-$39,999	130,145	142,760	153,680
	$40,000-$49,999	71,380	97,635	116,415
	$50,000-$59,999	83,515[b]	60,970	78,105
	$60,000 and over		87,190	136,215

Source: Statistics Canada 2006, 2011a, and 2016.

a) Statistics Canada data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5 and in some cases, 10. Columns may not add up due to rounding. Response to the 2011 National Household Survey was voluntary, compared with compulsory response in the other reported years, resulting in some variation in response rate and sample area in smaller communities between years.

b) The Statistics Canada 2006 Census of Population reported an income range of $50,000 and over.

c) Data for the National Household Survey (2011) has been suppressed for data quality or confidentiality reasons.

Table 6.9.5-10 presents household income for residents of municipalities and RMs in the LSA for 2005, 2010, and 2015. Pinawa had the largest proportion of private households with an income of $60,000 and over (41.3% in 2005, 67.6% in 2010, and 70.4% in 2015) compared to the LSA. The Town of Lac du Bonnet had the largest proportion of private households with an income of under $60,000 (77.1% in 2005 and 57.1% in 2015) compared to the LSA. Comparatively Manitoba had 61.1% in 2005, 52.2% in 2010, and 43.6% in 2015 of private households with an income under $60,000, and approximately 38.9% in 2005, 47.8% in 2010, and 56.3% in 2015 of private households with an income of $60,000 and over.

Table 6.9.5-10: Household Income for Municipal Communities in the Local Study Area, 2005, 2010, and 2015[a]

Community	Income Group	2005	2010	2015
Pinawa, Local Government District	Total number of private households with income	630	695	675
	Under $10,000	25	0	0
	$10,000-$19,999	25	0	10
	$20,000-$29,999	70	35	30
	$30,000-$39,999	80	30	30
	$40,000-$49,999	85	45	65
	$50,000-$59,999	75	90	60
	$60,000-$79,999	140	125	130
	$80,000-$99,999	70	195	120
	$100,000 and over	50	150	225
Lac du Bonnet, Town[b]	Total number of private households with income	480	N/A	525
	Under $10,000	20	N/A	15
	$10,000-$19,999	120	N/A	35
	$20,000-$29,999	60	N/A	75
	$30,000-$39,999	45	N/A	70
	$40,000-$49,999	85	N/A	70
	$50,000-$59,999	40	N/A	35
	$60,000-$79,999	40	N/A	75
	$80,000-$99,999	20	N/A	40
	$100,000 and over	45	N/A	105
Beausejour, Town	Total number of private households with income	1,245	1,375	1,445
	Under $10,000	60	50	35
	$10,000-$19,999	235	155	115
	$20,000-$29,999	195	210	150
	$30,000-$39,999	120	140	150
	$40,000-$49,999	105	130	160
	$50,000-$59,999	115	90	110
	$60,000-$79,999	155	165	210
	$80,000-$99,999	125	185	165
	$100,000 and over	135	260	340

Table 6.9.5-10: Household Income for Municipalities and Rural Municipalities in the Local Study Area, 2005, 2010, and 2015[a]

Community	Income Group	2005	2010	2015
Lac du Bonnet, Rural Municipality	Total number of private households with income	1,165	1,055	1,285
	Under $10,000	25	0	25
	$10,000-$19,999	65	50	45
	$20,000-$29,999	135	100	95
	$30,000-$39,999	140	130	115
	$40,000-$49,999	205	55	110
	$50,000-$59,999	135	125	100
	$60,000-$79,999	190	185	225
	$80,000-$99,999	115	215	180
	$100,000 and over	145	165	410
Brokenhead, Rural Municipality[b]	Total number of private households with income	1,530	N/A	1,975
	Under $10,000	45	N/A	35
	$10,000-$19,999	95	N/A	80
	$20,000-$29,999	180	N/A	120
	$30,000-$39,999	245	N/A	155
	$40,000-$49,999	165	N/A	135
	$50,000-$59,999	180	N/A	155
	$60,000-$79,999	245	N/A	290
	$80,000-$99,999	145	N/A	275
	$100,000 and over	220	N/A	720
Whitemouth, Rural Municipality	Total number of private households with income	555	585	600
	Under $10,000	30	0	10
	$10,000-$19,999	70	20	30
	$20,000-$29,999	80	55	55
	$30,000-$39,999	95	100	70
	$40,000-$49,999	55	50	60
	$50,000-$59,999	50	50	50
	$60,000-$79,999	85	110	110
	$80,000-$99,999	30	60	75
	$100,000 and over	40	75	125
Manitoba	Total number of private households with income	448,780	465,805	489,050
	Under $10,000	24,295	24,960	17,425
	$10,000-$19,999	51,875	41,375	29,710
	$20,000-$29,999	53,865	44,110	40,430
	$30,000-$39,999	55,445	47,695	42,835
	$40,000-$49,999	47,955	45,370	42,830
	$50,000-$59,999	40,855	39,855	40,240
	$60,000-$79,999	65,820	68,350	72,185
	$80,000-$99,999	43,210	51,095	58,770
	$100,000 and over	65,445	102,985	144,620

Source: Statistics Canada 2006, 2011a, and 2016.

a) Statistics Canada data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5 and in some cases, 10. Columns may not add up due to rounding. Response to the 2011 National Household Survey was voluntary, compared with compulsory response in the other reported years, resulting in some variation in response rate and sample area in smaller communities between years.

b) Data for the National Household Survey (2011) has been suppressed for data quality or confidentiality reasons.

Table 6.9.5-11 presents sources of total income for 2005, 2010, and 2015 for residents of the municipalities in the LSA. For 2005, 2010, and 2015, income from employment (wages, salaries, and self-employment income) was the most prevalent source of income for residents in the municipalities in the LSA. Of the municipalities compared, residents of Pinawa had the lowest proportion of income from employment income at approximately half the population (46.6% in 2005, 53.3% in 2010, and 52.6% in 2015) yet also had the highest proportion of income from other sources (35.8% in 2005, 31.3% in 2010, and 32.1% in 2015) including dividends, interest and other investment income, retirement pensions, superannuation and annuities and other money income. This is likely reflective of the large population of retirees in Pinawa. The Town of Lac du Bonnet had just over 60% of income from employment income for 2005 and 2015 and, when compared to other municipalities in the LSA, had the highest source of income from government transfer payments (22.5% in 2005 and 19.7% in 2015). The residents of the RM of Lac du Bonnet had a relatively low percentage of income from employment income (63.1% in 2005, 54.4% in 2010, and 61.7% in 2015) along with a comparatively high percentage of income from other sources (20.1% in 2005, 28.7% in 2010, and 24.1% in 2016). Similar to residents of Pinawa, this may reflect the growing retiree demographic of the RM of Lac du Bonnet. All the municipalities in the LSA had employment income levels below the Manitoba provincial level (75.2% In 2005, 75.4% in 2010, and 73.6% in 2015).

Table 6.9.5-11: Sources of Total Income for Municipalities and Rural Municipalities in the Local Study Area, 2005, 2010, and 2015[a,b]

Community	Source of Income	2005	2010	2015
Pinawa, Local Government District	Employment Income (%)[c]	46.6	53.3	52.6
	Government transfer payments (%)[d]	17.5	15.2	15.3
	Other (%)[e]	35.8	31.3	32.1
Lac du Bonnet, Town[f]	Employment Income (%)[c]	60.9	N/A	62.0
	Government transfer payments (%)[d]	22.5	N/A	19.7
	Other (%)[e]	16.6	N/A	18.0
Beausejour, Town	Employment Income (%)[c]	64.1	69.9	68.2
	Government transfer payments (%)[d]	20.2	15.8	16.9
	Other (%)[e]	15.7	14.2	14.8
Lac du Bonnet, Rural Municipality	Employment Income (%)[c]	63.1	54.4	61.7
	Government transfer payments (%)[d]	16.9	16.9	14.4
	Other (%)[e]	20.1	28.7	24.1
Brokenhead, Rural Municipality[f]	Employment Income (%)[c]	78.2	N/A	78.2
	Government transfer payments (%)[d]	12.5	N/A	11.1
	Other (%)[e]	9.2	N/A	10.8
Whitemouth, Rural Municipality	Employment Income (%)[c]	65.8	73.9	70.0
	Government transfer payments (%)[d]	20.9	17.0	16.4
	Other (%)[e]	13.2	9.4	13.5

Table 6.9.5-11: Sources of Total Income for Municipalities and Rural Municipalities in the Local Study Area, 2005, 2010, and 2015[a,b]

Community	Source of Income	2005	2010	2015
Manitoba	Employment Income (%)[c]	75.2	75.4	73.6
	Government transfer payments (%)[d]	12.5	12.5	12.0
	Other (%)[e]	12.3	12.2	14.4

Source: Statistics Canada 2006, 2011a, and 2016.

a) The composition of the total income of a population group or a geographic area refers to the relative share of each income source or group of sources, expressed as a percentage of the aggregate total income of that group or area. Total of income is considered from all sources, including employment income, income from government programs, pension income, investment income and any other money income.

b) Statistics Canada data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5 and in some cases, 10. Columns may not add up due to rounding. Response to the 2011 National Household Survey was voluntary, compared with compulsory response in the other reported years, resulting in some variation in response rate and sample area in smaller communities between years.

c) Employment income includes income from wages and salaries and self-employment income.

d) Government transfer payments include Old Age Security pension and Guaranteed Income Supplement, Canada and Quebec Pension Plan benefits, Employment Insurance benefits, Child Benefits and other income from government sources (Statistics Canada 2013b).

e) Other income includes dividends, interest and other investment income; retirement pensions, superannuation and annuities; and other money income (Statistics Canada 2013b).

f) Data for the National Household Survey (2011) has been suppressed for data quality or confidentiality reasons.

First Nation Communities

Table 6.9.5-12 presents personal income for the First Nations in the LSA for 2005, 2010, and 2015. For Sagkeeng First Nation, Black River First Nation, and Brokenhead Ojibway Nation, the average personal income after tax was lower than the provincial average for each of 2005, 2010, and 2015. Brokenhead Ojibway Nation had the highest average personal income after tax in 2015 ($18,734) when compared to Sagekeeng First Nation and Brokenhead Ojibway Nation, however Black River First Nation had the largest proportional increase to its average personal income after tax from 2005 to 2015 (from $11,788 in 2005 to $15,255 in 2015 or 29.4%). The provincial average personal income after tax grew at an even larger rate (from $25,978 in 2005 to $35,957 in 2015, or 38.4%) when compared to the First Nations.

For Sagkeeng First Nation, Black River First Nation, and Brokenhead Ojibway Nation, the majority of individuals 15 years of age and older with income on-reserve, had personal incomes of under $20,000. These proportions of individuals 15 years of age and older with income under $20,000 are in contrast to the Province of Manitoba as a whole where less than half the proportion of the population had incomes under $20,000 (45.9% in 2005, 38.4% in 2010, and 31.8% in 2015).

Table 6.9.5-12: Personal Income for First Nations in the Local Study Area, 2005, 2010, and 2015[a]

First Nation	Income Group	2005	2010	2015
Sagkeeng First Nation[b]	Total number of individuals 15 years of age and older with income	1,295	1,170	1,125
	Average personal income after taxes ($)	$13,867	$14,603	$17,204
	Under $10,000	680	590	515
	$10,000-$19,999	285	265	230
	$20,000-$29,999	155	145	160
	$30,000-$39,999	85	80	100
	$40,000-$49,999	50	30	40
	$50,000-$59,999	35[f]	30	25
	$60,000 and over		30	55
Black River First Nation[c]	Total number of individuals 15 years of age and older with income	260	255	375
	Average personal income after taxes ($)	$11,788	$12,932	$15,255
	Under $10,000	150	135	205
	$10,000-$19,999	50	60	65
	$20,000-$29,999	30	35	35
	$30,000-$39,999	20	15	30
	$40,000-$49,999	10	10	25
	$50,000-$59,999	10[f]	0	10
	$60,000 and over		0	10
Brokenhead Ojibway Nation[d,e]	Total number of individuals 15 years of age and older with income	290	N/A	350
	Average personal income after taxes ($)	$15,662	N/A	$18,734
	Under $10,000	120	N/A	135
	$10,000-$19,999	70	N/A	80
	$20,000-$29,999	55	N/A	50
	$30,000-$39,999	25	N/A	45
	$40,000-$49,999	0	N/A	20
	$50,000-$59,999	10[f]	N/A	10
	$60,000 and over		N/A	5
Manitoba	Total number of individuals 15 years of age and older with income	865,315	900,915	954,205
	Average personal income after taxes ($)	$25,978	$30,702	$35,957
	Under $10,000	180,735	166,870	142,035
	$10,000-$19,999	216,095	179,470	161,865
	$20,000-$29,999	183,430	166,025	165,880
	$30,000-$39,999	130,145	142,760	153,680
	$40,000-$49,999	71,380	97,635	116,415
	$50,000-$59,999	83,515[f]	60,970	78,105
	$60,000 and over		87,190	136,215

Source: Statistics Canada 2006, 2011a, and 2016.

a) Statistics Canada data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5 and in some cases, 10. Columns may not add up due to rounding. . Response to the 2011 National Household Survey was voluntary, compared with compulsory response in the other reported years, resulting in some variation in response rate and sample area in smaller communities between years.

b) Statistics Canada refers to Sagkeeng First Nation as Fort Alexander 3.

c) Statistics Canada refers to Black River First Nation as Black River 9.

d) Statistics Canada refers to Brokenhead Ojibway Nation as Brokenhead 4.

e) Data for the National Household Survey (2011) has been suppressed for data quality or confidentiality reasons.

f) The Statistics Canada 2006 Census of Population reported an income range of $50,000 and over.

Table 6.9.5-13 presents household income for the First Nations in the LSA for 2005, 2010, and 2015. For 2005, 2010, and 2015, the majority of on-reserve households for Sagkeeng First Nation, Black River First Nation, and Brokenhead Ojibway Nation had incomes of less than $30,000, which is in contrast to the province of Manitoba where, as of 2016, the majority of households had an income of $60,000 and over.

For Sagkeeng First Nation the majority of on-reserve households with income had incomes of less than $60,000 (85.2% in 2005, 82.9% in 2010, and 81.0% in 2015), with the majority of households having incomes of less than $30,000 (53.7% in 2005, 57.1% in 2010, and 49.5% in 2015). Sagkeeng First Nation had a small proportion of private households on-reserve with an income of $60,000 and over (13.0% in 2005, 16.2% in 2010, and 19.0% in 2015). For Black River First Nation the majority of on-reserve households with income had incomes of less than $60,000 (92.0% in 2005 and 85.7% in 2015), with the majority of households having incomes of less than $30,000 (60.0% in 2005 and 62.9% in 2015). The Black River First Nation had approximately 22.9% of households with an income of $60,000 and over in 2015 and no households with an income of $60,000 and over in 2005. Within Brokenhead Ojibway Nation, the majority of households had an income of less than $60,000 (86.7% in 2005 and 77.4% in 2015) with approximately half of the households having an income of less than $30,000 (56.7% in 2005 and 48.4% in 2015). In contrast, a small proportion of households had incomes of less than $30,000 provincially (29.0% in 2005, 23.7% in 2010 and 17.9% in 2015). As of 2016, the majority (56.3%) of households in the province of Manitoba had an income of $60,000 and over.

Table 6.9.5-13: Household Income for First Nations in the Local Study Area, 2005, 2010, and 2015[a]

First Nation	Income Group	2005	2010	2015
Sagkeeng First Nation[b]	Total number of private households with income	540	525	525
	Under $10,000	95	110	115
	$10,000-$19,999	105	115	70
	$20,000-$29,999	90	75	75
	$30,000-$39,999	75	60	75
	$40,000-$49,999	55	50	50
	$50,000-$59,999	40	25	40
	$60,000-$79,999	40	45	45
	$80,000-$99,999	15	20	25
	$100,000 and over	15	20	30
Black River First Nation[c,d]	Total number of private households with income	125	N/A	175
	Under $10,000	30	N/A	60
	$10,000-$19,999	30	N/A	25
	$20,000-$29,999	15	N/A	25
	$30,000-$39,999	15	N/A	20
	$40,000-$49,999	15	N/A	15
	$50,000-$59,999	10	N/A	5
	$60,000-$79,999	0	N/A	25
	$80,000-$99,999	0	N/A	5
	$100,000 and over	0	N/A	10

Table 6.9.5-13: Household Income for First Nations in the Local Study Area, 2005, 2010, and 2015[a]

First Nation	Income Group	2005	2010	2015
Brokenhead Ojibway Nation[d,e]	Total number of private households with income	150	N/A	155
	Under $10,000	25	N/A	30
	$10,000-$19,999	35	N/A	20
	$20,000-$29,999	25	N/A	25
	$30,000-$39,999	20	N/A	15
	$40,000-$49,999	15	N/A	15
	$50,000-$59,999	10	N/A	15
	$60,000-$79,999	10	N/A	20
	$80,000-$99,999	0	N/A	15
	$100,000 and over	10	N/A	10
Manitoba	Total number of private households with income	448,780	465,805	489,050
	Under $10,000	24,295	24,960	17,425
	$10,000-$19,999	51,875	41,375	29,710
	$20,000-$29,999	53,865	44,110	40,430
	$30,000-$39,999	55,445	47,695	42,835
	$40,000-$49,999	47,955	45,370	42,830
	$50,000-$59,999	40,855	39,855	40,240
	$60,000-$79,999	65,820	68,350	72,185
	$80,000-$99,999	43,210	51,095	58,770
	$100,000 and over	65,445	102,985	144,620

Source: Statistics Canada 2006, 2011a, and 2016.

a) Statistics Canada data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5 and in some cases, 10. Columns may not add up due to rounding. Response to the 2011 National Household Survey was voluntary, compared with compulsory response in the other reported years, resulting in some variation in response rate and sample area in smaller communities between years.

b) Statistics Canada refers to Sagkeeng First Nation as Fort Alexander 3.

c) Statistics Canada refers to Black River First Nation as Black River 9.

d) Data for the National Household Survey (2011) has been suppressed for data quality or confidentiality reasons.

e) Statistics Canada refers to Brokenhead Ojibway Nation as Brokenhead 4.

Table 6.9.5-14 presents sources of total income for the First Nations in the LSA for 2005, 2010, and 2015. For Sagkeeng First Nation, Black River First Nation, and Brokenhead Ojibway Nation, the majority of on-reserve total income came from employment income; however, the proportion was lower than the provincial average for 2005, 2010, and 2015. The proportion of total income from employment income also decreased between 2005 and 2015 on-reserve for the three First Nations. The lowest source of on-reserve total income for 2005, 2010, and 2015 for Sagkeeng First Nation, Black River First Nation, and Brokenhead Ojibway Nation was from other sources. Sagkeeng First Nation, Black River First Nation, and Brokenhead Ojibway Nations all had higher percentages of on-reserve total income from government transfer payments as compared to the provincial percentage.

Table 6.9.5-14: Sources of Total Income for First Nations in the Local Study Area, 2005, 2010, and 2015[a,b,c]

First Nation	Source of Income	2005	2010	2015
Sagkeeng First Nation[d]	Employment Income (%)[h]	70.2	63.5	60.0
	Government transfer payments (%)[i]	28.2	35.5	36.2
	Other (%)[j]	1.7	1.1	3.8
Black River First Nation[e]	Employment Income (%)[h]	67.9	52.0	55.4
	Government transfer payments (%)[i]	30.9	48.3	39.3
	Other (%)[j]	0.5	0.0	4.4
Brokenhead Ojibway Nation[f,g]	Employment Income (%)[h]	73.2	N/A	68.3
	Government transfer payments (%)[i]	24.4	N/A	28.0
	Other (%)[j]	1.5	N/A	3.8
Manitoba	Employment Income (%)[h]	75.2	75.4	73.6
	Government transfer payments (%)[i]	12.5	12.5	12.0
	Other (%)[j]	12.3	12.2	14.4

Source: Statistics Canada 2006, 2011a, and 2016.

a) The composition of the total income of a population group or a geographic area refers to the relative share of each income source or group of sources, expressed as a percentage of the aggregate total income of that group or area. Total of income is considered from all sources, including employment income, income from government programs, pension income, investment income and any other money income.

b) Income data for the 2016 Census of Population were derived from 25% data. However, on Indian reserves and in remote communities, Statistics Canada attempts to obtain data from 100% of the population.

c) Statistics Canada data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5 and in some cases, 10. Columns may not add up due to rounding. Response to the 2011 National Household Survey was voluntary, compared with compulsory response in the other reported years, resulting in some variation in response rate and sample area in smaller communities between years.

d) Statistics Canada refers to Sagkeeng First Nation as Fort Alexander 3.

e) Statistics Canada refers to Black River First Nation as Black River 9.

f) Statistics Canada refers to Brokenhead Ojibway Nation as Brokenhead 4.

g) Data for the National Household Survey (2011) has been suppressed for data quality or confidentiality reasons.

h) Employment income includes income from wages and salaries and self-employment income.

i) Government transfer payments include Old Age Security pension and Guaranteed Income Supplement, Canada and Quebec Pension Plan benefits, Employment Insurance benefits, Child Benefits and other income from government sources (Statistics Canada 2013b).

j) Other income includes dividends, interest and other investment income; retirement pensions, superannuation and annuities; and other money income (Statistics Canada 2013b).

6.9.5.2.4 Government Finances

As a federal Crown corporation, AECL is exempt from property taxes and instead pays a grant-in-lieu of taxes. Under the *Payments in Lieu of Taxes Act,* AECL has obligations to pay amounts similar to what would otherwise be required in taxes, notwithstanding the AECL and Provincial Government Master Agreement. The grant-in-lieu from AECL to Pinawa currently represents about 40% of the LGD's revenue base. The majority of the grant (57%) goes to the School District of Whiteshell, which oversees the two schools in Pinawa (KPI Program 2016). The community has received a stable amount of money for the grant-in-lieu of taxes since 2002 with the amount adjusted for inflation.

6.9.5.2.5 Community Infrastructure and Services

This section reviews existing facilities and services within the LSA.

6.9.5.2.5.1 Roads

The WL site is accessed from Winnipeg via Highway 44 east, Highway 11 north and Highway 211 east. Highway 44 begins at Lockport, runs through Garson to Beausejour (33 km) and is a four-lane divided highway. East of Beausejour, Highway 44 is a two-lane highway and continues southeast from the junction with Highway 11 terminating at the Trans-Canada Highway near West Hawk Lake. Connecting Lake Winnipeg to the north and the Trans-Canada Highway to the south, Highway 11 is a two-lane paved road spanning 9 km from Highway 44 to Highway 211 east. Highway 11 continues past the Highway 211 junction past Lac du Bonnet and northward to Highway 59.

For the majority of the year within the LSA, there are no load restrictions on any of the paved roads in the area; restrictions apply in the spring to portions of Highway 211 and Highway 11 and may also apply in the spring on unpaved roads (Manitoba Infrastructure and University of Manitoba Transportation Information Group 2019; Manitoba Infrastructure 2020). The bridge nearest to the WL site, at Highway 211 over the Winnipeg River, has no load restrictions (Manitoba Infrastructure 2020). At the WL site, the main access roads to the facility are paved, with access roads to facilities beyond the main complex, for example the waste management facility, generally unpaved. Spatial boundaries, including highways, for the socio-economic assessment are displayed on Figure 6.9.3-1.

6.9.5.2.5.2 Water Supply

The Town of Lac du Bonnet and Pinawa draw water from the Winnipeg River System and treat it at their water treatment plants (Province of Manitoba 2004; LGD of Pinawa 2015).

Pinawa has an emergency generator for the water and lift stations to maintain services if hydroelectric power is interrupted (LGD of Pinawa 2016a). The LGD of Pinawa has approximately 660 residential and 20 commercial water system connections. A 50-plus housing complex (Ironwood Housing) and subdivision (Trillium Ridge), along with two campgrounds (Pioneer Bay and Tim Horton's Children's Camp), have been connected to the water system. These additions will serve over 281 tenants (LGD of Pinawa 2015). All in-ground infrastructure requires updating and the Pinawa Public Works Committee has completed development of a 5-year plan for strategic water main renewal.

The Town of Lac du Bonnet water system has approximately 500 customers, the majority of which are residential, along with a few small commercial customers. The Town of Lac du Bonnet's bulk water station is also heavily used by seasonal customers located outside of the town's limits. The Town of Lac du Bonnet served a few customers beyond the town's limits (11 customers), provided water services to the RM of Lac du Bonnet and additionally had an agreement with the RM to directly serve the Glen Howard Inn (Province of Manitoba 2007). The Glenn Howard Inn has since closed and there are currently no water customers of the Town of Lac du Bonnet remaining in the Rural Municipality (Manitoba Public Utilities Board 2018). In general, the town's infrastructure is aging and the water lines need to be replaced. The community has begun replacing the water lines, the north half of the town has been replaced with work on the southern half awaiting grant application approval (KPI Program 2016). Council resolution has indicated that it has upcoming expenses associated to further replacement of cast iron water and wastewater lines (Manitoba Public Utilities Board 2020).

Sagkeeng First Nation is the only First Nation in the LSA known to draw water from the Winnipeg River for residential purposes (J.R. Cousin Consultants Ltd. n.d.).

6.9.5.2.5.3 Community Facilities

Municipalities

A summary of the facilities available in each of the LSA municipal communities is provided in Table 6.9.5-15.

Table 6.9.5-15 Community Facilities for Local Study Area Municipalities

Facility	Pinawa	Beausejour	Town of Lac du Bonnet
School	■ F.W. Gilbert School (Kindergarten to Grade 6) ■ Pinawa Secondary School (Grades 7-12)	■ Beausejour Early Years School (Kindergarten to Grade 5) ■ École Edward Schreyer School (Grades 6-12)	■ Centennial School (Kindergarten to Grade 6) ■ Lac du Bonnet Senior School (Grades 7-12)
Child care	■ Children's Place Co-op Day Care	■ Beausejour Kids Centre	■ Centennial School Daycare
Healthcare	■ Ambulance/Emergency Medical Services ■ Hospital /Community Health Centre (17 bed facility) ■ Community Cancer Program (at hospital) ■ Supportive Housing ■ Community Health Services (Public & Mental Health/Home Care) ■ Services to Seniors (Day Programs/ Meals on Wheels) ■ Medical Clinic ■ Dental clinic ■ Pharmacy	■ Ambulance/Emergency Medical Services ■ Hospital/Community Health Centre (30 bed facility) ■ Personal Care Home ■ Supportive Housing ■ Primary Health Care ■ Services to Seniors (Day Programs/Meals on Wheels/Outreach for Seniors) ■ Handivan Transportation ■ Medical Clinics (Beausejour Clinic and First Street Medical Clinic) ■ Dental Clinic ■ Pharmacy	■ Ambulance/Emergency Medical Services ■ Community Health Centre ■ Personal Care Home ■ Community Health Services (Public & Mental Health/Home Care) ■ Services to Seniors (Day Programs/Senior Resource) ■ Two Rivers Transit ■ Medical Clinic ■ Dental Clinic ■ Pharmacy
Recreational Facilities	■ Community Centre ■ Orville Acres Arena (indoor and outdoor ice rink) ■ Public Pool ■ Tennis courts ■ Library ■ Pinawa Golf and Country Club ■ Marina ■ Cross-country ski trails ■ Vanier Centre	■ Sun Gro Centre (indoor ice rink, curling club, outdoor pool and indoor walking track) ■ Rivers Edge Golf and Country Club	■ Community Centre ■ Curling Club ■ Arena (indoor ice rink) ■ Lac du Bonnet Granite Hills Golf Club

Table 6.9.5-15 Community Facilities for Local Study Area Municipalities

Facility	Pinawa	Beausejour	Town of Lac du Bonnet
Temporary Accommodations	■ Pinawa Motel ■ Deer Ridge Cabins ■ Wilderness Edge Retreat & Conference Centre ■ Pioneer Bay Campground ■ Relax Ridge Seasonal Park	■ Howland Hotel ■ Beausejour Hotel ■ Beausejour Motel ■ Superior Inn & Conference ■ Glass Lake B&B ■ Great Woods Park and Campground ■ Brokenhead River Park and Campground	■ Drifters Inn ■ Glenn Howard Inn ■ Lakeview Inn ■ Casey's Motor Inn ■ Champagne's RV Park ■ White Spruce on the Lake ■ Ember Ranch B&B ■ Wild Rose B & B

Source: Sunrise School Division 2018a,b,c; Beausejour Kids Centre 2012; Province of Manitoba 2012; LGD of Pinawa 2016b-i; Interlake-Eastern RHA. n.d.a,b,c; The Town and Lac du Bonnet 2019a,b; Beausejour Dental Centre 2019; Sun Gro Centre 2019; Granite Hills Golf Centre 2019; Golf Link 2016; Pinawa Golf and Country Club n.d.

Physician recruitment and retention is a challenge in Pinawa and Beausejour; the goal of a family doctor for everyone and 24/7 operation of the Emergency Room remains a current pursuit (LGD of Pinawa 2016d).

First Nation Communities

Sagkeeng First Nation, Black River First Nation, and Brokenhead Ojibway Nation have schools and Head Start Programs. All three First Nations offer health care within the community; see summary in Table 6.9.5-16.

Table 6.9.5-16 Community Facilities On-reserve for Local Study Area First Nations

Facility	Sagkeeng First Nation	Black River First Nation	Brokenhead Ojibway Nation
School	■ Sagkeeng Anicinabe School (Nursery School to Grade 8) ■ Sagkeeng Anicinabe High School (Grades 9-12)	■ Black River School (Nursery School to Grade 9) ■ Alternative Education Program	■ Sergeant Tommy Prince School (Nursery School to Grade 9)
Childcare	■ Sagkeeng Health Centre's Aboriginal Head Start on Reserve	■ Head Start Program	■ Sergeant Tommy Prince School Daycare/Head Start Program
Healthcare	■ Sagkeeng Health Centre ■ Sagkeeng Mino Pimatiziwin Family Treatment Centre (Family Addictions Treatment Centre) ■ George M. Guimond Care Centre – Personal Care Home	■ Health Centre	■ Brokenhead Health Centre
Recreational Facilities	■ Sagkeeng Arena	■ Information not publicly available	■ Brokenhead Ojibway Nation Entertainment Centre ■ Brokenhead Recreational Centre

Source: Sagkeeng Anicinabe 2020a; Manitoba First Nations Education Resource Centre Inc. 2016; Sagkeeng Health Centre 2016a; Sagkeeng Health Centre 2021; Black River First Nation 2009; SERDC n.d.a,b; Brokenhead Ojibway Nation 2014.

6.9.5.2.5.4 Housing

Municipalities and Rural Municipalities

A summary of the housing available in each of the LSA municipalities and rural municipalities is provided in Table 6.9.5-17. The average number of rooms per dwelling was 6.65 across all four municipalities (Statistics Canada 2016). Additionally, only the Towns of Pinawa and Beausejour have households with more than one person per room. Compared to other communities in the LSA, the RM of Lac du Bonnet and Whitemouth had the greatest percentage of households requiring major repairs (7.8% and 7.5% respectively).

In addition to private dwellings, Pinawa also maintains a 50-plus facility (The Ironwood), as well as a residential development called Trillium Ridge, which is a locally owned subdivision and the Awanipark residential development (Trillium 2016; KPI Program 2016). It was noted through the KPI Program that while there is ample housing available in the RM of Lac du Bonnet, there is a shortage of affordable housing. The housing market in the RM of Lac du Bonnet has been driven by the cottage market, which has increased the cost of housing throughout the RM.

Table 6.9.5-17: Housing Characteristics for Municipalities and Rural Municipalities in the Local Study Area, 2016

Housing Characteristics	Pinawa	Beausejour	RM of Lac du Bonnet	RM of Whitemouth
Total number of occupied private dwellings	675	1,445	1,285	595
Average number of rooms per dwelling	7.0	6.2	6.5	6.9
Number of households with more than one person per room	10	10	0	0
Percentage of households requiring major repairs	3.0%	5.5%	7.8%	7.5%

Source: Statistics Canada 2016.

a) Housing characteristic data for the 2016 Census of Population were derived from 100% data.

b) Statistics Canada data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5 and in some cases, 10. Columns may not add up due to rounding.

RM = Rural Municipality.

First Nation Communities

A summary of housing characteristics in First Nation communities in the LSA is provided in Table 6.9.5-18. Over half of the on-reserve households required major repair in Sagkeeng First Nations. In addition, 16.2% of on-reserve households had more than one person per room in Sagkeeng First Nation community. In the Black River First Nation community 36.1% of on-reserve households required major repair and almost 14% of on-reserve households had more than one person per room. Brokenhead Ojibway Nation had 25.0% of households on-reserve requiring major repair, and 6.3 % of households had more than one person per room.

Table 6.9.5-18 Housing Characteristics for Local Study Area First Nations, 2016

Housing Characteristics[a,b]	Sagkeeng First Nation[c]	Black River First Nation[d]	Brokenhead Ojibway Nation[e]
Total number of occupied private dwellings	525	180	160
Average number of rooms per dwelling	5.2	5.4	5.8
Number of households with more than one person per room	85	25	10
Percentage of households requiring major repairs	58.1%	36.1%	25.0%

Source: Statistics Canada 2016.
a) Housing characteristic data for the 2016 Census of Population were derived from 100% data.
b) Statistics Canada data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5 and in some cases, 10. Columns may not add up due to rounding.
c) Statistics Canada refers to Sagkeeng First Nation as Fort Alexander 3.
d) Statistics Canada refers to Black River First Nation as Black River 9.
e) Statistics Canada refers to Brokenhead Ojibway Nation as Brokenhead 4.

6.9.5.2.5.5 Services

Municipalities and Rural Municipalities

A summary of the services offered in the municipalities are displayed in Tables 6.9.5-19.

Table 6.9.5-19: Community Services for Local Study Area Municipalities and Rural Municipalities

Services	Pinawa	Beausejour	RM of Lac du Bonnet
RCMP	24 hr/day 7 days a week		
Fire	Volunteer	Volunteer paid on-call	Fire Department
Ambulance	Winnipeg River Ambulance Service		
Telephone/ Television/ Internet	Manitoba Telephone Services (MTS)		
	Shaw satellite service; Bell satellite service; Bell MTS; Xplornet; Pinawa Community Development Corporation	Shaw cable and fibre; Bell MTS phone and high-speed internet; Xplornet	Granite Internet Services, Waterside Wireless, Satellite
Transportation	Two Rivers Transit Services	Handivan	Two Rivers Transit Services

Source: LGD of Pinawa 2016c,d,,i; Government of Canada 2013a;b; KPI Program 2016; Beausejour Brokenhead Fire Department 2019; Interlake-Eastern RHA n.d.a; The Town and Lac du Bonnet 2019b; Beausejour Brokenhead Development Corporation 2019; Xplornet 2020; Bell Canada 2021.
RM = Rural Municipality; RCMP = Royal Canadian Mounted Police.

Two Rivers Transit Services is available in Pinawa and the RM of Lac du Bonnet. This service is available to seniors 55 years or older, or those unable to operate a motor vehicle. Service is provided throughout the Town and RM of Lac du Bonnet, Pinawa and the RM of Alexander by one handivan that can accommodate 18 passengers and two wheelchairs (LGD of Pinawa 2016e; Government of Canada 2013a). Beausejour offers a handivan service which provides door-to-door transportation to seniors and persons with disabilities via three wheelchair accessible vans. This service provides transportation throughout Beausejour, the RM of Brokenhead and travel to Winnipeg via special booking (Government of Canada 2013b).

Pinawa maintains a volunteer fire department which currently has 13 members, a pumper truck, a wildfire response trailer and a rescue vehicle equipped with the Jaws of Life. A new fire hall was built in 2011 to accommodate the newly acquired pumper truck and the goal is to purchase a new tanker truck (KPI Program 2016). The Volunteer Fire Department is a member of the North East Mutual Aid District which draws on 13 other Fire Departments for additional resources (LGD of Pinawa 2016d). The RM of Whitemouth has plans to build a new fire hall in the spring of 2017 (completed December 2018) and maintains four helicopter pads throughout the RM (KPI Program 2016).

In addition to housing the local RM of Lac du Bonnet fire department, the Town of Lac du Bonnet is home to the new Manitoba Environment, Climate and Parks, Fire Operations Centre. This regional fire operations centre improves firefighting capacity and forest protection in eastern and central Manitoba (KPI Program 2016). The Beausejour Brokenhead Fire Department services Beausejour, Garson, Tyndall and the residents of the RM of Brokenhead (Beausejour Brokenhead Fire Department 2019). Pinawa, Lac du Bonnet and Beausejour have ambulance services provided by Interlake Regional Emergency Medical Services 911, the Winnipeg River Ambulance Service (Interlake-Eastern RHA n.d.a, LGD of Pinawa 2016d).

The Pinawa waste disposal service collects household and yard waste and offers curbside recycling services. Recycling is supported by Pinawa Recycling Inc. which offers pick up services for commercial businesses, the post office and hospital (LGD of Pinawa 2016f). LGD of Pinawa recently entered into an agreement with Whitemouth, Reynolds, North Whiteshell Waste Management Facility to receive recycled materials. This effort will reduce materials headed for and extend the life of, the landfill facility (LGD of Pinawa 2016f). The Town of Lac du Bonnet provides garbage and recycling collection services for residents. Grass clippings and electronic waste curb-side pick-up is also available. Battery recycling and yard wastes can be dropped off at designated locations for recycling (The Town and Lac du Bonnet 2019b). Beausejour offers garbage tags which must be attached to bags to be picked up. Curbside recycling is offered via blue box collection and seasonal lawn and garden waste can be dropped off at the Lawn and Garden Compost Site (Beausejour Brokenhead Development Corporation 2019).

First Nation Communities

Sagkeeng First Nation has First Nations Safety Officers, a fire department and medical transportation (Sagkeeng Anicinabe 2020a,b; Sagkeeng Health Centre 2016b). Brokenhead Ojibway Nation has a security team that patrols the community as well as the buildings owned by the First Nation (Brokenhead Ojibway Nation 2020). A summary of the services offered in the First Nation communities is displayed in Table 6.9.5-20.

Table 6.9.5-20: Community Services for Local Study Area First Nations

Services	Sagkeeng First Nation	Black River First Nation	Brokenhead Ojibway Nation
RCMP	First Nations Safety Officers	Information not publicly available	Brokenhead Security
Fire	Fire Department	Information not publicly available	Information not publicly available
Ambulance	Pine Falls Ambulance Service	Information not publicly available	Information not publicly available
Telephone/television/internet	Information not available	Information not publicly available	Information not publicly available
Other Transportation	Sagkeeng Health Centre Medical Transportation	Information not publicly available	Information not publicly available

Source: Sagkeeng Anicinabe 2020a,b; Sagkeeng Health Centre 2016b; Brokenhead Ojibway Nation 2020
RCMP = Royal Canadian Mounted Police.

6.9.5.2.6 Community Well-being

Community well-being can be defined by a variety of factors. The most common elements of community well-being and quality of life include economic well-being (e.g., employment and income to meet the basic needs of food, shelter, clothing), physical well-being (e.g., personal health and safety), social well-being (e.g., family stability and social supports) and the environment. This section outlines a variety of factors that contribute to the communities' overall sense of well-being, including their relationship to the WL site.

6.9.5.2.6.1 Community Goals and Plans

During the KPI Program, participants noted that they wanted to ensure that their respective communities were able to thrive. Further description of community values shared through the KPI Program included the self-identification as nuclear communities by municipal communities, the high value placed on rural living and proximity and accessibility to remote wilderness (KPI Program 2016).

To contribute to the continued development of each community, all had some degree of focus on economic development. Economic development was seen as an important driver in maintaining quality of life and attracting and retaining residents. Most of the municipalities in the LSA have a community or economic development corporation with a dedicated economic development officer. Pinawa has a community development corporation and a dedicated economic development officer. Beausejour and the RM of Brokenhead have a joint economic development corporation (Beausejour-Brokenhead Development Corp.) and an economic development officer. In the Town of Lac du Bonnet, a community development corporation has been incorporated and a committee is currently working on the operational details, such as determining funding sources and by-laws (KPI Program 2016). Those municipalities that did not have a dedicated resource or development corporation at the time of the KPI Program (RM of Whitemouth, RM and Town of Lac du Bonnet) were still actively engaged in economic development. In the RM of Whitemouth, for example, the Chief Administrative Officer and a member of Council were working on economic development. The RM of Lac du Bonnet is currently in the process of expanding their airport in response to the new Manitoba Environment, Climate and Parks – Fire Operations Centre. It is hoped that the expansion will help attract future businesses to the area (KPI Program 2016).

Each municipality fosters economic development with a variety of means. In Pinawa, the LGD provides tax incentives, an incubator program (funded by CNL), the possibility of negotiating flexible business agreements and available commercial, industrial and retail space (LGD of Pinawa 2016h). While the community has commercial and industrial lots available, due to limited demand, they are undeveloped. The Beausejour-Brokenhead Development Corp. provides a variety of supports to attract business (KPI Program 2016).

The municipalities consider their development activities to be successful at the current time. Pinawa is the home of an eastern Manitoba office (North Forge East) of the North Forge Technology Exchange, which is an economic development agency with offices and a fabrication lab in Winnipeg (North Forge Technology Exchange 2016). North Forge East began operations in October 2016. Interest in participating in the incubator program, which helps entrepreneurs develop their ideas into viable businesses, secure funding and build prototypes at a reduced price, has been higher than originally anticipated. The organization is also seeking to expand its outreach efforts so residents of eastern Manitoba have a better understanding of entrepreneurship and will then be interested in taking advantage of the services North Forge East offers. The Beausejour-Brokenhead Development Corp. has attracted national retail and service chains (Tim Hortons, Home Hardware, and Dollar Tree) to open locations in Beausejour (BBDC 2021a). These operations provide local jobs and raise the profile of the municipalities (KPI Program 2016).

While each municipality is focused on developing its own economy, they also acknowledge that regional development activities are critical to their success. A large employer in any of the municipalities is anticipated to provide direct and indirect employment to residents of all the municipalities. One current initiative is the development of a technical school in Beausejour with an estimated completion date for 2023 to 2024 (BBDC 2021b). Multiple municipalities have contributed funding for a feasibility study that is currently underway. The hope is that once a technical school is established in Beausejour, it can help attract and/or retain younger residents (KPI Program 2016).

Whiteshell Laboratories Community Regeneration Partnership

In spite of their efforts to increase the economic development of the region, the communities have remained concerned about the closure of the WL site and the prospect of attracting a new industry or user for the location. The Partnership was formed in 2015 to address this concern and is facilitated and funded by CNL. According to the Terms of Reference from October 21, 2015: “the mandate of the Community Regeneration Partnership is to develop a Socio Economic Plan for the region by the WL site decommissioning activities, to subsequently implement the plan and to review, update and report on the plan annually” (Skinner 2016). Overall, the goal of the Partnership’s activities is to replace the positions lost in the past, along with the jobs that will be lost by the time decommissioning is complete. Partnership members are pleased with the current activities and tangible outcomes of the Partnership; there is a sense of greater commitment to Partnership efforts (KPI Program 2016).

The municipalities and rural municipalities in the LSA strongly identify with the nuclear industry (e.g., atomic energy) and the past activities at the WL site and would like to attract a future industry to the site either during or after decommissioning activities (KPI Program 2016). They feel that the site is an asset to attracting business because of the site’s basic characteristics (e.g., inexpensive land, good power supply, good and abundant water), which discussions with a site selector have confirmed. While the Partnership is open to pursuing both nuclear and non-nuclear options for the site, they acknowledge that ISD of WR-1 may limit its attractiveness for certain opportunities (Whiteshell Laboratories Community Regeneration Partnership 2016). However, CNL continues to participate in ongoing programs to support hosting, for example, a small modular reactor at the WL site, and proposed associated businesses.

Public Liaison Committee

In addition to working with the communities through the Partnership, CNL also engages them through the Public Liaison Committee. This committee meets twice a year and the focus is on building relationships and creating dialogue between CNL, stakeholder groups and communities and RMs around the WL site. Discussions focus on environmental practice and performance of CNL. Members of the committee are expected to share information from the meetings with their home communities and/or organizations.

6.9.5.2.6.2 Community Well-being Index

The Community Well-being Index (CWB) uses data from Statistics Canada about education, labour force, income and housing to provide "a relatively quick and convenient measure of well-being, focusing on the socio-economic dimensions" (Murphy 2010). A community's CWB score is a single number that can range from zero to 100. The lower a community's Community Well-being Index, the poorer that community's well-being is considered to be. The index is intended to provide a systematic summary of socio-economic well-being for communities, illustrate differences across communities, enable tracking over time, and be compatible with other community-level data on well-being (ISC 2019).

The component scores consider the following:

- **Income,** which is based on income per capita;
- **Education,** which factors in the proportion of a community's population, 20 years and older, that has at least a high school certificate and the proportion of a community's population, 25 years and older, that has at least a bachelor's level degree;
- **Housing,** which comprises indicators of housing quantity and quality; and
- **Labour Force Activity,** which quantifies the labour force participation and employment rates in the community (Government of Canada 2019).

The CWB is calculated as follows:

$$CWB = \frac{Income\ [(2/3)\ Literacy + (1/3)\ HSP] + (HQual + HQuant/2) + (LFP + Employment/2)}{4}$$

Where: HSP: High School Plus;
HQual: Housing Quality;
HQuant: Housing Quantity; and
LFP: Labour Force Participation.

The community well-being index presents one aspect of community well-being dictated by available quantitative data. Among the critiques of numerical indices to measure well-being and quality of life is that they rely on quantitative data and, therefore, cannot capture some aspects of well-being and, in Canada, one of the criticisms is that the community well-being index do not incorporate any aspects of Indigenous worldviews (Cooke 2008).

Municipalities and Rural Municipalities

Table 6.9.5-21 presents the Community Well-being Index for municipal communities in the LSA. Pinawa's CWB score increased between 2006 to 2016 from 79 to 82. Except for housing, all the component scores for Pinawa increased between 2006 and 2016. Beausejour's CWB score also increased between 2006 and 2016. During this time frame, the component scores for income and education increased, while the component score for housing remained the same and the component score for labour force activity decreased by one point. The CWB score and component scores of the Town of Lac du Bonnet followed a similar trend as Beausejour. The RMs all experiences an increase in CWB scores between 2006 and 2016.

Table 6.9.5-21: Community Well-being Index for Municipalities and Rural Municipalities in the Local Study Area, 2006, 2011, 2016

		Income	Education	Housing	Labour Force Activity	Community Well-being Index
Pinawa	2006	72	64	99	79	79
	2011	82	70	99	82	83
	2016	82	68	97	81	82
Beausejour	2006	68	44	96	87	74
	2011	74	48	97	90	77
	2016	76	55	96	86	80
Lac du Bonnet	2006	67	47	91	86	73
	2011	74	38	94	84	73
	2016	76	59	97	82	78
RM of Lac du Bonnet	2006	72	50	94	85	75
	2011	76	53	97	77	76
	2016	82	56	96	86	80
RM of Brokenhead	2006	69	48	92	89	75
	2011	76	58	94	90	79
	2016	76	57	94	91	79
RM of Whitemouth	2006	63	39	92	89	71
	2011	69	48	96	88	75
	2016	72	43	97	90	75

Source: CIRNAC 2019.
RM = Rural Municipality.

First Nation Communities

Table 6.9.5-22 presents the Community Well-being Index for First Nations in the LSA. The First Nations in the LSA had substantively lower CWB scores compared to the municipalities and rural municipalities in the LSA. The CWB index score for two of the First Nations in the LSA, Black River First Nation and Brokenhead Ojibway Nation increased between 2006 and 2016, while the CWB index score for Sagkeeng First Nation decreased slightly during the same time period. Component scores for Sagkeeng First Nation increased except for the component score for labour force activity, which decreased substantially. The component scores for Black River First Nation followed similar trends to Sagkeeng First Nation, while for Brokenhead Ojibway Nation the component scores for income

and education increased between 2006 and 2016 and component scores for housing and labour force activity decreased.

Table 6.9.5-22: Community Well-being Index for First Nations in the Local Study Area, 2016

		Income	Education	Housing	Labour Force Activity	Community Well-being Index
Sagkeeng First Nation[a]	2006	40	34	51	68	48
	2011	38	35	52	65	48
	2016	41	35	55	56	47
Black River First Nation[b]	2006	33	29	52	67	45
	2011	28	18	52	61	40
	2016	35	38	67	60	50
Brokenhead Ojibway Nation[c]	2006	45	29	83	78	58
	2011	N/A	N/A	N/A	N/A	N/A
	2016	48	40	82	73	61

Source: CIRNAC 2019.

a) Government of Canada refers to Sagkeeng First Nation as Fort Alexander 3.

b) Government of Canada refers to Black River First Nation as Black River 9.

c) Government of Canada refers to Brokenhead Ojibway Nation as Brokenhead 4.

N/A = not available

6.9.5.2.6.3 Regional Health Overview

Health is influenced by a wide variety of factors, which makes it difficult to describe a community's overall health status. Drinking water, food choices, personal behaviours, such as smoking and physical activity and air quality, among others, all affect health. Socio-economic factors, including housing, income, social status, education, early childhood development and family and community support, are also considerations. Measuring these determinants of health can be challenging due to the breadth of factors and the lack of availability of data, since this type of information is not routinely collected.

This section presents data regarding five indicators of community health, as follows:

- infant and maternal health;
- life expectancy and causes of death;
- chronic diseases;
- service delivery; and
- non-medical determinants of health.

These data are often not available at the community-level for confidentiality reasons; therefore, community health data are presented at the regional health authority level. The municipalities and RMs of the LSA are located in the Interlake-Eastern RHA. The RHA extends east to the Ontario border, north to the 53rd parallel, west to the eastern shores of Lake Manitoba and south to Winnipeg's north perimeter dipping down just past Winnipeg to slightly below the Trans-Canada (Interlake-Eastern RHA 2015).

Infant and Maternal Health

This section outlines infant and maternal health, including statistics regarding birth rates, birth weight and infant mortality data. Birth rates and infant health, such as high- and low-birth weights, provide useful indications of the health of a community.

The Interlake-Eastern RHA reports number of live births per 1000 female residents. In 2016/17 there were 54.7 live births per 1000 which is slightly lower than the rate for Manitoba as a whole (55.5 live births per 1000 female residents). Overall, live birth rates have decreased over time. Female residents in Northern Remote Zone have a birth rate three times higher than female residents in Selkirk. Over time the disparity in live birth rates has slightly increased between districts. Low birth weight (under 10th percentile at birth) has remained consistent at 6% of live births which is slightly lower than the provincial average (8%). Teen pregnancies have been in decline over a five-year period; there were 30.8 births per 1000 females aged 15-19 (2012/13-16). At the district level, there has been a narrowing of disparity over time (Interlake Eastern RHA 2019).

Life Expectancy and Cause of Death

Life expectancy is an indicator that can measure the overall effectiveness of a health care system in maintaining the health of the population. While it measures the quantity of life (i.e., the number of years), it does not measure the quality of life. In the Interlake-Eastern RHA, the life expectancy for females have remained stable between 2007-2011 and 2012-2016 and did not differ substantially from the provincial average, see Table 6.9.5-23 (Interlake-Eastern RHA 2019. However, life expectancy for males has increased from 76.8 to 78.2 years at both the regional and provincial level (Interlake-Eastern RHA 2019).

Table 6.9.5-23: Male and Female Life Expectancy in the Interlake-Eastern RHA and Manitoba, 2007 to 2016

	2007 to 2011	2012 to 2016
Female	82.2	82.5
Manitoba Female Average	82.2	82.8
Male	76.8	78.2
Manitoba Male Average	77.5	78.5

Source: Interlake-Eastern RHA 2019.

Between 2007-2011 and 2012-2016 there were no considerable changes in the order of most frequent causes of death for Interlake Eastern residents during the two time periods, with exception to mental illness where the proportions of deaths increased over time from 2.6% to 4.7%. Similar to the provincial key findings, both cancer and circulatory diseases account for the majority of all deaths within Interlake-Eastern (Interlake-Eastern RHA 2019).

Chronic Diseases

Chronic disease includes cancer, heart disease, diabetes, chronic lung disease, kidney disease and arthritis. Chronic disease is an important measure of a community's overall health because not only does it reflect a community's demographics, but also has negative effects on the quality of life of affected individuals, causes premature deaths and creates adverse economic effects on families, communities and societies (WHO 2005). In the Interlake-Eastern RHA, the rates for new diagnosis of diabetes are higher than the provincial average (0.97 instances per 100 person years compared to 0.80 at the provincial level). The number of residents in Interlake-Eastern RHA with diabetes has increased to 10.3% in 2014/15-2016/17 from 9.1% in 2009/10-2011/12.

The prevalence rate for hypertension (23.8%) and congestive heart failure (1.93%) in the RHA are also higher than provincial rates (20.7% and 1.59% respectively). The 2014-16 regional cancer incidence rate was 511.8 per 100,000 residents which is higher than the provincial average of 478.4. The proportion of residents with arthritis has decreased, decreasing from 22% in 2010/11-2011/12 to 21% in 2015/16-2016/17 which was similar to the provincial average of 20.4%. Chronic lung diseases include asthma, chronic obstructive pulmonary disease, lung cancer, cystic fibrosis, sleep apnea and occupational lung disease. Total respiratory morbidity declined from 9.8% in 2011/12 to 9.4% in 2016/17. This rate was lower than the provincial average of 10.3%. Overall instances of respiratory illness increased in Manitoba from 9.6% to 10.3%. There is, however some variance by region with in the Interlake-Eastern RHA (Interlake-Eastern RHA 2019).

Service Delivery

According to Interlake-Eastern RHA (2014), there were 97 physicians practicing full- or part-time in the RHA and 83 of those had hospital admitting privileges in 2014. Nearly 85% of residents in the RHA have a medical doctor and 88% of those who visited their doctor were satisfied with the experience. The LSA municipalities, however, note that there has been a physician shortage in their communities and are working together on a regional level to recruit physicians to the area (KPI Program 2016).

According to Interlake-Eastern RHA (2019), 78.9% of residents visited a physician or nurse practitioner in 2016/17 which is a slight decrease compared to 2011/12. In 2015-2016, nearly 85% of residents in Interlake-Eastern reported they have access to a regular health care provider.

In 2016/17, a total of 8,232 Interlake-Eastern residents were hospitalized which represents 6.2% of the population. This is slightly higher than the provincial average of 5.8% and a decrease compared to 2011/12 (6.9%). There was a statistically significant decrease in Interlake-Eastern inpatient hospitalization from 98.9 to 87.5 per 1,000 population. (Interlake-Eastern RHA 2019).

Non-medical Determinants of Health

Non-medical determinants of health include factors such as education, income and employment. These three factors are linked, since education presents pathways to employment and higher income potential. Improved job security and education provide people with a feeling of control over their life (Health Council of Canada 2005), which influences overall health. People who are unemployed are more likely to experience “psychological distress, anxiety, health problems, hospitalization, etc. than the employed” (Health Canada 1999). There is a growing body of evidence to indicate that income and social status are the most important social determinants of health, since “health status improved at each step up the income and social hierarchy” (Health Council of Canada 2005). Higher income is also associated with improved living conditions and the ability to access resources. These predominantly economic factors contributing to health in the LSA are described in greater detail in Section 6.9.5.2.3 Employment and Income.

Living conditions are also among the factors of the physical environment that contribute to health. Housing, for example, can contribute to quality of life, since the average number of persons per room, indoor air quality and need for repairs are indicators related to housing that influence overall health status. Accessibility of services, such as proximity to a hospital, also contributes to health (Natural Resources Canada 2019). These factors that contribute to health in the LSA are described in greater detail in Section 6.9.5.2.5 Community Infrastructure and Services.

6.9.5.2.6.4 Indigenous Health

Health Overview

Data on Indigenous Health are also presented at the RHA level, which is described above. In the Interlake-Eastern RHA, 27% of residents self-identify as Indigenous (Interlake-Eastern RHA 2019). The region's Indigenous population is generally young and growing with a high birth rate, although the on-reserve birth rates for Indigenous Nations within the RHA have declined gradually between 1993 and 2012, especially among the 15-19 and 20-24 age categories (Interlake-Eastern RHA 2014).

Indigenous people living on-reserve in the Interlake-Eastern RHA were hospitalized primarily for injury, poisoning and respiratory conditions, while non-First Nations residents were hospitalized most frequently for digestive and circulatory conditions (Interlake-Eastern RHA 2014).

The overall cancer incidence rate among the Indigenous population of the Interlake-Eastern RHA was 629.6 cases per 100,000 people, substantively higher than the Manitoba average of 471.2. First Nations incidence for lung, rectal, prostate and breast cancer were all above the regional and provincial averages, but these differences were not statistically significant (Interlake-Eastern RHA 2014). The age- and sex-adjusted cancer incidence rates for 2005-2015 were higher for registered First Nations members living off-reserve than on-reserve (Manitoba Centre for Health Policy 2019).

According to the Manitoba Centre for Health Policy (2019) The top three causes of death (2012-2016) for registered First Nations members living off-reserve in the Interlake-Eastern RHA are external causes (e.g., self-harm or poisoning), circulatory, and cancer, which are also the same three leading causes of death for registered First Nations members living on-reserve. The 2012-2016 rates for premature mortality for are higher for registered First Nations members living on-reserve in the Interlake-Eastern RHA than for registered First Nation members living off-reserve. The premature mortality rates are substantially higher for both populations than for all other Manitobans in the Interlake-Eastern RHA. The top three causes of premature morality for registered First Nations members living on- and off-reserve in the Interlake-Eastern RHA were external causes, circulatory, and cancer.

Non-medical Determinants of Health

Raphael (2004), in his analysis of Canadian health determinants, identifies Indigenous status as one of the key determinants of health in Canada. Indigenous people are more likely than other Canadians to experience inequalities and disadvantages that act as barriers to overall health. Examples of these inequalities include the following:

- **Education:** Indigenous people have lower education levels than their non-Indigenous counterparts. Indigenous youth are less likely to complete high school. Insufficient education diminishes the level of skills people have to enter the labour market.
- **Employment:** Unemployment rates are higher for Indigenous people than the general Canadian population. See Sections 6.9.5.2.3.2 Employment by Sector and 6.9.5.2.3.3 :Labour Force for additional detail on Indigenous employment.
- **Income and Social Status:** Indigenous people are typically overrepresented in the low-income bracket. Annual earnings are lower than other Canadians, irrespective of whether they are working full-time or part-time. See Section 6.9.5.2.3.4 Income for additional detail on Indigenous income.

- **Social Support Networks:** Colonialism resulted in losses of land, language and socio-cultural resources. The residential school system furthered these losses by removing young children from their communities, which has been linked to Indigenous people being unable to establish effective family relationships.
- **Physical Environments:** Indigenous Nations often face housing shortages and people are more likely to live in crowded conditions or in homes in need of major repairs. This can result in stressors, such as children having little room to study or play, or adults lacking private space to relax. Housing is discussed in Section 6.9.5.2.5.4.
- **Access to Services:** Indigenous Nations are less likely to have community facilities and infrastructure to promote healthy lifestyle choices/behaviours, such as recreation centres, playgrounds, swimming pools (Loppie and Wien 2009; Health Council of Canada 2005). Community facilities are described in Section 6.9.5.2.5.3 Community Facilities.

Indigenous Community Perspectives and Observations on Health and Wellness

Indigenous perspectives and observations on-health are rooted in four balanced aspects of wellness: emotional, mental, physical, and spiritual, which is often represented by the medicine wheel (National Collaborating Centre for Aboriginal Health 2013). Emotional needs include the need for relationships and belonging, while mental needs include the need for identity and self-actualization. Physical needs include the need for shelter, food, water, safety, and security. Lastly, spiritual needs may be met through spirituality and feeling that one has a life purpose (First Nations Information Governance Centre 2020). Indigenous ways of knowing and being frame these four aspects of health and wellness through their interaction across the environment, people and community, and history (First Nations Information Governance Centre 2020).

In Manitoba, the First Nations Health and Social Secretariat uses a holistic health framework to describe First Nations health, which also includes aspects of emotional, mental, physical, and spiritual wellness. Their holistic health framework has five components (First Nations Health and Social Secretariat of Manitoba 2018):

- community wellness, which is considered the core of health and wellness and includes strengths, progress, challenges, and relationships, as well as the language and culture of a community;
- holistic well-being, which considers the balance of emotional, mental, physical, and spiritual health and well-being;
- physical well-being, which considers the health conditions and access to health care (both western and traditional);
- healthy behaviours and lifestyle, which considers health habits such as diet, food security, sexual health, recreational activity, and health challenges like smoking and substance use; and
- mobility: movement, which considers the movement to and from communities, as well as non-medical determinants of health such as education, employment, and income.

The Red River Métis' perspective on health and wellness, as described by the Manitoba Métis Federation as holistic, consider both Indigenous and Western "ways of knowing." This holistic approach is also founded on four pillars of health and wellness: data, experience, information, and narrative. Data encompasses research and what is physical; experience encompasses the emotional aspects; information describes the intellectual fusion of the data, experience, and narrative; and narrative encompasses one's story and spirituality. The Manitoba Métis

Federation considers eight wellness areas that define the health and wellness of the Red River Métis: nature, identity, development, relationships, networks, supports, environment, and governance (Sanguins et. al. 2013).

While these frameworks are an important starting point for understanding health and wellness for Indigenous Nations, each Indigenous community has their own perspectives on what contributes to community member well-being. Below are some of the perspectives shared in community-led studies for the Project.

Sagkeeng First Nation

Connections are important to the well-being of Sagkeeng First Nation members. Connections include those among family, other community members, the natural world, and the landscape. Each type of connection provides members with the space and opportunity to embody and live their culture. The TKLU Study (Sagkeeng Aniciabe and Firelight Research Inc 2019), defines and describes Anicinabe pimatiwizin (Anicinabe life), which is the interconnectedness of Sagkeeng's sense of place, identity, culture, history, and knowledge transmission. Examples of the interconnectedness include the way intergenerational ties facilitate transfer of language and knowledge:

> *And I always tell my generation and the generation before me, I tell them, practice it. Practice it, because it's inside of us. You can say it's here. But to speak it, because there's that conditioning gets in the way of speaking our language. That's impacted a lot of us, and it's impacted all our children. So, it goes down generation from generation.* (Narratives Inc., p. 15)

The same bonds are also supported by sharing resources and knowledge within the community.

> *When I grew up … we weren't rich, but say if my neighbour killed a deer, well that was shared in the community. If there was fishing and you got abundance of fishing, that was shared in the community. The gardens were shared in the community. Milk was shared in the community. Butter that you made was shared in the community. I hate cottage cheese to this day because I ate so much of it. But that was all shared. Like just all shared. You didn't have to have money… Your neighbours fed you or you fed your neighbours.* (Narratives Inc. 2020, p. 16)

> *…taking the fish out of the nets and just spending time with my dad [are the fondest memories of Lake Winnipeg] … teaching me survival skills, you know? For my future if I had to live off the land … I still carry that.* (Sagkeeng Anicinabe and Firelight Research Inc, p.35)

Ceremony is a way to reinforce the spiritual connection with the natural world more broadly, and specific places, such as the WL site:

> *The importance [of ceremonies to the Sagkeeng way of life] is that our ancestors and ourselves have a direct connection with Mother Earth … We're all connected on way or the other. We need each other in order for us to sustain a livelihood here … for us it's a spiritual connection to all of creation and that's what this area [Whiteshell Laboratories] signifies for me because it reminds me of those things that were taken away from us long time ago (*Sagkeeng Anicinabe and Firelight Research Inc 2019 *p.68)*

Medicinal plants contribute to general community health, as well as the treatment of specific ailments. Accessing them is important to the Sakgeeng First Nation member's cultural identity and as such maintaining access to traditional health care is an important aspect of Sagkeeng wellness (Sagkeeng Anicinabe and Firelight Research Inc 2019).

> *So that's where they used to come and there was a lot of area around there [Brightstone]. I remember like they used to pick a lot of – my dad was – he was, I guess, in his own way, he was considered a medicine man. And I know we used to go – we used to walk out, I don't know, if it's Lee River, but there's one medicine that you only find in the muskeg. It's called a [maska-eg]. It'd for the heart – the heart medicine. So, we used to work way out. Way out. I used to help him quite a bit. I remember that. And it's only found, he said, in the muskeg. (p.50)*

Sagkeeng First Nation members shared their perspective on aspects of healthy behaviours and lifestyles, including the importance of a traditional diet and food security, which are supported by a healthy environment and traditional land and resource use activities. Food plants and game provide both fresh and preserved foods to maintain a healthy diet. Maintaining access to plants and game habitats plays an important role in the food security of community members for Sagkeeng First Nation members (Sagkeeng Anicinabe and Firelight Research Inc. 2019).

> *Say you shot a moose and it was canned and everything, jarred in, you know, it was canned, you know, and it was pickles and ... big gardens and stuff like that, everything was put away in the cellars, you know.* (p.57)

One Sagkeeng First Nation member shared the importance of their control over their diet and well-being.

> *Food sovereignty… is very important for us, to go back to the land. Because that's the only connection we have left, really. Money's not going to buy us happiness. It's going to be the land, still, and I really want to emphasise the food sovereignty part because it's healthy*. (Narratives Inc. 2020, p.17)

Sagkeeng First Nation members have expressed concern over psychosocial impacts as a result of the Project and the WL site. To better understand Sagkeeng's concerns regarding the psychosocial impacts that Sagkeeng associates with the WL site and effects that may result from the Project, Sagkeeng prepared a Psychosocial Impact Assessment Report (Narratives 2020). The overwhelming sentiment shared was regarding the confusion and fear related to nuclear in general; the expressed concerns about the use of a nuclear reactor and waste in Sagkeeng's territory; and the lack of engagement with Sagkeeng First Nation on the siting and operations of the WL site (Narratives 2020). One community member succinctly drew the connection between the secrecy and historic lack of consultation or engagement surrounding the WL site on the one hand, and negative feelings of self-worth, family cohesion, and traditional lifestyle on the other (Narratives 2020).

Black River First Nation, Brokenhead Ojibway Nation and Hollow Water First Nation

The Anishinaabe (or Ojibway) people of Black River First Nation, Brokenhead Ojibway Nation, and Hollow Water First Nation, hold similar perspectives on health and wellness that are supported by traditional land use: water, harvesting plants, hunting/trapping, and preserving traditional lands and ways of life in the area. Alongside these values, the Anishinaabe people see other aspects of their environment as important to community health and wellness, namely, relationships with spirituality not considered in technical, western science (Black River First Nation, Brokenhead Ojibway Nation, and Hollow Water First Nation 2019).

In their collective study, Black River First Nation, Brokenhead Ojibway Nation, and Hollow Water First Nation (2019) members describe their culture as an important aspect of wellness, which includes interconnection and spirituality of all aspects of the world:

> *Although spiritual beings cannot be captured, they are actors in the environment, as 'real' as the plants, animals, and fish that are studied through western science. Even tangible objects on Mother Earth are not*

> *just physical, they are inherently spiritual. For example, the Anishinaabemowin word for rock, Asin, is an animate noun because rocks have the potential to carry spirits and to be animate.* (p. 16)

Culture is expressed in multiple ways, including medicines, ceremony, and harvesting (Black River First Nation, Brokenhead Ojibway Nation, and Hollow Water First Nation 2019). A Brokenhead Ojibway Nation member shared how everything is a medicine for community members:

> *Everything is a medicine – even the air we breathe, what I'm speaking - it's medicine. A lot of our people are disconnected from this. Even those that walk with us and have their spirit name, they get their name and turn their backs on the Grandmother.* (Black River First Nation, Brokenhead Ojibway Nation, and Hollow Water First Nation 2019, p.32)

Black River First Nation, Brokenhead Ojibway Nation, and Hollow Water First Nation members shared their perspective on aspects of healthy behaviours and lifestyles, including the importance of a traditional diet and food security, which are supported by a healthy environment and traditional land and resource use activities. Harvesting from the land not only contributes to the fulfillment of cultural and family traditions amongst the Anishinaabe people but provides a source of nourishment and food security for the community year-round (Black River First Nation, Brokenhead Ojibway Nation, and Hollow Water First Nation 2019).

> *"That was their living. Everything was done seasonally. Rice picking, blueberry picking, fishing. Rice picking was the last [in the season]. Then they came home to the community."* (p.30)

Red River Métis

The Red River Métis perspective on health and wellness is linked the use of and harvesting of resources from both land and water sources. The historical family ties of the Red River Métis to tradition and culture in the area continue to influence their current connection to the land (Shared Value Solutions 2019). The Red River Métis have a distinctive culture that contributes to well-being that is expressed in part through their connection with the land and the water (SVS 2019). One citizen shared their family history and the connections it fostered:

> *I mean my family history—I come from the fur trade on my dad's side, and we come from Red River here—my great-great-great grandfather through Hudson Bay—were part of the fur trade. So, we were trappers and fur-traders, and same thing on the mother's side; they were as well voyageurs and stuff. So, my connection to it is very strong; I'm very proud of that, and that's the lifestyle that I live. I mean when I'm out there, I was raised out that—raised to trap, hunt, fish—and I've been very fortunate to have that. Same as my history, and as I look back and do it, it's such a colourful past that we were here. So, I mean there are very strong ties to the land there, and like I say, I live in between it—it was Dawson Trail and the Winnipeg River. It's the homeland. (p. 27)*

The harvesting of plants and animals provide the community with food and can also be a source of traditional medicine (SVS 2019).

6.9.5.2.7 Public Safety

6.9.5.2.7.1 Road Safety

Traffic volume near the WL site can be estimated through coverage count stations (CCS) surveyed by the Province of Manitoba on a three-year cycle. Table 6.9.5-24 presents the annual average daily traffic counts for the three CCS locations near the WL site. The CCS station (No. 692) on Highway 211, west of the WL site access road and

east of Highway 11, showed an annual average daily traffic count of 1,420 vehicles in 2011, 1,440 vehicles in 2014, and 1,450 vehicles in 2017. The CCS station (No. 657) on Highway 11, north of Highway 211, showed an annual average daily traffic count of 1,310 vehicles in 2011, 1,380 vehicles in 2014, and 1,460 vehicles in 2017. The CCS station (No. 726) on Highway 11, north of Highway 307 and south of Highway 211, showed an annual average daily traffic count of 1,560 vehicles in 2011, 1,630 vehicles in 2014, and 1,690 vehicles in 2017 (Manitoba Infrastructure and University of Manitoba Transportation Information Group 2019).

Table 6.9.5-24: Traffic Statistics for Highways near the Whiteshell Laboratories Site

Highway and Coverage Count Station (CCS) number	2009	2011	2014	2017
Highway 211, CCS 692	1,340	1,420	1,440	1,450
Highway 11, CCS 657	1,340	1,310	1,380	1,460
Highway 11, CCS 726	1,590	1,560	1,630	1,690

Source: Manitoba Infrastructure and University of Manitoba Transportation Information Group 2019.

Outside of off-road vehicle collisions, Manitoba Public Insurance does not break out collisions based on geographic location in its reporting beyond urban centres and all rural locations. Overall, the level of traffic collisions in Manitoba decreased in 2020 by 19% as compared to 2019 and a decrease by 10% compared to the previous five-year annual average (2015 to 2019) (Manitoba Public Insurance 2020). The decrease in the total number of collisions in 2020 compared to 2019 is attributable to decreases in injury and property damage only (PDO) collisions. Traffic collisions in urban locations account for the majority of causalities overall. In 2020, 83% of all casualties result from traffic collisions in urban areas (Manitoba Public Insurance 2020). Traffic collisions in rural locations, however, account for 55% of people killed. In the previous five years (2015 to 2019) annual average, nearly 87% of all victims are from traffic collisions in urban locations, while 62% of people killed are from traffic collisions in rural locations (Manitoba Public Insurance 2020).

6.9.5.2.7.2 Site Access

Access to the WL site is restricted. There is a security program in place that provides access control, visual monitoring and patrolling. There is an extensive surveillance system at the WL site to detect and deter unauthorized entry and diversion of materials and equipment. Part of the system is the use of progressive zones to provide increasing levels of security that are specific to certain areas in the WL site. This is in accordance with the *Nuclear Security Regulations* SOR/2000209.

6.9.6 Project Interactions and Mitigation

6.9.6.1 Methods

This section describes the process by which interactions between Project components and activities and socio-economic VCs were identified and evaluated. Potential effect pathways are identified and mitigation options to eliminate and/or reduce effects are presented. A pathways analysis is then used to focus on key interactions between the Project and the environment by evaluating the different effect pathways to determine if, after incorporation of mitigation, there is still potential to cause residual effects. Where effects will be adequately mitigated and are not forwarded for further analysis (i.e., secondary pathways, or where mitigation will remove the pathway altogether), the reasons for concluding the assessment at this stage are articulated. Primary pathways that may lead to residual effects after incorporation of mitigation are further characterized in Section 6.9.6 Residual Effects Analysis. As such, this section helps to focus the remainder of the assessment on those interactions (effects pathways) likely to result in residual adverse effects.

The first part of the analysis was to identify the potential effects pathways for all stages of the Project. The pathways analysis considers interactions that may result during normal or routine activities. Potential effects from accidents and malfunctions are assessed in Section 7.0 Accidents and Malfunctions. The next step in the analysis was the development of environmental design features and mitigation practices that could be incorporated into the Project to eliminate and/or reduce effects to socio-economic VCs. Environmental design features included design elements, environmental best practices and management policies and procedures. Environmental design features and mitigation were developed through an iterative process between the engineering and environmental teams, combined with input from project-specific or regional engagement with other interested parties. The design features and/or mitigation activities were selected considering their effectiveness for implementation and maintenance, and their appropriateness within the context of the identified effect pathways.

After incorporation of mitigation, potential pathways were evaluated into the following categories using scientific knowledge, logic, experience with similar developments and the effectiveness of environmental design features and mitigation.

- **No linkage pathway** – pathway is removed by environmental design features or mitigation such that the Project would not be expected to result in a measurable environmental change to measurement indicators identified for socio-economic VCs relative to Base Case values, and therefore would have no residual effects to socio-economic VCs.
- **Secondary pathway** – the pathway could result in a measurable minor change to measurement indicators identified for socio-economic VCs, but would have a negligible residual effect on socio-economic VCs relative to Base Case values and is not expected to contribute cumulatively to other Project effects or to the effects of other past, present or reasonably foreseeable developments to cause a significant effect. Secondary pathways may also include Project effects that were identified as important to people during Project engagement, but that do not specifically fall under the requirements of the *Canadian Environmental Assessment Act, 2012* (CEAA 2012). This pathway includes direct or indirect socio-economic effects that are not expected to arise as a result of direct effects on the environment, but were included as a secondary pathway due to their importance to people, as required in paragraph 5(2)(b) of CEAA 2012.

- **Primary pathway** – the pathway is likely to result in an environmental change to measurement indicators identified for socio-economic VCs relative to the Base Case that could contribute to residual effects to socio-economic VCs. This includes direct and indirect effects stemming from changes to the environment, as required in paragraph 5(2)(b) of CEAA 2012.

Environmental design features and mitigation that have been or could be incorporated into the Project to eliminate and/or reduce adverse effects to socio-economic VCs were considered. Potential pathways that were completely removed due to implementation of environmental design or mitigation were not assessed further. Pathways that were assessed to be secondary and demonstrated to have a negligible residual effect to socio-economic VCs through simple qualitative or semi-quantitative evaluation of the pathway were also not advanced for further assessment. Primary pathways were carried forward for more detailed quantitative and qualitative effects analysis to characterize the residual effects of the Project on socio-economic VCs (see Section 6.9.6 Residual Effects Analysis).

6.9.6.2 Results

Pathways through which all stages of the Project may interact with and result in changes to measurement indicators for socio-economic VCs is provided in Table 6.9.6-1.

Table 6.9.6-1: Pathways Analysis for Socio-economic Valued Components

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
Expenditures associated with the overall preparation, grouting, removal and remediation of WR-1 and above-grade facilities	■ Changes to the current decommissioning plan will generate different employment opportunities. ■ Changes to the current decommissioning plan will generate different contracting opportunities.	■ CNL may contract with a Manitoba-based contractor for the grouting work provided one with the necessary qualifications is available. ■ To the extent feasible, CNL will work with interested Indigenous peoples to provide employment opportunities during decommissioning activities. For example: ▪ CNL worked to enhance options to better match capabilities of First Nation members and Red River Métis citizens with their contracting needs including adding provisions to its procurement process that encourages the use of Indigenous and local small and medium sized businesses ▪ CNL shared information regarding the procurement and contracting opportunities and asked for specific capabilities that Indigenous peoples have, related to the Project. ▪ CNL facilitated introductions between Indigenous Nations and the CNL procurement department. ▪ To facilitate information sharing, capabilities and opportunities, CNL planned and executed three industry days, and invited Indigenous Nations. ▪ CNL created a First Nation and Métis affairs summer student position that was advertised in Indigenous Nations interested in the Project. ▪ During site visits Human Resources shares information about employment opportunities at the WL site and CNL will continue that practice. ▪ CNL will continue to share job postings with Sagkeeng First Nation. ▪ CNL has made a commitment to help job candidates find appropriate housing in the region. ▪ Where feasible, introduce Indigenous individuals, contractors and community to CNL contractors to discuss mutual opportunities. ■ CNL is willing to participate in Indigenous-led job and contracting events. ■ To the extent feasible, CNL will fill positions with local qualified staff. ■ CNL recognizes that the commute from the Wabaseemoong Independent Nations community is long and has made a commitment to help job candidates find appropriate housing in the region.	Secondary (no direct or indirect change to the environment identified)

Table 6.9.6-1: Pathways Analysis for Socio-economic Valued Components

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
Overall activities associated with WL site preparation, ISD of WR-1 and above-ground facilities	■ The Project will result in changes to local and regional traffic volumes in connection with contractor and new employee traffic requirements. ■ The Project will reduce the amount of transport required for off-site waste disposal, which will reduce traffic volumes and risks to public safety in the RSA.	■ The handling and disposition of waste material resulting from decommissioning will be conducted in accordance with CNL company-wide requirements, the WL waste materials management procedure and existing regulatory requirements. ■ Disposal methods for non-radioactive waste materials will meet all provincial and municipal requirements, with the order of preferred disposition of reuse/recycle, disposal in the CNL landfill, or disposal in a licensed off-site landfill.	Secondary (no direct or indirect change to the environment identified)
Preparation for and implementation of institutional control	■ The presence of long-lived radioactive material as part of ISD may affect community well-being for Indigenous Nations through the changes to the suitability of the site for future uses, the continued inability to exercise stewardship and governance over land and resource management decisions.	■ CNL is committed to involving Indigenous peoples in the follow-up monitoring, including initiatives that considers Indigenous values. This would involve Indigenous peoples during the monitoring stage of the Project to assess potential effects on fish and wildlife resources and changes to vegetation and water quality upon which traditional uses are dependent. It would also involve discussions in post decommissioning monitoring. ■ CNL will work with Indigenous Nations to ensure that relationships endure, grow and adapt to future activities. As such, CNL will establish an Indigenous Advisory Committee and relationship agreements with each engaged Indigenous community, which include liaison positions, and create mechanisms to develop and implement initiatives that will help address each Nation's unique interests and concerns related to the Project and the Whiteshell Laboratories Closure Project. ■ Follow-up monitoring during the post-closure phase will be completed to verify effects predictions and to provide information for use in adaptive management to address potential unforeseen effects. Results will be shared with Indigenous Nations. ■ A long-term funded Sagkeeng community liaison position, and committee will be created. ■ Sagkeeng First Nation, AECL and CNL plan to complete a Long-term Relationship Agreement. ■ CNL and AECL will support the development of a Healing and Resiliency Action Plan[4] in relation to the Whiteshell Laboratories' effects over time on Sagkeeng members. ■ Maximize the areas available for future use using CCME criteria for land use.	Secondary (elevated from no linkage due to the importance to Indigenous Nations)

[4] Now called, Healing and Resiliency Action Plan (Formerly Trauma Informed Action Plan)

Table 6.9.6-1: Pathways Analysis for Socio-economic Valued Components

Project Activity	Effects Pathways	Management Practices and Mitigation Actions	Pathway Assessment
Preparation for and implementation of institutional control	■ The suitability of the site for future business ventures may change as a result of the presence of long-lived radioactive material as part of ISD. ■ The use of ISD as the decommissioning method for the WR-1 Building will change the proportion of the site that can be released with no restrictions on use.	■ Continued activities through the WL Community Regeneration Partnership to help the region develop economically. ■ Maximize the areas available for future use using CCME criteria for land use. ■ Communication of environmental monitoring results to confirm the safety of the WL site and lands around it. ■ Final ISD design so that projections of doses to members of the public are well below the average Canadian individual background dose rate. ■ Final ISD design will be done to maximize hazard reduction.	Secondary
Preparation for and implementation of institutional control	■ Changes to the overall decommissioning plan may accelerate changes to the sources of municipal revenue for Pinawa. ■ Changes to the overall decommissioning plan may affect municipal revenue sources, which will change the provision of infrastructure and services in Pinawa.	■ AECL will engage with the Province and Pinawa regarding municipal revenue that is currently provided by the grant-in-lieu of taxes and future use of the WL site.	Secondary (no direct or indirect change to the environment identified)

ISD = in situ disposal; RSA = Regional Study Area; AECL = Atomic Energy of Canada Limited.

6.9.6.2.1 No Linkage Pathway

There are no interactions with no linkage to residual direct or indirect effects on socio-economic VCs.

6.9.6.2.2 Secondary Pathways

In some cases, a Project source of effect and an interaction with an assessment endpoint exists but with mitigation is expected to cause minor changes to the environment and a negligible effect on the socio-economic environment relative to the existing Base Case. The following are expected to result in negligible effects on the socio-economic environment and will not be examined further in the EIS.

- **Changes to the current decommissioning plan will generate different employment opportunities.**
- **Changes to the current decommissioning plan will generate different contracting activities.**

As of July 31, 2021, there were 321 employees employed on-site, with almost all of them working directly on or supporting decommissioning projects. Positions included engineering, scientific and technical staff; licensed skilled trades; unskilled trades; managers; and administrative and business professionals. Of these employees, approximately 6 full-time equivalents work directly on WR-1 and approximately 14 full-time equivalents support the ongoing storage with surveillance of the WR-1. The decommissioning workforce has been maintained since July and is expected to increase to approximately 430 staff and then decline to less than 10 employees by 2027.

A large workforce is not required during institutional control (i.e., post-closure phase). Changes to the decommissioning of the WR-1 are not anticipated to substantively increase employment on the WL site relative to the previous decommissioning plan. In both scenarios, the employment generation is not anticipated to be considerable in relation to the surrounding population.

The CNSC approved the current decommissioning licence in 2002 and decommissioning are ongoing. CNL assumed responsibilities for day-to-day operations of the WL site in 2014. Current employment at the WL site is contractual and understood to be finite. The implications of the change in decommissioning activities associated with WR-1 does not necessarily alter the number of new employment and/or contracting opportunities during the closure phase, but rather indirectly changes the nature of the employment and/or contracting opportunities available. Previously, the above- and below-grade infrastructure of WR-1 would have been dismantled, packaged and dispositioned to appropriate disposal sites. This would have resulted in construction and transport opportunities. The proposed change will increase the requirements for engineering and construction, while decreasing the amount of transportation labour required. In addition, the Project creates an opportunity, which may go to a local contractor, to encase the below-grade structures with grout before constructing a concrete cap and engineered cover for the below-grade structure.

The change in decommissioning plan may also create additional employment and/or contracting opportunities for the Indigenous Nations in the LSA. Many Indigenous Nations have expressed interest in employment opportunities and in particular Sagkeeng First Nation has noted that some of its members are qualified to work on the Project in certain capacities (e.g., transportation). CNL is committed to hiring members of the Indigenous Nations where feasible and has completed a number of initiatives to support contracting opportunities, including the following.

- CNL has worked to enhance options to better match the Indigenous capabilities with their contracting needs including adding provisions to its procurement process that encourages the use of Indigenous and local small and medium sized businesses.
- CNL shared information regarding the procurement and contracting opportunities and asked for specific capabilities that communities have related to the Project.
- CNL facilitated introductions between the communities and the CNL procurement department.
- To facilitate information sharing, capabilities and opportunities, CNL planned and executed three industry days, and invited Indigenous Nations.
- CNL created a First Nation and Red River Métis affairs summer student position that was advertised in Indigenous Nations interested in the Project.
- During site visits Human Resources shared information about employment opportunities at the WL site.
- CNL has been sharing job postings and will continue to share job postings with Indigenous Nations.

CNL recognizes that the commute from the Wabaseemoong Independent Nations community is long and has made a commitment to help job candidates find appropriate housing in the region. This commitment has been included in the EIS.

CNL has worked to enhance options to better match Indigenous capabilities with their contracting needs, added provisions to its procurement process to encourage the use of Indigenous and local businesses, and considers single source contracting opportunities with Indigenous companies where well suited to the work. CNL has also adjusted the evaluation criteria for competitive bids to favour contracts that are Indigenous owned or have Indigenous employees.

CNL recognized the need for better information sharing regarding procurement and contracting opportunities and asked for specific capabilities that communities have related to the Project. This included CNL facilitating introductions between the communities and the CNL procurement department, as well a representative from CNL Human Resources sharing information about employment opportunities. In addition, CNL has conducted meetings with the Manitoba Métis Federation and Métis N4 Construction to learn more about their capabilities and CNL has meet with Métis businesses and shared employment and contracting opportunities for the Project.

To further facilitate information sharing, capabilities, and opportunities, CNL planned and executed three Industry Days, and invited Indigenous Nations. The Industry Days were held in Winnipeg, WL Site, and the SFN arena. CNL is currently considering how to provide training to First Nation members and Red River Métis Citizens, including an option to open vacant seats in CNL training courses. CNL has been sharing job postings and will continue to share job postings with Indigenous Nations.

CNL continues to explore the best ways to reach out to communities about employment opportunities. CNL also toured and engaged with the South East Regional Development Corporation as it was recommended as the best way to explore First Nations capabilities and procurement opportunities. CNL has created a First Nation and Red River Métis summer student position that was advertised in Indigenous Nations interested in the Project. CNL is also reviewing long-term economic opportunities in relation to Indigenous economic interest and capacity to determine where they may be in alignment. CNL has expressed an interest in creating an Indigenous Liaison Committee and proposed Indigenous membership on a WL site Indigenous Advisory Committee.

The termination of existing employment will be accelerated with the Project, including those science-based positions which typically pay at rates higher than the regional average. While the schedule for reducing employment has been accelerated, there is mitigation in place to enhance benefits for area communities and the Indigenous Nations in the LSA to the extent possible. Mitigation focuses on supporting current employees in transitioning to new work and helping foster business opportunities in the area to replace lost employment. For current employees, CNL has programming at the WL site to explore other employment and take advantage of training opportunities.

In terms of fostering economic development in the region, CNL provides support for the Community Regeneration Partnership, which has been established to create a feasible socio-economic plan for the region, facilitate economic development and hopefully provide high quality employment to replace the losses associated with the overall WL site closure. CNL has also provided substantial support to North Forge East, which offers services to entrepreneurs interested in establishing businesses in eastern Manitoba. The level of interest in participating in North Forge East has been higher than anticipated, and to date, North Forge East has accepted twenty proposals for their programming, which is above their initial target of six to nine proposals. These proposals are from a diverse range of sectors, including social media and manufacturing. Due to the different requirements from different sectors of the economy, these projects are moving forward on their own timelines (KPI Program 2016).

Considering the economic development activities undertaken by the municipalities and RMs in the LSA, the Project's indirect effects on employment and income, and business opportunities are expected to be negligible relative to the overall closure of the site despite the accelerated timeline.

- **The Project will result in changes to traffic volumes in the LSA in connection with contractor and new employee traffic requirements.**

Two factors are considered in determining the extent of effects changes to local traffic volumes could have: the size of the workforce and the capacity of transportation infrastructure near the WL site. The current peak of about 321 employees at WL has been maintained since July 2021 and is expected to increase to approximately 430 staff and then decline to less than 10 employees by 2027. Specific to the Project, CNL anticipates a mobilization of about 25 employees (mostly contractors) between when approvals are received in 2023 and the peak workforce in 2024-25, when grouting of below-grade systems and structures is anticipated to occur. After the below-grade structures are grouted, the size of the workforce will continue to reduce until institutional control begins, along with the overall WL site workforce reduction. While there will be a temporary increase during closure work, it is smaller in absolute terms when compared to the current workforce, or peak workforce on the WL site in 1984.

With respect to transportation infrastructure, the WL site can be accessed from the communities and RMs in the LSA via Roads and Transportation Association of Canada (RTAC) routes (with a carrying capacity of 63,500 kg), Class A1 highways or Class B1 highways. Since the WL site can be accessed using relatively major roadways (as opposed to smaller, more rural roadways), the temporary increase of 50 passenger vehicles is not anticipated to pose a problem to the transportation infrastructure between communities in the LSA and the WL site. This includes the transportation infrastructure between the reserve parcels of the First Nations in the LSA and the WL site.

When the small number of additional employees required by the Project and the capacity of roadways leading to the Project are considered together, the increase in traffic volumes associated with Project-related employment will have a negligible effect on the transportation in the LSA.

- **The Project will reduce the amount of transport required for off-site waste disposal, which will reduce traffic volumes and risks to public safety in the RSA.**

The Project currently involves transporting up to 2,000 loads of waste from the WL site to the appropriate disposal site. These shipments would occur over the course of four years, from 2022 to 2026. This means that there would be an increase in current traffic of between two to three trucks a day (weekdays only). The lowest class of highway heavy Project-related traffic would likely use are Class B1 highways (e.g., Highway 211), which can carry a maximum gross vehicle weight load of 47,630 kg. The Trans-Canada Highway and Highway 44, which will also be used to haul waste to the Chalk River Laboratories site, is a Roads and Transportation Association of Canada route with a load limit of 62,500 kg for vehicles not conforming to RTAC standards and 63,500 kg for vehicles that do conform. Highway 211 and Highway 44 have load restrictions between March 11 and May 31.

The Comprehensive Study Report for the previous decommissioning plan did not provide anticipated traffic volumes for transporting radioactive waste (AECL 2001) from the decommissioning of WR-1. Overall activities, however, included transporting low-level and intermediate-level radioactive material to permanent off-site disposal facilities, some of which would have been from the WR-1 Building. With ISD, there will be a reduced amount of radioactive waste transported, and thus a reduced amount of traffic generated.

The reduction in traffic will limit the potential for transportation incidents. The reduced potential for incidents will limit risks to public safety as the chance for injury and mortality will be reduced. Transportation of waste is routine and safe. Exposure to radioactive waste from transportation incidents was not considered a substantial risk to public safety as transportation involves specialized packaging and shipping containers.

This pathway is anticipated to have a negligible effect on regional transportation infrastructure since the capacity of the roadways in the region is good and the Project will result in lower traffic volumes than previously planned. Together, this will reduce the demands placed on infrastructure and reduce the probability that the public may be exposed to radioactive material.

- **The suitability of the site for future business ventures may change as a result of the presence of long-lived radioactive material as part of ISD.**
- **The use of ISD as the decommissioning method for WR-1 will change the proportion of the site for unrestricted use.**

The permanent presence of the WRDF will change the suitability of the WL site for future uses due to the restrictive land use categories that will be applied to the WL site. While the Project does not return the WL site to an area completely available for unrestricted use, no primary pathways were identified between the Project and the aquatic environment (Section 6.5 Aquatic Environment) or the terrestrial environment (Section 6.6 Terrestrial Environment). With negligible effects predicted to the biophysical environments, the assessment does not indicate the potential for direct or indirect effects to the well-being of Indigenous Nations. Similarly, the ecological and human health risk assessment (Section 6.7 Human and Ecological Health) concluded that residual effects from radiological and non-radiological contaminants are not significant. Even under an accidents and malfunctions scenario (i.e., a WRDF Barrier Failure Disruptive Event), all predicted radiological and non-radiological doses are well below their respective protective benchmark values indicating that no adverse residual effects are expected.

The availability of land for future uses does not stem directly from environmental effects of the Project, but rather from the indirect effect of zoning restrictions that will be required for the WL site into the distant future. Participants in the KPI Program expressed concern with the Project because it would limit the types of businesses and industries that could use the WL site for future operations and therefore reduce the number of economic development opportunities available to them. This is a major concern for communities in the LSA who have considered the operation of the WL site as an important economic contributor in the region, as expressed through the desire to recruit a new industry to the site.

The previous decommissioning plan assumed that radioactive wastes, except for those designated to remain in the Waste Management Area and a limited area of radioactive contaminated sediment in the Winnipeg River, would eventually be removed and placed in permanent disposal facilities (AECL 2001). The communities had assumed that this would provide them with the ability to recruit a new industry (and associated employment) to the WL site, which features ample land, connection to the power grid, access to water from the Winnipeg River system and reasonable transportation network connectivity (1.5 hours to the James Richardson International Airport in Winnipeg, 20 minutes to the nearest railway and 45 minutes to the TransCanada Highway). This was combined with the understanding that the overall site (beyond the Waste Management Area and a limited area of the Winnipeg River System) would eventually be available with no restrictions on use. The WL site will now have restriction on use in proximity to the WRDF over an indefinite period of time associated with institutional control.

CNL is currently working with the communities and RMs in the LSA by funding the activities of the Community Regeneration Partnership. The goal of the Community Regeneration Partnership is to develop a socio-economic plan for the region. CNL supported development of the regional socio-economic plan through the provision of in-kind technical resources and contracting of graphic arts services. The plan lays out the steps needed to facilitate future economic development of the region. Through the KPI Program, participants expressed hope that activities through the Community Regeneration Partnership would replace the employment lost at the WL site with stable, high-quality employment in the region. It was felt that as a result of this development, people would stay or move to communities in the LSA for employment and they would flourish (KPI Program 2016). CNL has displayed a renewed commitment to the group through staffing changes to support the development of the socio-economic plan, sponsoring travel for community representatives to similar sites in the US and designating a board member of the Canadian National Energy Alliance, which owns CNL, to advocate for the WL site (KPI Program 2016).

Future uses and zoning for the site have not been determined. Currently the WL site occupies four different land use designations in the LGD of Pinawa (2004), including general agriculture, heavy industrial, recreational/commercial, and natural area (Section 6.8.25.2.1 Whiteshell Laboratories Site). The land including the WL main campus, waste management area, and landfill are used for heavy industrial use. Indigenous NortherAlthough a small proportion of the WL site will have restrictions on use because of the Project (i.e., 0.07 ha), it is still anticipated that the majority of the site will be safe and appropriate for unrestricted use, and that future designations will seek to maximize the amount of lands available for other uses. While the Project does not return the WL site to an area completely available for unrestricted use, the restrictions are anticipated to have a negligible effect on the socio-economic VCs.

Although uncertainty remains about the timing and nature of a new industry being attracted to the site, CNL is encouraged by the interest that has been expressed to develop the site for alternative uses. In 2017, CNL offered an invitation to site a small modular reactor demonstration unit at one of its managed campuses, including the WL Site. By 2019, two organizations (out of 80 applications and 19 expressions of interest) advanced to the due diligence stage of assessment by CNL, which considers the technical and business merits of the applicants. Although this process is not an indication of project approval (which would require a separate review by the CNSC), it provides support to the attractiveness of the site for future development.

CNL will share information regarding future uses and access to the WL site with the Community Regeneration Partnership as it becomes available. This information will influence the actions described in the socio-economic plan that presents a feasible path forward containing realistic possibilities for future economic development. Depending on the future uses and access to the WL site, the plan is expected to help focus recruitment efforts or provide another route for achieving the same economic goals without reliance on the WL site. Consequently, suitability of the site for future business ventures and the portion of the site available for unrestricted use is anticipated to have a negligible effect on socio-economic VCs.

Communication around timelines and uses for the WL site are key for development of an implementable socio-economic plan. CNL will also support robust communication of environmental monitoring results to confirm the safety of the WL site and help address concerns and mitigate concerns about the site's suitability for future uses. Members of the Public Liaison Committee are currently expected to share monitoring results with residents of their respective home communities, and it is anticipated that they will have a substantial role with sharing monitoring results with community members once decommissioning is complete. CNL can provide communication support to committee members, to help disseminate monitoring results. Similar efforts for the sharing of monitoring results will be extended to Indigenous peoples.

CNL will continue to use a public website and direct engagement to share information and receive feedback from immediate local and Indigenous Nations. Communication efforts will build on the current Environmental Assessment Follow-up Program, which focuses on environmental monitoring, interim storage and future use support and communications. The public and Indigenous communication component of the Environmental Assessment Follow-up Program is to develop and maintain communication mechanisms during decommissioning that support ongoing communication (CNL 2016a). CNL will also consider other mechanisms for disseminating monitoring results that are suggested or requested by any interested parties, as they will help reduce the concerns associated with ISD. Sharing monitoring results, including activities that connect with whole communities and not just with leadership will be considered. CNL has developed several initiatives to improve how CNL communicates now, including incorporating country harvested foods into the current environmental monitoring programs, and has committed to supporting future initiatives, such as a Community Environmental Monitoring Program (CEMP) (see Section 11.4 Indigenous Engagement and Participation in Environmental Monitoring).

- **The presence of long-lived radioactive material as part of ISD may affect community well-being for Indigenous communities through the changes to the suitability of the site for future uses, the continued inability to exercise stewardship and governance over land and resource management decisions.**

The permanent presence of the WRDF will change the suitability of the WL site for future uses due to the restrictive land use categories that will be applied to the WL site. The Project represents a change from the previous decommissioning plan, which assumed that radioactive wastes, except for those designated to remain in the Waste Management Area and a limited area of radioactive contaminated sediment in the Winnipeg River, would eventually be removed and placed in permanent disposal facilities, (AECL 2001). The change is understood from an Indigenous perspective as having the potential to result in fear, stigma and anxiety associated with the long term presence of nuclear materials in the region. Given the importance of the topic to Indigenous Nations, CNL considers this to be a secondary pathway so that Sagkeeng First Nation concerns reflected are included in the assessment.

In the LSA, Indigenous Nations have commented on the ongoing adverse effects the presence of the WL site has had on their well-being (Section 6.9.5.2.1) since the site's establishment in the 1960s, including ongoing fear and trauma for Sagkeeng First Nation members, which they highlighted in their alternative means assessment report, "Mental stress, fear and stigma associated with Whiteshell has already had a significant effect on Sagkeeng people" (Sagkeeng Ancinabe and Firelight Research Inc. 2020, p. 35). Black River First Nation, Hollow Water First Nation, and Brokenhead Ojibway Nation have also noted that WL site, along with other historical industrial development in the LSA, have affected the communities' well-being by adversely affecting the environment.

All engaged communities expressed some level of concern over the proposed Project. The Sagkeeng First Nation specifically identified a preference for the full removal of the WR-1 reactor either immediately or in the future to address past and ongoing trauma (Section 2.8 Sagkeeng's Alternative Means Assessment). The presence of radioactive materials associated with the Project is identified as a source of distress for the community (Sagkeeng Ancinabe and Firelight Research Inc. 2020); however, the previous decommissioning plan against which the Project is being assessed, similarly assumed some radioactive materials would remain in place. As such the existing conditions, have contributed to the Sagkeeng First Nation identified effects.

While the Project does not return the WL site to an area completely available for unrestricted use, no primary pathways were identified between the Project and the aquatic environment (Section 6.5 Aquatic Environment) or the terrestrial environment (Section 6.6 Terrestrial Environment). Similarly, the ecological and human health risk

assessment (Section 6.7 Human and Ecological Health) concluded it is unlikely that there would be significant adverse effects on either aquatic or terrestrial populations or communities as a result of maximum potential contaminant releases associated with the Project. Even under an accidents and malfunctions scenario (i.e., a WRDF Barrier Failure Disruptive Event), all predicted radiological and non-radiological doses are well below their respective protective benchmark values indicating that no adverse residual effects are expected. With negligible effects predicted to the biophysical environments, the assessment does not indicate the potential for direct or indirect effects to the well-being of Indigenous Nations because of the Project-related changes to the environment.

Due to the importance of well-being to Indigenous Nations, CNL acknowledges that efforts to support dialogue and learning are central to the relationship going forward. While the Project may not be the preferred alternative of the Sagkeeng First Nation, CNL and AECL recognize and acknowledge the cumulative impacts and trauma experienced by Sagkeeng First Nation members in relation to the initial siting of the WL and are willing and committed to begin addressing this through community-led initiatives facilitated by the Technical Working Group. In addition, CNL, Black River First Nation, and Hollow Water First Nation signed a comprehensive relationship agreement, on April 6, 2021, to support greater community involvement in the Project. The relationship agreement supports the establishment of a community committee and a community liaison position, provides support to participate in the Indigenous Advisory Committee and provides capacity support to ensure the communities are able to continue to participate in discussions on future land use of the WL site. CNL and the Manitoba Métis Federation have also been working together to develop the draft multi-year relationship agreement that will help to mitigate the Manitoba Métis Federation's concerns on the Project and ensure the Manitoba Métis Federation and its citizens participation in environmental monitoring, communication initiatives, and other key initiatives.

Since the effects documented by Indigenous Nations in the LSA are linked to the historical presence of the WL site, there are no predicted changes to the biophysical environment, and CNL and AECL are committed to working with Indigenous Nations going forward, the assessment does not indicate the potential for direct or indirect effects to the well-being of Indigenous Nations.

- **Changes to the overall decommissioning may accelerate changes to the sources of municipal revenue for Pinawa.**
- **Changes to municipal revenue streams for Pinawa may change the provision of infrastructure and services in the community.**

In the 1960s, AECL and the Provincial Government signed a Master Agreement, which stipulates that AECL will pay Pinawa a grant-in-lieu of taxes. As a federal Crown corporation, AECL is exempt from property taxes and instead pays a grant-in-lieu of taxes. Under the Payments in Lieu of Taxes Act, AECL has obligations to pay amounts similar to what would otherwise be required in taxes, notwithstanding the Master Agreement. Upon closure of the site, the agreement states that the LGD will be incorporated as a municipality when it is economically feasible and desirable. The agreement, however, does not contain a defined strategy for ending the grant-in-lieu of taxes or a process for negotiating a different fiscal relationship between the signatories. Any changes negotiated to the Master Agreement may have an effect on municipal finances for Pinawa.

The proposed approach to decommission WR-1 contributes to an overall acceleration of the WL site decommissioning timeline. These timeline changes may necessitate finding additional sources of revenue to compensate for budget shortfalls sooner than previously considered. To date, Pinawa has been focused on developing economic development options to increase municipal revenue. Economic development activities are supported through the Community Regeneration Partnership, which is examining future uses for the WL site. In

addition to this, efforts through North Forge East are intended to promote entrepreneurial initiatives in eastern Manitoba; potentially creating new jobs and other economic benefits. Pinawa-specific initiatives are also being explored through the Pinawa Community Development Corporation and are intended to diversify the area's economic drivers (KPI Program 2016). Overall, the Project is anticipated to have a negligible effect on the continued financial viability of the communities and rural municipalities in proximity to the Project.

6.9.6.2.3 Primary Pathways

There are no interactions with primary linkages to effects to the socio-economic VCs.

6.9.7 Monitoring and Follow-up

CNL will implement an Environmental Assessment Follow-up Program for the Project to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. This monitoring will be integrated with that for the existing Environmental Assessment Follow-up Program for the WL site, where practical. Monitoring and follow-up programs associated with effects on vegetation, wildlife, fish and water quality are critical to supporting community well-being, as the continued confirmation that the WRDF is safe will help ease concerns regarding the suitability of the site for future business ventures.

It is noted that data generated by the monitoring program will be evaluated on an ongoing basis within an adaptive management framework. Within this framework, modifications to the program may be appropriate to confirm data continue to fulfill program objectives. Any proposals for modifications to the monitoring program and the rationale for the modifications will be communicated to the CNSC prior to implementation.

During Project engagement activities, the First Nations and the Manitoba Métis Federation expressed concerns about the potential long-term effects of the Project on the environment. They indicated that the health of the environment, species relied on for fishing and harvesting, and the risk to people in the area of the WL site are of great concern. They also expressed an interest in being actively involved in the development and implementation of an ongoing monitoring program. This initiative would enable the involvement of Indigenous interests in CNL's monitoring programs and create a forum for direct participation in monitoring activities.

To reduce the potential effect of these concerns, CNL is committed to sharing information and working collaboratively with Indigenous Nations and the Partnership to help them develop a feasible socio-economic plan and development of robust communication plan to convey and confirm the Project's safety. It is assumed that the Public Liaison Committee and the Partnership will continue for the duration of the Project and provide a means through which CNL can disseminate information with the communities and RMs in the LSA. Communities and RMs in the LSA can also bring their concerns and issues regarding future use and access to the site forward to CNL. Communication efforts will build on the existing Environmental Assessment Follow-up Program at the WL site, which focuses on environmental monitoring, interim storage and end-state support and communications. The public communication component of the Environmental Assessment Follow-up Program for the WL site is to develop and maintain communication mechanisms during decommissioning that support ongoing communication (CNL 2016a).

As the WL site is undergoing decommissioning over the next several years, CNL will work with Indigenous Nations to ensure that relationships endure, grow and adapt to future activities. As such, CNL is currently working on establishing an Indigenous Advisory Committee and relationship agreements with each engaged Indigenous Nation, which include liaison positions and create mechanisms to develop and implement initiatives that will help address each Nation's unique interests and concerns related to the Project and the Whiteshell Laboratories Closure overall.

Specifically for Sagkeeng First Nation, CNL has committed to co-developing a CEMP through the Technical Working Group that will incorporate country food monitoring and risk communication. The community-led environmental monitoring program is currently under discussion, but the CEMP may include the development of key objectives, indicators, threshold, and responses and may include community monitoring both at the WL site and near their community.

Public information activities required as part of CNL's Public Information Program (2021) will be part of the Environmental Assessment Follow-up Program for the Project and will be summarized as part of the annual Environmental Assessment Follow-up Program progress report.

6.9.8 Conclusions

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). The socio-economic VCs chosen for the Project to reflect identified concerns, professional judgement and/or standard practice in environmental assessment are:

- employment and income;
- business opportunities;
- government finances;
- community infrastructure and services;
- community well-being; and
- public safety.

With ISD, there will be a reduced amount of radioactive waste transported off-site, and thus a reduced amount of traffic generated. The reduction in traffic will limit the potential for transportation incidents and risks to public safety. Considering the small number of additional employees required by the Project and the reduced amount of waste transported off-site, changes to traffic volumes associated with Project employment will have a negligible effect on the transportation infrastructure in the local area and reduce the probability that the public may be exposed to radioactive material.

The permanent presence of the WRDF will change the suitability of a small portion(i.e., 0.07 ha) of the WL site for future uses due to the restrictive land use categories that will be applied to the Project site. However, it is still anticipated that the majority of the site will be appropriate for unrestricted use, and that future designations will seek to maximize the amount of lands available for other uses.

The availability of land for future uses does not stem directly from environmental effects of the Project, but rather from the indirect effect of zoning restrictions that will be required for the WL site into the distant future. The public expressed concern with the Project because it would limit the types of businesses and industries that could use the WL site for future operations and therefore reduce the number of economic development opportunities available to them. CNL provides support for the Community Regeneration Partnership, which has been established to create a feasible socio-economic plan for the region, facilitate economic development and hopefully provide high quality employment to replace the losses associated with the overall WL site closure. Depending on the future uses and access to the WL site, the plan is expected to help focus recruitment efforts or provide another route for achieving the same economic goals without reliance on the WL site.

The implications of the change in decommissioning activities associated with WR 1 does not necessarily alter the number of new employment and/or contracting opportunities, but rather indirectly changes the nature of the employment and/or contracting opportunities available and associated timeframe. The proposed change will increase the requirements for engineering and construction, while decreasing the amount of transportation labour required. While the schedule for reducing employment has been accelerated, the Community Regeneration Partnership is working to enhance benefits for area communities and the Indigenous Nations in the local area to the extent possible.

While the Project does not return the WL site to an area completely available for unrestricted use, no residual adverse effects were identified between the Project and the aquatic environment or the terrestrial environment. Similarly, the ecological and human health risk assessment concluded it is unlikely that there would be significant adverse effects on aquatic or terrestrial populations or communities as a result of maximum potential contaminant releases associated with the Project. Even under an accidents and malfunctions scenario (i.e., a WRDF Barrier Failure Disruptive Event), all predicted radiological and non-radiological doses are well below their respective protective benchmark values indicating that no adverse residual effects are expected. With negligible effects predicted to the biophysical environments, the assessment does not indicate the potential for direct or indirect effects to the well-being of communities.

Considering CNL's programming to support current employees in transitioning to new work, CNL's support of fostering economic development in the region, and the potential for attracting future industry to the WL site, the Project's indirect effects on employment and income, and business opportunities are expected to be negligible relative to the over closure of the site despite the accelerated timeline and change in land use restrictions.

Indigenous Nations have commented on the ongoing adverse effects the presence of the WL site has had on their well-being since the site's establishment in the 1960s, including ongoing fear and trauma for Sagkeeng First Nation members. The Manitoba Métis Federation, Black River First Nation, Hollow Water First Nation, and Brokenhead Ojibway Nation have also noted that WL site, along with other historical industrial development in the LSA, have affected the communities' well-being by adversely affecting the environment.

The change in the decommissioning strategy for WR-1 is understood from an Indigenous perspective as having the potential to result in fear, stigma and anxiety associated with the long-term presence of nuclear materials in the region. Given the importance of the topic to Indigenous Nations, CNL acknowledges that efforts to support dialogue and learning are central to the relationship going forward. CNL and AECL recognize and acknowledge the cumulative impacts and trauma experienced by Sagkeeng First Nation members in relation to the initial siting of the WL and are willing and committed to begin addressing this through community-led initiatives facilitated by the Technical Working Group. In addition, CNL, Black River First Nation, and Hollow Water First Nation signed a comprehensive relationship agreement, on April 6, 2021, to support greater community involvement in the Project. CNL and the Manitoba Métis Federation have also been working together to develop the draft multi-year relationship agreement that will help to mitigate the Red River Métis' concerns on the Project.

The assessment does not indicate the potential for effects to the well-being of Indigenous Nations since the effects documented by Indigenous Nations in the LSA are linked to the historical presence of the WL site and there are no predicted changes to the biophysical environment. CNL and AECL are committed to working with Indigenous Nations going forward to develop programs and initiatives that provide meaningful mitigation to Indigenous Nations to address the issues of fear and stigma identified.

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7.0 ACCIDENTS AND MALFUNCTIONS

This section of the Environmental Impact Statement (EIS) seeks to provide an understanding of the potential effects due to characterized malfunctions and accidents of the In Situ Decommissioning of WR-1 at the Whiteshell Laboratories Site (the Project). The three objectives of the effects assessment for accidents and malfunctions are as follows:

- identification of the primary hazards for potential accidents and malfunctions in the Project facilities that could affect the environment, public safety or worker safety;
- identification of planned mitigation, including prevention measures that would reduce the probability of these hazards from occurring, and control measures to mitigate the severity of consequences from an accident or malfunction; and
- estimation of the residual risks following the implementation of mitigation, and prioritization of the resources for risk management based on the levels of residual risks identified.

Accidents and malfunctions could take place as internally initiated events and externally initiated events. Internal events are defined as those that are initiated within the Whiteshell Reactor 1 (WR-1) Building and are under Canadian Nuclear Laboratories (CNL) direct control (e.g., equipment failures or other unplanned releases). External events are defined as those that are initiated outside the WR-1 Building and are outside of CNL's direct control (i.e., aircraft crash). This section of the EIS focuses on internal events and external man-made events. Natural events, such as extreme weather events, glaciation and seismic events, are assessed in Section 10 Effects of the Environment on the Project.

Hazards and accidents and malfunctions which result in consequences only over long time-frames (i.e., Post-closure Phase) are not included in the accident and malfunction assessment, as they are assessed in the Decommissioning Safety Assessment Report (Golder 2021), and encompassed by the bounding scenarios presented in Section 6.7.1.7 Residual Effects Analysis where human health is assessed.

7.1 Indigenous Engagement Feedback – Key Interests and Concerns

Information and concerns raised specifically by Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations during engagement related to the assessment of accidents and malfunctions are summarized in Table 7.1.1-1. Other general concerns and questions raised during the engagement are documented in Section 4 Indigenous Engagement.

Table 7.1.1-1: Summary of Key Interests and Concerns Raised During Indigenous Engagement Activities Related to the Assessment of Accidents and Malfunctions

Interest and Concern	Inclusion Status	Additional information and Rationale
Interested in how accidental releases could be contained in the soil, and how CNL detects spills.	Already included in the accident assessment	Spills and leak containment is described in Section 7.3.2 and Section 3.2.2.4 of the EIS
Questions about which material will be sent to Chalk River for disposal and how it will be transported	Already included in the accident assessment	Management of accidents resulting from off-site transportation are described in section 7.3.4

7.2 Methods

The environmental assessment for the Project is being carried out under the C*anadian Environmental Assessment Act*, *2012* (CEAA 2012). The environmental effects of accidents and malfunctions that could occur in connection with the Project are assessed in accordance with the Canadian Nuclear Safety Commission (CNSC) Generic Guidelines for the Preparation of an Environmental Impact Statement (CNSC 2016) and REGDOC-2.9.1 Environmental Protection: Environmental REGDOC-2.9.1 (CNSC 2020). The assessment was also conducted using the Systems Failure Modes and Effects Criticality Analysis approach, which is a standard risk assessment method (CSA Group 1991, 1997; ISO 2018, 2019).

The assessment criteria for accidents and malfunctions are different from the criteria that are used for the environmental effects assessments. Residual effects for accidents and malfunctions are defined in terms of risk. The risk characterization used to classify residual effects is based on both the likelihood of the postulated event, as well as the severity of the potential effects to the environment and public. The approach includes hazard identification (Section 7.2.1), risk measurement (Section 7.2.2) and risk evaluation (Section 7.2.3). The assessment of accidents and malfunctions identified for the Project is provided in Section 7.3, with a summary of the results of the risk evaluation in Section 7.4.

7.2.1 Hazard Identification

The assessment began by systematically identifying hazards associated with the Project components that could affect the environment, public safety or worker safety. A structured Hazard and Operability Study (HAZOP) was completed for the project at the early design stage to identify high-level risks and scenarios that could occur (Appendix 7.0-1). An Accidents and Malfunctions Report (Appendix 7.0-2) was also prepared to identify credible events which could arise during the WR-1 closure phase based on five work packages identified for the in situ disposal (ISD) of WR-1 (i.e., building systems, preparing reactor systems, grout installation and building demolition and site remediation), causing potential harm to people or the environment.

Additional accidents and malfunctions were identified through the following activities:

- review of CNL documentation related to the WR-1 Building, including annual reports and environmental monitoring reports;
- review of the Comprehensive Study Report (CSR; AECL 2001);
- review of EIS accidents and malfunctions reports for other similar facilities;

- review of lessons learned documents from previous decommissioning work, including operating experience; and
- engagement input collected as part of the *Public Information Program for Canadian Nuclear Laboratories* CNL (2019a), including public and Indigenous feedback regarding long-term waste storage options.

Where potential adverse effects are identified from an accident or malfunction, feasible environmental design features and/or mitigation practices are implemented to avoid and minimize these potential adverse effects. Mitigation actions were identified for each hazard scenario and include prevention measures that would minimize the probability of the scenarios occurring, and control measures to mitigate the severity of consequence from and accident or malfunction.

Essential to the assessment of potential accidents and malfunctions is identification of the sources of hazards currently present within the WR-1 Building. Internally or externally initiated events could result in radiological and/or non-radiological accidents. Radiological accidents refer to those that could result in the acute release of radioactivity to the environment and potentially affect the environment, the public or workers. Non-radiological accidents refer to those that involve only non-radiological substances and will not have any adverse radiological effects on the environment and humans (e.g., the spill of chemicals, lubricants and oils).

The hazards associated with the Project during the Closure Phase are thus grouped into two categories:

- radiological hazards; and
- non-radiological hazards.

A high-level overview of the waste inventories and other hazards anticipated to be encountered during Project activities is presented.

7.2.1.1 Radiological Hazards

Radiological hazards associated with decommissioning the WR-1 Building include potential exposure to beta, gamma and alpha-emitting radionuclides produced during the operational period of WR-1. These consist primarily of the following types of radiological hazards.

- **Fission products –** Fission products are normally contained within the fuel, although fuel defects or failures result in the release of fission products in small quantities, which are then circulated throughout the reactor core and heat transport system, during the operational life of the reactor.
- **Activation products –** Activation products are produced by irradiation of neutron absorbing materials, which become radioactive. They are most abundant in structures and components in or near the core of the reactor, such as the fuel channels.
- **Tritium –** Tritium is produced when heavy water captures neutrons. Residual moderator left from draining WR-1 is expected to contain tritium.
- **Corrosion products –** Corrosion products are small, mobile activation products, produced when small debris from corrosion is transported through the core (e.g., in the moderator or coolant) and are irradiated.

The dominant radionuclides associated with the main systems and components of the WR-1 Building are provided in Table 7.2.1-1. Derived radionuclide inventories for the main systems and components are described in detail in the ERA (EcoMetrix 2021) and are summarized in Section 6.7 Human and Ecological Health. The bulk of the

remaining radioactivity is known to be within the reactor vessel (i.e., calandria, fuel channels, thermal shield and biological shield) (CNL 2020b).

Table 7.2.1-1: Radionuclides Associated with Main Systems and Components of the WR-1 Building

System/Component	Radionuclide
Reactor Core	Carbon-14, iron-55, cobalt-60, nickel-59, nickel-63, niobium-94
Primary Heat Transport	Caesium-137, strontium-90, cobalt-60, (small amounts of niobium-94, zirconium-95, antimony-125, europium-152, radium-226, americium-241), isotopic plutonium, technetium-99, iodine-129, curium-244
Biological Shield	Carbon-14, chlorine-36, calcium-41, nickel-63, cobalt-60, europium-152
Heavy Water and Helium System	Tritium, carbon-14
Corrosion products	Carbon-14, chlorine-36, iron-55, nickel-63, nickel-59, cobalt-60, niobium-94
Surface contamination	Caesium-137, strontium-90, cobalt-60

7.2.1.2 Non-radiological Hazards

Non-radiological hazards present during the decommissioning of the WR-1 Building include conventional industrial hazards, chemical hazards, biological hazards and fire hazards. Conventional industrial hazards associated with the decommissioning activities include working at heights, working in confined spaces, working with energized systems, hoisting and rigging and falling objects. Dismantling and demolition of the WR-1 Building will involve the use of cranes and movement of heavy loads. The use of saws, drills and compressors represent potential sources of physical injury to the operators. Changes in site conditions (e.g., excavations and trenching) also represent potential sources of physical injury. These conventional hazards are discussed further in Section 7.3.1. Hazardous materials present within the WR-1 Building include asbestos, lead, polychlorinated biphenyl compounds (PCBs), mercury, mould and various chemicals.

A select number of non-radiological contaminants are identified as a potential concern and are evaluated in ERA (EcoMetrix 2021). These include: potassium hydroxide, boron, lead, xylene, palladium, chromium, cadmium, organic coolant (HB-40) and mercury. The hazardous materials within the WR-1 Building are summarized in Table 7.2.1-2. Details on derived non-radiological waste inventories are provided in the ERA (EcoMetrix 2021).

No PCBs are planned to be left in place for ISD that exceed exemption quantities. CNL has conducted an examination to identify potential PCB containing equipment and materials (CNL 2021a). These PCB containing materials will be removed in accordance with CNL's Waste Management Program prior to grouting or demolition. If additional PCB-suspect materials are encountered, additional samples may be taken to confirm their exemption or identify them for removal. All PCB-containing waste material generated at WL site will be sent to an off-site hazardous waste processing facility for treatment and disposal. Waste with both radiological and other hazardous properties may require segregation or use of a treatment facility to be acceptable for disposal.

Asbestos containing materials located in the ISD portion of the WR-1 Building will be left in place and disposed of in situ. The asbestos containing material is primarily piping and tank insulation. The estimated amount of asbestos containing material to be disposed of in-situ is 1,000 m^3 (CNL 2021a). All asbestos containing material located in the portion of the building to be demolished will be removed following the CNL asbestos remediation procedure and adhering to provincial and federal regulations. The estimated amount of asbestos containing material to be removed from the WR-1 building is 801 m^3 (CNL 2021a). Most of this material will be considered radioactively contaminated waste and will be packaged for storage/disposal at the Chalk River Laboratories site.

With respect to the liquid drained from the reactor systems, an estimated residual percentage is assumed to remain in the system after draining/flushing.

In cases where hazardous materials could not be directly quantified (e.g., chromium plating on various components), conservative assumptions have been made to provide a reasonable estimate. For several contaminants (e.g., xylene), there is no confirmation of their presence within WR-1 and their inclusion in this inventory is precautionary, to ensure the effects of the discovery of detectable quantities is not significant. Any additional non-radiological contaminants of potential concern identified during decommissioning will be assessed and remediated as needed to ensure there are no significant effects to the environment.

Table 7.2.1-2: Non-radiological Hazards Associated with Main Systems and Components of the WR-1 Building

Chemical/Material	Expected Locations	Quantity (kg)	Form
HB-40[(a)]	Primary Heat Transport (PHT) System; Auxiliary Organic System and Gas System; Fuel Wash Down system, calandria tubes, tanks	87,700	Liquid in system low points
Lead	Throughout the WR-1 Building	40,800	Solid, Various shielding uses (sheets and bricks)
Xylene	Spent Fuel Handling and Storage System; Wash Down System – Trapped in system low points or blockages	1.9	Liquid/Vapour,
Boron	Heavy Water System; Auxiliary Systems, including Boron Addition System – Low points/Joints where residual solutes collect.	0.0009	Solids/Solutes
Palladium	Organic Supply System, Helium System – Low points/Joints where residual solutes collect	15.5	Solids/Solutes
Potassium Hydroxide	Chemical Addition Tank in the Concrete Cooling System –Low points/Joints where residual solutes collect	0.01	Solids/Solutes
Cadmium	Ion chamber Component and as plating on Fuel Storage Block	91.4	Solid/Plating
Chromium	Various Thermocouples and as Plating on various components (Condenser Tubes; Boiler Tubes)	148	Solid/Plating
Mercury	Drains low points and joints throughout the WR-1 Building	0.33	Liquid/Vapour
Beryllium	WR-1 – Fuel Elements	Limited	Trace solid residuals
Platinum	FLUX Detectors	Limited	Trace solid residuals
Magnesium Oxide	FLUX Detectors	Limited	Trace solid residuals
Gadolinium Nitrate	SLOWPOKE Demonstration Reactor Liquid Absorber Safety System	Limited	Trace solid residuals
Ozone Depleting Substances	Multiple systems	Limited	Trace solid residuals
Multiple Ion Exchange Columns	Heavy Water System, Distilled Water System, Spent Fuel Bay Circulation System, Concrete Cooling System, Boron Addition System, SLOWPOKE Demonstration Reactor Auxiliary Systems, WR-1 L2 Loop, Fast Neutron Loop	Limited	Trace solid residuals

Note:

a) Organic coolant, also known as OS-84 or HB-40, has been drained and properly disposed of; however, residual coolant anticipated to coat the PHT system, and found in some tanks and some calandria tubes. The used organic coolant is potentially contaminated from fuel failure events and corrosion products. The properties of the organic coolant are known to change with irradiation; therefore, residual amounts are expected to be in the form of a viscous liquid sludge, or a dried coating. The volume of organic coolant remaining was very conservatively estimated by assuming 30% of the total organic cooling system volume remains. Subsequent source term investigations indicate that the volume remaining is much lower.

7.2.2 Risk Measurement

After identifying accidents and malfunctions, the consequence severity and the likelihood (frequency) of occurrence associated with each scenario was estimated using a risk matrix that was developed for the Project. The matrix includes a *Likelihood Index* (Table 7.2.2-1) and a *Consequence Severity Index* (Table 7.2.2-2). Likelihood and consequence severity were estimated based on industry and operation experience, Project-specific conditions, and the knowledge base of the Project team.

The process of estimating the likelihood index includes consideration of past performance indicators and safety statistics for site operations and similar closure work performed at the WL site in the last 10 years. Likelihood can be described as how often the hazard scenario might occur (Table 7.2.2-1). The likelihood index ranges from a "Highly Unlikely" event to an "Almost Certain" event and is more formally defined through the events per year value. Order of magnitude of events per year values are defined for each likelihood level. For example, the "Possible" level ranges from more than 1 event in 100 years up to 1 event in 10 years. The categories selected for the likelihood index reflect the Project timescales and type of hazards that may arise. The likelihood of events occurring beyond 1000 years is more related to disruptive events during posts-closure, which is assessed in the DSAR (Golder 2021) and in Section 6.7 Human and Ecological Health.

Table 7.2.2-1: Likelihood Index

Index	A Almost Certain	B Very Likely	C Possible	D Unlikely	E Highly Unlikely
Events per Year	>1 occurrence in 1 year	≤1 occurrence in 1 year and >1 occurrence in 10 years	≤1 occurrence in 10 years and >1 occurrence in 100 years	≤1 occurrence in 100 years and >1 occurrence in 1,000 years	≤1 occurrence in 1,000 years

> = greater than; ≤ less than

The process of estimating the consequence severity index includes a consideration of existing CNL programs, procedures and policies that are in place to mitigate potential hazards. The consequence severity index ranges from "Negligible" to "Very High," and is applied to two categories of consequences: 1) environment; and 2) worker and public safety. Therefore, there are a total of 2 risk matrices combined in the Project Risk Matrix. A description of the consequence levels from "Negligible" to "Very High" for each of the two categories is presented in Table 7.2.2-2. Consequence severity considers anticipated and public perceived risks, including longevity of consequences. For the environment, the consequence severity index also acts as a surrogate to describe the magnitude of an environmental effects.

Table 7.2.2-2: Consequence Severity Index

Category	1 Negligible	2 Low	3 Moderate	4 High	5 Very High
Environment	Negligible environmental effect	Short-term effects (<1 month; effects are restricted to on-site	Reversible or repairable effect (less than one year in duration); local effects, off site	Long-term effect (e.g., 10 years in duration), local or regional effect off-site	Long-lasting with long-lasting (> 10 years) or irreversible environmental effects
Worker and Public Safety	Medical treatment not required	Minor first aid injuries with no lost time	Reversible injury with lost time	Severe injuries with long-lasting effects and/or disability	Fatalities, or multiple disabilities

7.2.3 Risk Evaluation

As mentioned in Section 7.2.1, where potential adverse effects are identified from an accident or malfunction, feasible environmental design features and/or mitigation practices are implemented to avoid and minimize these potential adverse effects. Mitigation includes prevention measures that would minimize the probability of the scenarios occurring, and control measures to mitigate the severity of consequence from and accident or malfunction. Estimating the likelihood and consequence severity of an accident and malfunction includes consideration of the environmental design features and/or mitigation practices implemented for a particular hazard.

Each scenario is assigned a Risk Matrix Priority Level according to the likelihood and consequence severity ranking. Risk evaluation requires determining risk priority according to the Project Risk Level Matrix (Table 7.2.3-1). The colour ranking system for each risk level in the Project Risk Matrix and the associated management actions are shown in Table 7.2.3-2. The risks are ranked according to three priority levels, ranging from low (green) to moderate (yellow) to high (red). Evaluation of the individual identified accidents and malfunctions is presented in Section 7.3 and summarized in Section 7.4.

Table 7.2.3-1: Project Risk Level Matrix

Index		Consequence Severity				
		1 Negligible	2 Low	3 Moderate	4 High	5 Very High
Likelihood	A Almost Certain	Low	Moderate	Moderate	High	High
	B Very Likely	Low	Low	Moderate	High	High
	C Possible	Low	Low	Moderate	Moderate	High
	D Unlikely	Low	Low	Low	Moderate	High
	E Highly Unlikely	Low	Low	Low	Moderate	Moderate

Table 7.2.3-2: Risk Matrix Priority Levels

Risk Level		Management Action
	High	High-risk scenarios have High to Very High severity with likelihood ranging from Almost Certain to Unlikely. For high-risk scenarios, additional mitigation measures are required to lower the severity of the potential effects of an accident and malfunction.
	Moderate	Moderate-risk scenarios have Low to Very High severity with likelihood ranging from Almost Certain to Highly Unlikely. In many cases, risk reduction activities will reduce the risk associated with these scenarios, but may require monitoring and active management.
	Low	Low-risk scenarios have Negligible to Moderate severity with likelihood ranging from Almost Certain to Moderate. These risks may require monitoring in certain cases but are not considered to require active management.

7.3 Accidents and Malfunctions

The CSR (AECL 2001) outlined the accidents and malfunctions relevant to the overall decommissioning of WL, identified the expected effects of each scenario, and described mitigations to be put in place as part of the emergency response to those events. Closure activities for the proposed ISD of WR-1 are encompassed by current operating conditions and approved emergency preparedness and response planning identified in the CSR, specifically the Emergency Preparedness Program (CNL 2020a) and WL Site Emergency Response Plan (CNL 2018a), which form the basis of the CNSC-issued site decommissioning licence. The types of hazards anticipated during closure activities are aligned with similar hazards under existing conditions. The procedures, controls and proven mitigative measures in the Emergency Response Plan are considered to appropriately limit the consequence of these hazards such that they would not increase from existing conditions. If new hazards are identified during the execution of the Project, the WL Site Emergency Response Plan (CNL 2018a) will be updated accordingly.

7.3.1 Conventional Occupational Accidents

7.3.1.1 Hazard Identification

Potential worker accidents and injury may arise from non-radiological hazards such as conventional industrial hazards, including working at heights, working in confined spaces, working with energized systems, hoisting and rigging and the potential for falling objects. Dismantling and demolition of the WR-1 Building will involve extensive use of cranes and the movement of heavy loads, resulting in fall hazards and falling object hazards. Failure to isolate all energized systems (e.g., electrical, pressurized) during building isolation, either through improper isolation or accidental exclusion, may result in electrocution or physical shock hazards for workers. The use of saws, drills and compressors represent potential sources of physical injury to the operator, as well as changes in site condition (e.g., excavations).

In addition to the potential injury or accident itself, initiating incidents during decommissioning activities may result in increased exposures to other hazards present within the workplace. For example, if injured personnel require the assistance of rescuers or face delays in being removed from an unsafe location this could increase hazard exposure magnitude and timeframe. In particular, accidents or injuries in confined spaces increase potential exposure of the worker and rescuers to confined space hazards, such as exposure to poor air quality, chemicals and radiation. The hazard initiating the accident or injury may also pose a particular threat to rescuers.

The risk of occupational accidents, such as trips, fall, strains, electrocution, crushing and pinching are no different for the Project than at other industrial projects; these are likely to occur. Conventional industrial hazards associated with Project activities are limited to on-site personnel who are working on the Project under controlled and monitored conditions, and do not pose a threat to the public or the environment. Occupational health and safety

aspects of these types of industrial projects are heavily regulated and programs must be compliant with federal regulations, ensuring that occupational hazards are appropriately managed.

The non-radiological, industrial hazards are systematically identified and assessed through CNL's Occupational Safety and Health (OSH) Program. The Whiteshell Laboratories (WL) site has demonstrated the ability to develop and implement effective health and safety procedures and training programs to reduce the occurrence of an accident and limit the potential extent of personnel injury. The work required as part of the Project will be carefully executed and will be completed in accordance with established CNL procedures. Furthermore, CNL has a rigorous Emergency Preparedness Program and personnel at the WL site are adequately trained to prevent and respond to occupational accidents, including on-site fire fighters who are trained in confined space rescue and procedures for dealing with injured workers.

Predicting the human factor that is central to occupational health and safety accidents is not always possible; however, assessment of human factors and performance and their influence on the work safety is a key part of the work planning process at CNL. WL Integrated Work Control (CNL 2020e) process provides that all work steps are identified and reviewed against possible risks. Occupational hazards and risks, including those influenced by human factors, associated with the work are identified, consequences are considered and appropriate engineered and procedural controls are applied. Proven workplace controls (e.g., job scope and safety analysis, signage, training, standard work procedures and controlled access where applicable) and Personal Protective Equipment and Clothing (PPE&C) (e.g., hard hats, gloves, fall protection and hearing protection) are expected to mitigate these hazards to an acceptable level. Over the past 10 years, decommissioning activities have been taking place on the WL site (e.g., SLOWPOKE demonstration reactor, Decontamination Centre and B300 R&D Laboratory). During this time period the WL site received a ranking from the CNSC of "Satisfactory" for Conventional Health and Safety.

The key performance measure for conventional Health and Safety is the Recordable Lost-time Injuries (i.e., an injury that takes place at work and results in the worker being unable to return to work for a period of time). Both the frequency and severity of incidents for every 200,000 person-hours is considered in the performance measure. A summary of WL injury rate data are provided in Table 7.3.1-1. It was noted in 2013 by the CNSC that although most injuries were minor (i.e., only requiring first aid) there was an increasing trend in the number of days required to return to work (i.e., increasing event severity). As such, CNL has since implemented improvements, which have been successful as shown by the decline in Recordable Lost-time Injuries and working days lost in Table 7.3.1-1 (CNL 2017a, 2020b).

Table 7.3.1-1: Summary of Whiteshell Laboratories Injury Rate Data

Year	2013	2014	2015	2016	2017	2018	2019	2020
Person Hours Worked	860,250	883,500	741,000	684,450	706,000	688,000	642,000	584,030
Lost-time Injuries	7	4	0	1	3	1	0	1
Working Days Lost	62	54	0	5	27	5	0	4
Frequency[(a)]	1.6	0.9	0	0.29	0.85	0.28	0	0.34
Severity[(b)]	14.4	12.2	0	1.46	7.67	1.45	0	0.68

7.3.1.2 Risk Measurement and Evaluation

Potential worker incidents and injuries may arise from conventional industrial hazards such as working at heights, in confined spaces, with energized systems, hoisting and rigging systems, falling objects and heavy equipment. Management actions in place to reduce the likelihood and consequence of potential worker incidents are consistent with the safety management system and safety culture already in effect at the WL site, where regular assessment of safety performance is conducted and lessons learned from experience are applied. The likelihood of a worker injury is **Very Likely**, which is to be expected at an industrial operation. However, with the management systems currently in place, coupled with WL's strong safety culture that includes regular assessments of safety performance and human performance, the consequence of a worker injury is expected to be **Moderate** (i.e., reversible injury with lost time) as shown in Table 7.3.1-1. A consequence severity of **Moderate**, combined with a likelihood of **Very Likely**, results in a risk evaluation of **Moderate,** where appropriate management actions will reduce the risk associated with occupational accidents.

7.3.2 Spills and Leaks

7.3.2.1 Hazard Identification

Spills and leaks of hazardous substances are possible during all stages of Project activities, including hydraulic fluid or fuel leaks from vehicles or heavy equipment, failure of storage equipment (e.g., Low Level Waste Collection system). For example, during cutting and perforation of components and structures as part of preparation for grouting or other dismantling work, unknown or greater than expected quantities of radiological and non-radiological hazardous substances may be encountered. Accidental cuts or breaks of contaminated piping during decommissioning may also release radioactive substances from these systems. Non-radiological hazardous materials in excess of the regulated exemption quantities in the above-grade structure (as well as easily removed quantities in the WR-1 ISD envelope) will be removed and disposed of at an appropriate disposal site. However, spills and leaks are possible during removal and handling of these materials, including friable asbestos, lead, PCBs and chemicals of various degrees of toxicity.

The CNL Emergency Plan, as part of the Emergency Preparedness Program, provides an analysis of potential emergencies that could occur and focuses on planned response to a release of hazardous material. As part of the Emergency Preparedness Program, this plan is revised annually to identify any changes required to keep the plan current. WL employees have basic training in the management of emergencies, while other personnel at the WL site have been highly trained to respond to incidents involving contamination dispersion.

Risks associated with a spill or leak affecting the environment is mitigated through the implementation of engineering controls including use of secondary containment and spill trays that would be continued for the Project. During closure, operational procedures pertaining to spill response will also still be in effect (i.e., Emergency Preparedness Program including WL Emergency Plan). The use of appropriate PPE&C (e.g., chemical resistant gloves, eye protection), routine inspections of equipment, spill trays, spill kits and established emergency procedures will also be used to manage these hazards and mitigate the effects of spills and leaks to workers, the public and environment. With implementation of mitigation and the operation procedures in effect, spills and leaks of hazardous substances are expected to be contained within the WL site. On-site spills are not considered a risk to public safety given no public access within the WL site.

Essential to preventing spills and leaks is the consideration of contamination characterization (e.g., location and composition) during detailed work planning. All activities related to the Project will be covered by either CNL's work permits with completed Radiological Safety Assessments, as required, or through WL Integrated Work Control (CNL 2020e) procedure that ensures all work steps are identified and reviewed against possible risks.

A Work Permit System for all non-routine work involving potential health and safety hazards provides that hazards are evaluated and appropriate protective measures taken.

To minimize the potential effects of radiological spills and leaks, all work will be executed following the procedures and practices of CNL's Radiation Protection Program. Procedures developed under CNL's Environmental Protection Program, Waste Management Program and OSH Program will also aid in protecting workers and the environment from radiological and non-radiological hazards. CNL's Radiation Protection Program is designed and implemented to ensure CNL complies with, or exceeds, the level of radiation safety that is required by the relevant regulations pursuant to the *Nuclear Safety Control Act* and CNL's Health and Safety Policy.

The fundamental objectives of the CNL Radiation Protection Program are to:

- limit the doses to less than the regulatory limits;
- limit doses to employees and members of the public to levels As Low As Reasonably Achievable (ALARA), social and economic factors being taken into account; and
- prevent detrimental non-stochastic (deterministic) health effects caused in employees and members of the public by CNL's use of radiation.

At all WL facilities, these objectives are achieved through facility design, staff training, administrative exposure control procedures, contamination control requirements and work planning and supervision. A combination of Action Levels and dose management tools are used to keep radiation doses to employees below regulatory limits and ALARA (social and economic factors being taken into account).

CNL's Environmental Protection Program (CNL 2021c) provides compliance with applicable environmental regulatory requirements and requirements that CNL has adopted as a matter of policy. The program is registered under ISO 14001 (ISO 2015) and is designed to provide for the protection of the environment and the public in relation to CNL's activities.

The Environmental Protection Program incorporates the following key elements of the ISO 14001 Environmental Management System Standard:

- **Environmental Policy**
  - Commitment to pollution prevention.
  - Setting environmental objectives and targets to support continual improvement of environmental performance.
  - Complying with applicable laws, recognized standards and guidelines applicable to CNL activities.
  - Reviewing the effects of CNL facilities, projects, services and products on the environment.
- **Planning**
  - Identification and determination of significance of those environmental aspects associated with CNL's activities.
  - Establishment of environmental objectives and targets.
  - Development of appropriate plans and/or programs to achieve the objectives and targets.

- **Implementation and Operation**
  - Defining and documenting appropriate roles and responsibilities.
  - Establishment and maintenance of operational controls over environmental aspects.
- **Checking and Corrective Action**
  - Monitoring to verify environmental performance and compliance.
  - Maintaining non-conformance and corrective and preventative action procedures.
- **Management Review**
  - Periodic review by CNL's management to ensure the ongoing suitability, adequacy and effectiveness of the Environmental Protection Program.

CNL's Management of Waste Program (CNL 2020c) includes requirements and processes for CNL activities that involve planning for, handling, processing, packaging, transporting, storage and disposal of wastes to ensure that they are performed in a manner that complies with applicable regulatory and licence requirements and protects workers, the public and the environment. The Waste Management Plan at the WL site includes identification of waste inventory and the characteristics of the waste (radiological and hazardous non-radiological), waste segregation waste packaging and transfer requirements and the plan for storage or disposal of the wastes.

CNL's Occupational Safety and Health Program is designed to provide for the protection of workers and public health and safety in relation to CNL activities. CNL and its contactors will meet all applicable health and safety legislative requirements. CNL requires that contractors and their subcontractors maintain a level of safety equivalent to that of CNL employees while on-site.

From 2015 through 2019, there were no incidents requiring the initiation of the WL Site Emergency Plan, including no reportable spills (CNL 2018c, 2019b, 2020d, and 2021b). Table 7.3.2-1 summarizes the number and types of spills and leaks recorded at the WL site over the past five years. Definitions and examples of the four levels of incident categories are provided below.

- **Level 4 (Negligible) –** Non-reportable (i.e., unpublished internal data for trending performance) environmental incidents with no potential for, or actual generation of public concern. For example, an on-site release immediately contained by on-site controls or readily cleaned up resulting in pollution or degradation with a short-term (less than 3-month), reversible detrimental effect on the environment.
- **Level 3 (Minor) –** Non-reportable (i.e., unpublished internal data for trending performance) environmental incident with no potential for, or actual generation of public concern. For example, an environmental nuisance release resulting in pollution or degradation with a persistent (greater than 3-month), reversible detrimental effect on the environment.
- **Level 2 (Moderate) –** Reportable environmental incident that could generate public concern and/or negative press. Incident requiring significant company resources and likely additional resources, to clean-up. The incident poses a potential serious threat to natural are sources, the environment, or public property. There are on-site and off-site effects.

- **Level 1 (Major) –** Reportable environmental incident that generates a significant amount of public concern. Refers to pollution or degradation which has or may have irreversible detrimental effects on the environment. Catastrophic environmental (extends to a wide scale beyond the site) effect requiring a full-scale response by outside agencies and allocation of additional resources to conduct clean-up. Level 1 incidents may involve international boundaries; could seriously affect natural resources, the environment and/or public property; could have a major effect on production capability.

Table 7.3.2-1: Whiteshell Laboratories Recorded Spills and Leaks

Year	Level 1	Level 2	Level 3	Level 4	Total
2015	0	0	0	9	9
2016	0	0	0	20	20
2017	0	0	0	17	17
2018	0	0	0	26	26
2019	0	0	2	26	28

Note: Level 1 = Highly Significant Problem; Level 2 = Significant Problem; Level 3 = Problem / Minor Incident; and Level 4= Minor Problem / Improvement / Negligible Incident.

7.3.2.2 Risk Measurement and Evaluation

With implementation of mitigation and the operation procedures in effect, spills and leaks of hazardous substances are expected to be contained within the WL site. On-site spills are not considered a risk to public safety given no public access within the WL site. CNL's Emergency Preparedness Program, Radiation Protection Program, Environmental Protection Program, Management of Waste Program, and Occupational Safety and Health Program aid in protecting workers and the environment from radiological and non-radiological hazardous substances.

Based on the statistics presented in Table 7.3.2-1, the likelihood of a spills or leak during Project activities is **Very Likely**. From 2015 through 2019, there were no incidents requiring the initiation of the WL Site Emergency Plan, an all events were non-reportable (i.e., Level 3 and 4) environmental incidents with no potential for, or actual generation of public concern. As such, with the management systems currently in place, coupled with WL's strong safety culture that includes regular assessments of safety performance and human performance, the consequence of a spill or leak on the environment and to worker safety is **Low.** A consequence severity of **Low**, combined with a likelihood of **Very Likely**, results in a risk evaluation of **Low,** where implementation of appropriate mitigation will reduce the risk associated with spills and leaks. These mitigations are consistent with the safety system that would be in place during the closure phase.

7.3.3 Material Handling Accidents

7.3.3.1 Hazard Identification

Various ISD activities may involve lifting and moving of large, potentially contaminated materials. The heat exchangers from the PHT system may be placed inside the WRDF. Other contaminated items, such as fume hoods and active ventilation ducts that will not be placed within the WRDF, will be removed from the WR-1 Building and properly stored or disposed where licenced disposal facilities exist. All wastes collected during decommissioning activities will be placed in containers and properly stored or disposed.

Demolition activities will require handling of heavy loads. Drops of, or effects from, large objects pose physical hazards for workers nearby, and dropped objects could also damage other equipment or structures, resulting in leaks and spills. Cleanup or remediation required following such an incident could result in higher worker exposures. Dropping of contaminated rubble or concrete could cause fine, radioactive particles to be suspended in air, posing an internal exposure hazard. Drops and ruptures of waste containers, or contaminated equipment, such as fume hoods, could also spread contamination and cause it to become airborne.

During closure, operational procedures pertaining to the prevention of spreading contamination will be in effect (i.e., Radiation Protection planning and WL Integrated Work Control planning) and the waste collection system for the WR-1 Building will be operational (i.e., sump water collection, storage and treatment) for as long as it can be reasonably done. The establishment of adequate ventilation in the workplace and the confinement of sources of contaminants from the active ventilation system will curtail airborne releases. Contamination release as a result of accidents during the bulk of the demolition activities to be completed following ISD is anticipated to be limited because the majority of the contamination will be encased in the grout. In addition, the use of stabilizing and immobilizing agents prior to demolition can reduce the spread of any remaining contaminants present in the WR-1 Building. Adherence to the CNL procedures, including hoisting and rigging, will reduce the likelihood of a material handling accident. Therefore, the exposure hazards associated with a material handing accident are limited to on-site personnel who are working on the Project and accident do not pose a threat to the public or the environment.

CNL's Emergency Preparedness Program (CNL 2020a) will reduce the consequences of an accident if it occurs and is designed to respond to any emergency at the WL site. The Emergency Preparedness Program provides guidelines for CNL's emergency management staff to ensure that adequate staff and materials are available to meet the requirements of provincial and municipal emergency plans. A four-tier classification of emergencies is used to assist the Emergency Preparedness Program in making preparations and in implementing response. The classification ranges from:

- **Emergency Classification 1 –** an emergency condition relating to industrial workplace hazards within the facility boundary.
- **Emergency Classification 2 –** an emergency condition having the potential to create significant consequences within the facility boundary.
- **Emergency Classification 3 –** an emergency condition having the potential to create a significant consequence on-site, outside the facility boundary.
- **Emergency Classification 4 –** an emergency condition having the potential to create significant consequences off-site.

7.3.3.2 Risk Measurement and Evaluation

Contamination release as a result of a material handling accident is anticipated to be limited because the majority of the contamination will be encased in the grout. In addition, the use of stabilizing and immobilizing agents prior to demolition can reduce the spread of any remaining contaminants present in the WR-1 Building. As such, the likelihood of a material handling accident occurring, considering controls and mitigation, and adherence to the CNL procedures, is **Unlikely.** Although it is unlikely that a material handling accident would occur, the consequence severity of a loss of control on worker safety would be **High**. A consequence severity of **High**, combined with a likelihood of **Unlikely**, results in a risk evaluation of **Moderate.** Risk reduction activities will reduce the risk associated with a material handling accident, but monitoring and active management will be required. The required management actions are consistent with the safety management system and safety culture already in place at the WL site, where regular assessment of safety performance is conducted, and lessons learned from experience are applied.

7.3.4 Off-site Transportation Accidents

7.3.4.1 Hazard Identification

Non-radiological hazardous wastes not planned for encapsulation will be transported to an appropriate off-site waste facility. Radioactive wastes not planned for encapsulation will be managed in the Waste Management Area or transported off-site (e.g., CNL's Chalk River Laboratories in Ontario). In addition to exposing emergency response personnel from the WL site, transportation accidents involving vehicles carrying hazardous and radiological wastes off-site may expose the driver or other members of the public, or release contaminants to the environment.

Transport of waste is routine and safe. The movement of hazardous and radioactive materials off-site is governed by the *Packaging and Transport of Nuclear Substance Regulations, 2015* (SOR/2015-145), and WL staff and drivers are trained in response procedures. Transport containers for nuclear waste are designed taking into account foreseeable accidents. Packaging materials are tested to withstand conditions associated with fire, impact, wetting, pressure, heat and cold. Therefore, the risk of public exposure during transport is considered to be well known and controlled.

Procedures developed under CNL's Radiation Protection Program, Environmental Protection Program, Waste Management Program, Management of Non-Radiological Hazardous Chemical Waste and OSH Program will aid in protecting workers, the public and the environment, and reduce the risk of transportation accidents and their potential severity. In addition, WL Emergency Preparedness Program has emergency plans for off-site accidents. WL personnel at the WL site have been highly trained to respond to incidents involving contamination dispersion and there are proven procedures in place to protect workers, the public and environment during such an event requiring the management of radiological emergencies. Many Whiteshell Laboratories' workers have extensive training and experience in those aspects of radiation hazard control and environmental hazard control relevant during an emergency.

Any deployment of the off-site response team will result in the automatic activation of the Emergency Operations Centre (EOC) at CNL. The role of the EOC is to support the team with access to subject matter experts and additional CNL or contracted resources as required. The EOC is staffed by members of Occupational Safety and Health, Environmental Protection, Radiation Protection and Health Physicists and its' Facility Managers. All WL resources can be called upon by the EOC to support the emergency response and remediation activities. *Whiteshell Emergency Operations Centre Operating Procedure* (CNL 2017b) establishes the EOC Operations structure and response framework.

In 2012, it was reported that just over 107 million tonnes of dangerous goods were transported on Canadian highways (Statistics Canada 2015). In 2011, 385 reportable accidents occurred involving the transport of dangerous goods by air, boat, rail and road (18% increase from 2010, but 5% below the five-year average for 2006 to 2010). Over 70% of these accidents occurred during material handling at transportation facilities, while the remaining less than 30% occurred during transit (Transport Canada 2012). The six-year average reportable accident rate for road is 102 (2006 to 2011). In 2009, the total distance travelled by trucks carrying dangerous goods in Canada was estimated at 308 million vehicle kilometres (Statistic Canada 2015). This translates into an accident rate of 0.33 accidents per million vehicle kilometres travelled. From 2004 to 2012, the average distance of all dangerous good shipments trucked in Canada was estimated to increase from 608 to 632 km (Statistics Canada 2015). CNL, and Atomic Energy of Canada Limited (AECL) previously, have been transporting radioactive materials between sites across North America with no release of radioactive material to the environment. For this analysis the distance required for the Project (one-way trip to disposal facility) was assumed to be triple the average (1,896 km), translating into an accident likelihood of 0.0006 on-site and an accident likelihood off-site of 0.0002.

For CNL to ship radioactive materials in Canada (CNL 2021g), CNL maintains an emergency response assistance plan that is registered with Transport Canada (Filed in CANUTEC as ERAP Number 2-1456). As part of the emergency response assistance plan, both Chalk River Laboratories and the WL site maintain teams of Radiological Protection staff and response vehicles that can respond to off-site radiological emergencies. These teams operate under specific procedures to respond to accidents that have the potential to disperse contamination to people or the environment (i.e., CNL's environmental response plans *Transportation Accidents Involving Hazardous/Dangerous Goods* [CNL 2021d] and *Response to Off-Site Transportation Accidents Involving Radioactive Material* [CNL 2021g). Whether or not the materials are owned by CNL, the teams will support first responders in the area with radiological assessments and information/resources needed to protect the responders, the public and the environment. This response is part of the mutual aid response assistance agreement between CNL, Bruce Power, Ontario Power Generation, Hydro Quebec and New Brunswick Power (per the *Mutual Initial Response Assistance Agreement* [CNL 2018c).

The CNL team is expected to report to the Local Authority having jurisdiction over the emergency (typically a local fire department or police service) and support them with the emergency response portion of the event. This includes performing ongoing radiological assessments as well as providing guidance on how to protect themselves, other responders and the public in general. The team will also be responsible for implementing mitigating measures to attempt to prevent the further spread of contamination to the environment. Once the emergency is dealt with, CNL will assume responsibility for the remediation of the site, employing decontamination practices determined appropriate for restoring the site to pre-accident conditions (CNL 2021d). Contaminated materials will be removed to a CNL location for proper long-term remediation and environmental monitoring of the site would continue as long as required to ensure the event has not had any adverse effects to the environment.

7.3.4.2 Risk Measurement and Evaluation

CNL, and Atomic Energy of Canada Limited (AECL) previously, have been transporting radioactive materials between sites across North America with no release of radioactive material to the environment. By applying the Transport Canada and Statistics Canada statistics to the Project translating into an accident likelihood on-site of 0.0006 and an accident likelihood off-site of 0.0002. As such, the likelihood of a transportation accident is considered to be **Highly Unlikely**.

Procedures developed under CNL's Radiation Protection Program, Environmental Protection Program, Waste Management Program, Management of Non-Radiological Hazardous Chemical Waste and OSH Program

will aid in protecting workers, the public and the environment, and reduce the risk of transportation accidents and their potential severity. In addition, the movement of hazardous and radioactive materials off-site is governed by the *Packaging and Transport of Nuclear Substance Regulations, 2015* (SOR/2015-145) and transport containers for nuclear waste are designed taking into account foreseeable accidents. Therefore, the consequence severity of such a loss of control is considered to be **Low** for both effects on the environment and public and worker safety. A consequence severity of **Low**, combined with a likelihood of **Highly Unlikely**, results in a risk evaluation of **Low.**

7.3.5 System and Equipment Failure

7.3.5.1 Hazard Identification

Equipment failure and malfunctions may result from improper operation or maintenance or loss of services. Safety-significant systems and equipment, including alarm and monitoring systems (e.g., continuous air monitors), contamination collection and confinement (e.g., Low Level Liquid Waste Collection system, active ventilation system, storage tanks), could potentially be affected. Such failures could result in the accumulation or release of airborne or liquid contaminants potentially affecting worker dose exposures. As secondary containment and Emergency Preparedness Plans already exist, these hazards associated with Project activities are limited to on-site personnel who are working on the Project and do not pose a threat to the public.

Procedures developed under CNL's Environmental Protection Program (CNL 2021c), and *Management and Monitoring of Emissions* (CNL 2018b), describe the use of secondary containment as standard design features of equipment containing hazardous materials. For instance, CNL's *Management and Monitoring of Emissions* (CNL 2018b) indicates that secondary containment systems shall be provided for containers or systems containing radioactive or non-radioactive contaminants (e.g., chemicals, oils, solvents, or other hazardous or nuclear substances) that are stored outdoors or indoors near a storm drain or open draining trench. The exact design of the containment varies from equipment to equipment, but in general takes the form of spill trays and ventilation ducts connected to effluent collection systems, or spill trays with sufficient volume capacity to contain the potential spill.

Failures of systems or equipment could result in radiological and non-radiological hazards through the accumulation or release of airborne and liquid contaminants, as well as increased worker exposure. Failure of alarm and monitoring systems could put workers at higher risks of exposures or fail to provide notification of unsafe conditions. Worker injuries and accidents are also possible with failed equipment or systems. Preventative maintenance is performed to prevent failures from occurring and to assure the continuing capability to perform designed function. Design of equipment with fail-safe modes, use of reliable power supplies, maintenance programs and Defence-in-Depth reduce the likelihood or effects of failures. Use of PPE&C and adherence to OSH procedures, contingency planning and safe back-out procedures provide protection to workers from system and equipment failure.

From 2011 to 2019, there were no instances where criteria were exceeded as a result of equipment failure (i.e., no serious process failures). In 2012, 2013 and 2014, there were short-duration issues with the WL outdoor emergency siren that was believed to be the result of freezing rain and high wind events. The WL outdoor emergency siren has been repaired to prevent such failures in the future. In 2013, there was one unplanned event of unavailability of monitoring data when the outfall sampling pump lost its prime due to maintenance being performed on the main supply pump. This potential consequence of the maintenance was known, and inspection of the outfall sampling pump was scheduled to occur; however, for 95 hours the pump was offline.

In 2015, there was one unplanned instance of failure of the Class 4 power affecting the WL site that was of sufficient duration to initiate the Class 3 emergency power generators. Instances of monitoring unavailability in

2017 included a planned 10-hour outage for WL Building 200 air monitoring (CNL 2018c). Instances of air monitoring unavailability in 2018 included two instances of unplanned outage for the WR-1 Complex (total 57 hours) and two unplanned instances for Building 200 (104 hours) (CNL 2019b). Three instances of unplanned unavailability of the outfall sampling pump in 2017 were due to equipment failure or electrical power issues, resulting in a total of 86 hours of unavailability. There were also seven instances of unplanned unavailability to the outfall sampling pump in 2018 due to equipment failure or electrical power issues, resulting in a total of 106 hours of unavailability. The outfall sampling pump also had two cases of planned unavailability, totaling 7 hours in 2018. In each instance an estimate of the release during unavailability was calculated as per procedure.

In 2019, there were 4 instances of planned unavailability to Outfall monitoring were due to required maintenance that affected the electrical power supply 3 times and the water flow once. The total time of monitoring unavailability in 2019 was 9.3 hours. In each instance, an estimate of the release during unavailability was calculated as per procedure. Monitoring unavailability also occurred during the fall discharge of the Lagoon when the auto sampler failed due to frozen sample lines. Although the daily grab samples provided a reasonable substitute for auto sampling, strictly speaking there was a loss of monitoring for the remainder of the discharge. The total time for loss of unplanned monitoring, was 107 hours.

7.3.5.2 Risk Measurement and Evaluation

From 2011 to 2019, there were no instances where criteria were exceeded as a result of equipment failure (i.e., no serious process failures). As such, the likelihood of a system and/or equipment failure causing radiological and non-radiological exposure hazards to workers is considered to be **Highly Unlikely**. Use of PPE&C and adherence to OSH procedures, contingency planning and safe back-out procedures provide protection to workers from system and equipment failure. Therefore, the consequence severity of a loss of system and equipment function would be **Moderate** for worker safety. A consequence severity of **Moderate**, combined with a likelihood of **Highly Unlikely**, results in a risk evaluation of **Low.** Management actions are already in place at the WL site and will continue for the Project, where regular assessment of safety performance is conducted and lessons learned from experience are applied.

7.3.6 Fires and Explosions

7.3.6.1 Hazard Identification

Fires

Risks to the environment during a fire and/or explosion at WR-1 can be categorized as potential emissions to air, deposition of air emissions to soil or surface water, or runoff of wastewater generated from fire suppression activities. Fires may result by ignition of combustible materials, hot work, equipment malfunction, and electrical faults and could result in on-site and off-site effects. A number of systems and components will require cutting or perforating during reactor systems preparation. The use of saws, grinders, cutting torches and drills pose a risk of ignition of combustible material. These hazards are consistent with decommissioning activities currently taking place within the WL site and are addressed through the WL Integrated Work Control process (CNL 2020e). From 2015 to 2019, there were no reportable fire events. In 2012, there was one reportable fire in Building 408 (an electrical fire in a heating unit, with no injuries or releases to the environment [AECL 2012]).

Adequate ventilation will be provided to prevent the build-up of volatile components. If the ventilation is adversely affected by a fire in the building, there is possibility that workers exposure to airborne contaminants could be increased. The building contains standard emergency response equipment and required PPE&C is provided.

Small radioactive releases to the environment are also possible during fires from the burning of contaminated material. Waste generated from decontamination activities, such as wipes, protective clothing and HEPA filters introduces combustible contaminated material, which could be released to the atmosphere during a fire. Firefighting methods may spread contamination, primarily inside the WRDF, but also outside of the WRDF (e.g., contamination spread in the 600 and 700 level from sections of the PHT system and active ventilation system). The potential for contamination spread beyond the WRDF as the result of a fire would depend on the stage of decommissioning activities (e.g., if above-ground portions of PHT system have been dismantled and relocated below-grade). Since most of the reactor hall outside of the WRDF will be removed, cross-contamination in these areas will burden the removal process with greater decontamination effort.

Wastewater generated from fire suppression activities in the event of a fire would come from internal fire suppression activities or exterior suppression activities. Interior wastewater could result from the activation of sprinkler systems within the building or the application of portable hose streams. Controls are in place to limit the potential for liquid borne contamination as the result of firefighting to spread to the surrounding environment. Most rooms in the WR-1 Building have floor drains, allowing water to be collected and then sampled for non-radiological and radiological contaminants. The floor drains terminate in one of two sumps located in the WR-1 Building, the Organic Sump and the conventional sump. The organics sump is connected to the drains of any room that had organic coolant flowing in or through it to capture any potential releases of organic material separately from the main water collection system in the WR-1 Building. Based on analytical results, the water can either be transferred directly into barrels or filtered and pumped into the conventional sump system for final dispositioning. Water collected by the conventional sump system is transferred to wastewater reservoirs inside the WR-1 Building until it can be sampled. Once the samples are collected the water can be released as per protocol or held back for treatment. In this respect interior wastewater generated in the event of a fire is contained and controlled.

The other potential for wastewater generated would be from exterior fire response on the facility in the form of runoff. This is less likely considering there is very little material left in the building that is capable of burning or to burn for long enough to generate enough heat to create the conditions that require exterior fire suppression. The combination of the lack of fuel load and the fact that the structure is of non-combustible construction under negative air pressure means that fire in this location would likely only be fought with interior fire suppression activities. In the event of exterior fire response, runoff could make its way from the roof of the facility down the exterior walls to the ground around the building. Any soils around the WR-1 Building affected by a fire would be tested after the event against established Canadian Council of Ministers of the Environment (CCME) soil quality standards, and remediated accordingly.

As part of CNL's Environmental Protection Program, there are requirements and processes in place for the *Management of Land, Habitat and Wildlife* (CNL 2018d), which includes mitigation strategies and actions that are to be employed to prevent contaminated run-off from the site to receiving waters. For example, in cases where runoff is of sufficient quantity to reach the roadway, road drains, which are connected to the site storm sewer system would capture the runoff. The runoff would then be sent to the Outfall where runoff is continuously monitored. A post-closure storm water management plan is being developed for the Project and regular site inspection and grounds maintenance is included as tasks under Work Package #10 in the Environmental Assessment Follow-Up program.

A fire could also result in radiological and non-radiological air emissions to the environment. The release of radiologically contaminated air from a fire inside of WR-1 has a low probability. The entire WR-1 structure operates under a negative air pressure ventilation system. This means all the air in the facility flows from the least contaminated areas to the most contaminated areas before being vented from the building. The building is

equipped with a HEPA filtration system that would be engaged in the event of a fire in a contaminated space to filter the air prior to releasing it to the atmosphere. The air exiting the stack is also monitored to detect if any radiological releases have occurred to the environment. The effect of the soot and ash on the soils and flora would be evaluated against established soil quality standards and remediated accordingly, as per direction from CNL Environmental Protection Specialists.

Fire hazards can be reduced through further removal of combustibles and preferential use of cold cutting equipment. Sealed components will be carefully surveyed prior to cutting or perforation, and remote and cold cutting equipment will be used as necessary. Grout specification and formulation will take into account the potential of hydrogen generation and radiolysis of water trapped in the grout. Waste from decontaminated activities will be packaged and managed in compliance with WL Waste Material Management reducing the likelihood of ignition and good housekeeping will reduce the fuel available for a fire. Wastes from decontamination activities will be packaged and managed in compliance with WL materials management procedures to reduce the likelihood of ignition. Worker doses during cleanup following a fire can be kept to a safe level through radiation protection practices.

Under Environmental Incident Reporting, Investigation and Mitigation, unplanned events, such as fire, are investigated until the cause of the incident has been identified and any adverse effects to the environment have been documented, or until due diligence has been demonstrated. This document also outlines all reporting responsibilities placed on CNL in the event of a fire. The environmental impacts are then mitigated to the extent practical to minimize adverse environmental impacts. Mitigative actions shall be directed on a case-by-case basis by the Facility Authority in consultation with Environmental Management staff.

Implementation of WL Fire Protection/Prevention Program will reduce the potential for a fire and the duration and consequences of a fire. CNL maintains a separate procedure for fires involving radioactive material at the WL site. CNL also maintains an Emergency Preparedness Program that reduces consequences from fires and explosions. These plans are discussed in more detail below. Promoting fire safety and preventing fire losses at WL are the main objectives of the WL Fire Protection/Prevention Program. Program objectives are achieved by the following:

- **Promoting Fire Safety:** Provide fire safety information such as pamphlets, displays, presentations, newsletters and employee awareness bulletins, participate in facility safety meetings and provide portable fire extinguisher training to WL employees.
- **Monthly Fire Prevention Inspection:** Inspect all buildings at WL every month to identify and report fire deficiencies and infractions.
- **Monitoring:** Monitor the activities at WL to prevent fire, including the fire watch (for hot works), follow-up inspections following hot works, inspection of construction, demolition and renovation sites and fire prevention inspections to verify (visually) that identified deficiencies are rectified.
- **Fire Scene Investigation:** Examine the fire scene to determine the cause of fire by identifying physical evidence, and protect the scene until the investigation is complete and adopt measures to prevent re-occurrence.
- **Change Control:** Ensure that proposed changes on site are in line with governing fire and building code requirements and site operating licence conditions. Conduct fire screenings and provide recommendations to the Fire Protection Program Manager for consideration.
- **Training:** Training of on-site personnel, facility operations staff and Fire Prevention Inspector.

- **Documentation:** Maintain database to monitor fire prevention trends, compile a list of fire hazard analyses (FHAs) and update as required.

If a fire does occur, the Fire Response Involving Radioactive Material at WL manages the hazards for emergency personnel involved in fire suppression and/or rescue activities that potentially involve radioactive materials. The plan includes the following requirements:

- keep individual doses below CNSC Emergency Response Dose Limits;
- keep potential radiation doses to fire fighters as low as reasonably achievable;
- minimize the potential spread of contamination after the fire is extinguished; and
- prevent possible nuclear criticality excursions for fires involving special fissionable materials.

CNL's WL Site Emergency Response Plan (CNL 2018a) includes emergency preparedness strategies for both on and off-site incidents. In the extremely unlikely event of an on-site fire associated with WR-1 triggering an off-site forest fire, the Emergency Response Plan identifies external organizations which would work with CNL during such an event including the Manitoba Emergency Measures Organization and the Local Government District of Pinawa, Emergency Coordinator and Pinawa Fire Department.

At the WL site, a full-time well-trained fire protection team is employed to ensure rapid and appropriate response to fires involving or potentially involving radiological material. CNL's Emergency Preparedness Program (CNL 2020a) is designed to respond to any emergency at the WL site, including fire and explosions. The Emergency Preparedness Program provides guidelines for CNL's emergency management staff to ensure that adequate staff and materials are available to meet the requirements of provincial and municipal emergency plans, as well as training and exercise requirements. The program provides the earliest possible coordinated response to reduce the effects from an emergency to workers, the public and the environment, as well as restore normal operations as quickly as possible to site.

The monitoring system within the WR-1 Building underwent upgrades in 2011, and is monitored directly at the Security Monitoring Room, providing rapid notification for first responders of any fire event. The response time for the WL on-site Emergency Services Operations, which includes the fire brigade, is under the industry standard set by *CSA N393-13: Fire Protection for Facilities that Process, Handle, or Store Nuclear Substances* (CSA Group 2013), as verified by a third-party *Fire Response Needs Analysis* (Jensen Hughes 2019). The initial response to the facility would include one Fire Engine, one Pumper/Tanker and a minimum of 5 fire fighters. Upon a confirmed fire in any facility on site, all off-duty Emergency Services Operations members and the Pinawa Fire Department are called in for support. Further details on the fire protection staffing and response times are provided in the *Fire Response Needs Analysis* (Jensen Hughes 2019).

The Emergency Services Operations training is skills focused, diving into specific response topics. All members of the WL Emergency Services Operations undergo specialised "Group 4 Enhanced" radiological training, WR-1 Building orientation and specific radiological response procedures/guidelines training. This training is over and above their already rigorous industrial fire training (CNL 2017c) which meets or exceeds the NFPA 1081 *Standard for Facility Fire Brigade Member Professional* (NFPA 2018). Each member of the Emergency Services Operations fire brigade is required to complete annual qualifications in various aspects of their training, including most aspects of the NFPA 1081 and On the Job Training topics. Each crew of first responders is required to participate in Environmental Monitoring and Protection Program exercises as required. The Environmental Monitoring and Protection program exercises focus on interoperability, combining the First Responder's response with various other groups to ensure smooth responses anywhere across the site. Both the Emergency Operations Center and

Building Emergency Teams, including fire response teams, are tested and evaluated according to the WL exercise and drill plan, which is a five-year guideline from which the annual exercise schedule is created (CNL 2018a). These exercises serve to validate the expected effectiveness of the emergency preparedness procedures, and provide an opportunity to adjust the response procedures to better fit the risk levels. The Emergency Services Operations training is skills-focused, diving into specific response topics.

Along with the general skills and procedures that the Emergency Services Operations fire brigade use for their responses, the WR-1 Building has specific Pre-Fire Plans which are primarily used by the Incident Commander in establishing a safe and appropriate response to emergency events within the WR-1 Building (CNL 2019c). The few contaminated spaces within the building are locked and responders have no access to these spaces without a facility operator present. Most of these spaces also contain sprinkler systems that are activated via a fusible link. Several of these spaces also have fog nozzles that con be operated remotely as a back-up to the sprinkler systems.

Confirmed fire in the WR-1 Building would also result in the activation of the WL EOC. The role of the EOC is to support the Incident Commander in their operations at the emergency site and to look after all the other issues that arise outside the emergency site, both on and off the WL site. The WL EOC is structured based on the Incident Command System which is the industry standard across North America. In addition to the standard EOC positions, the WL EOC is also staffed by members of Occupational Safety and Health, Environmental Protection, Radiation Protection and Health Physicists and its' Facility Managers.

Explosions

The WR-1 Building is in a "Storage and Surveillance" state, with the reactor having been shut-down and de-fuelled for over 30 years. The building has had no fissile material in it for at least 20 years. When the last of the fuel was removed from the reactor, the organic coolant was also drained and removed. In the past 3 years, staff has been moved out of the building and offices and labs have been decommissioned. This decommissioning includes the removal of all office furniture, non-structural walls and partitions and flooring and ceiling materials. The building is now occupied only by the Project team and facility operators in a couple of office spaces next to the control room. Access to the building is controlled, with access to the reactor hall and below-grade areas controlled by locks. There is no superfluous material stored in the building and only a minimal amount of flammable materials stored in the appropriate storage cabinets for routine maintenance and compliance work.

Given the current state of the building and the lack of any material, nuclear or otherwise, capable of creating an 'explosive' atmosphere, the risk of an explosion in the WR-1 Building is not considered feasible. There is therefore no current risk posed to employees, the public or the environment from an explosion from the WR-1 Building. As there is no explosion hazard posed by the WR-1 Building there is no corresponding emergency preparedness procedures for this particular hazard. During decommissioning, cutting of sealed components, which may be specifically targeted so that grout will infiltrate them and reduce voids, may pose an explosion hazard if they contain combustibles. During grouting, metals and alloys (i.e., aluminium) exposed to high pH (e.g., an improperly specified or mixed grout) produce hydrogen, which could potentially reach an explosive concentration above the grout surface. As the introduction of these items could create a localised explosion hazard and an ignition hazard for any remaining combustible products, special approval for these items will be provided within CNL's Fire Protection Program (CNL 2021e) and additional mitigation measures put in place.

Environmental monitoring of the site will continue as part of the WL Environmental Assessment Follow-up Program. During incident response, CNL will assess monitoring data against established limits for contaminants of potential concern based on information in the DSAR (Golder 2021), including the findings from the Environmental Risk Assessment (EcoMetrix 2021). These limits are concentrations that are well below established benchmarks for the protection of humans and the environment. Cessation of a monitoring activity would occur only once it can be shown that an effect has stabilized or has been reduced to a level where it is no longer considered significant by regulatory requirements or community concerns. Any proposals on modifications to the monitoring program will be communicated to the CNSC. A progress report will be prepared each year and will include a summary of the environmental monitoring results and the safety considerations of the contaminants left in-situ.

7.3.6.2 Risk Measurement and Evaluation

A four-tier classification of emergencies is used to assist the Emergency Preparedness Program in preparing and implementing responses. From 2015 to 2019, there were no reportable fire events. Therefore, the likelihood of a fire or explosion occurring as a result of an accident or malfunction, considering the controls and mitigation in place, is **Highly Unlikely**. Controls are in place to limit the potential for liquid contamination to spread to the surrounding environment as the result of firefighting activities. For airborne emissions from a fire, the WR-1 building is equipped with a HEPA filtration system that would be engaged in the event of a fire to filter the air prior to releasing it to the atmosphere. The air exiting the stack is also monitored to detect if any radiological releases have occurred to the environment As such, the consequence severity of such an incident is considered to be **Low** for the environment and the public. The consequence of a fire or explosion is considered to be **High** for worker safety.

A consequence severity of **High**, combined with a likelihood of **Highly Unlikely**, results in a risk evaluation of **Moderate.** Monitoring and management actions are already in place at the WL site for these hazards and will continue for the Project.

7.3.7 Aircraft Crash

7.3.7.1 Hazard Identification

The WL site is about 13 km from the nearest airfield (Lac du Bonnet airport), and over 100 km away from the nearest international airport (Winnipeg Jameson Armstrong Richardson). As the local airports are small and relatively distant, the likelihood of an aircraft crashing into the WR-1 Building during closure or post-closure phase can be based on the general aircraft crash rate. The general risk factor of 10^{-4} per square mile (US DOE 2006) applies to the Project. Decommissioning activities are planned to begin in 2022 with demolition of the WR-1 Building complete in 2025. The footprint of the WR-1 Building is approximately 0.07 ha. Given the small size of the WR-1 Building and the small footprint of the WRDF that will be present throughout post-closure, the likelihood of an aircraft crash directly affecting the Project is remote. As part of the Emergency Preparedness Plan, a regularly updated site inventory (radiological and non-radiological hazardous materials) is maintained. This inventory is used to characterize hazards and informed the execution of emergency response teams. If a crash does occur, damage may occur to the concrete cap and engineered cover, potentially reducing the long-term performance of the WRDF.

7.3.7.2 Risk Measurement and Evaluation

Given the small footprint of the WRDF that will be present throughout post-closure, the likelihood of an aircraft crash directly affecting the Project is **Highly Unlikely**. Because the occurrence of an aircraft crash is outside of

CNL's control, there are no mitigation that can be implemented to reduce the likelihood of an event occurring. If a crash does occur, damage may occur to the concrete cap and engineered cover.

The concrete cap and engineered cover designed to prevent human intrusion by providing a hard barrier to actively resist drilling and excavations should someone bypass the earth cover. Should the concrete cap and engineered cover be damaged or breaches, the wastes are further isolated through the grout used within the cavities of the WRDF. Therefore, the consequence severity of an aircraft crash would be **Low** for effects on the environment and **Low** for. Although the consequence severity of an aircraft crash and the direct effect to worker safety is considered to be **Very High,** effects to worker and public safety as a result of a breach of the concrete cap and cover are considered to be **Low**. The consequence severity of **Low** is considered in the risk evaluation as mitigation and management actions to be implemented would be related to the cap and cover. A consequence severity of **Low**, combined with a likelihood of **Highly Unlikely**, results in a risk evaluation of **Low.**

7.4 Summary of Risk Evaluation for Accidents and Malfunctions

The Project Risk Level Summary (Table 7.4-1) is a resource for communicating results, prioritizing risks for risk management and facilitating implementation of the most effective risk mitigation options. The risk management actions and mitigation for potential accidents and malfunctions, including applicable CNL processes and procedures to implement these actions and mitigation, are summarized in Table 7.4-1. Estimates of residual risk following the implementation of the management actions and mitigation is also provided in Table 7.4-1. Some hazards have both an Environment component and a Worker and Public Safety component that may have different consequence severity levels. The highest consequence severity between Environment and Worker and Public Safety was used to determine the Risk Matrix Priority Level.

None of the hazard scenarios in Table 7.4-1 were classified as High (red). The environmental design features and mitigation measures to be implemented are known to be effective based on past performance and safety statistics for site operations and similar closure work performed at the WL site in the last 10 years. The highest category is "Moderate" indicating that the risks may require monitoring and active management. This is done routinely for all work performed at CNL sites. All work at WL site is planned in accordance with WL Integrated Work Control (CNL 2020) process that ensures that all work steps are identified and reviewed against possible hazards and risks, consequences are considered, and appropriate engineered and procedural controls are applied.

Conventional occupational accidents, material handling accidents, and fires and explosions were evaluated as Moderate priority level during closure. Spills and leaks, off-site transportation accidents, system and equipment failure, and aircraft crash were evaluated as Low priority level during closure. All of these potential hazards are well understood and encompassed by existing and proven engineering controls, management program and standard operating procedures at the WL site. The residual risks for these accidents and malfunctions are expected to be within regulatory requirements. In addition, no off-site effects are predicted for the accident and malfunction scenarios, including those identified by the public and Indigenous communities.

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Table 7.4-1: Project Risk Level Summary

Accident/ Malfunction	Project Phase	Environmental Design Features and Mitigation	Likelihood	Consequence Severity		Risk Matrix Priority Level (after mitigation)[1]
				Environmental	Public and Worker Safety	
Conventional Occupational accidents	Closure	■ Implementation of CNL procedures for hoisting and lifting, working at heights, confined space entry and working with energized systems; use of cranes and movement of heavy loads; the use of saws, drills and compressors; and hazard identification regarding changing site conditions (e.g., excavations). ■ Workplace controls, and Personal Protective Equipment and Clothing (PPE&C)	Very Likely (B)	n/a	Public = n/a Worker = Moderate (3)	Moderate
Spills and leaks	Closure	■ Implementation of CNL's Radiation Protection Program, Environmental Protection Program, including Emergency Plan and Occupational Safety and Health Program ■ Adequate ventilation during decommissioning activities ■ PPE&C (e.g., chemical resistant gloves, eye protection) ■ Routine inspections of equipment ■ Spill trays and spill kits ■ Chemical protection suits and self-contained breathing apparatuses	Very Likely (B)	Very Low (1)	Public = n/a Worker = Low (2)	Low
Material handling accidents	Closure	■ Confinement from ventilation ■ Implementation of CNL procedures, including hoisting and rigging and Emergency Preparedness plans	Unlikely (D)	n/a	Public = n/a Worker = High (4)	Moderate
Off-site transportation accidents	Closure	■ Proper packaging and handling of hazardous waste ■ Use of CNL's procedures on Management of Non-Radiological Hazardous Chemical Waste and WL Waste Materials Management Emergency ■ Preparedness Program has emergency plans for off-site accidents	Highly Unlikely (E)	Low (2)	Public and Worker = Low (2)	Low
System and equipment failure	Closure	■ Design of equipment with fail-safe modes, use of reliable power supplies, maintenance programs, Defence-in-Depth minimize the likelihood or effects of failures ■ Use of PPE&C and adherence to Occupational Safety and Health procedures, contingency planning and safe back-out procedures provide protection to workers from system and equipment failure	Highly Unlikely (E)	n/a	Public = n/a Worker = Moderate (3)	Low
Fires and explosions	Closure and Post-closure	■ Wastes from decontamination activities will be packaged and managed in compliance with WL materials management procedures to reduce the likelihood of ignition ■ Implementation of WL Fire Protection Program and Emergency Preparedness Program ■ Removal of combustibles and preferential use of cold cutting equipment ■ Careful surveying prior to cutting and through preferential use of remote cutting equipment ■ This risk of hydrogen explosion is avoided through proper specification and formulation of the grout (i.e., appropriate pH, adequate ventilation) ■ Adequate ventilation during decommissioning activities ■ Worker doses during cleanup following a fire can be kept to a safe level through radiation protection practices	Highly Unlikely (E)	Low (2)	Public = Low (2) Worker = High (4)	Moderate
Aircraft crash	Closure and Post-closure	■ During closure implementation of WL Fire Protection Program and Emergency Preparedness Program	Highly Unlikely (E)	Low (2)	Public and Worker = Low (2)	Low

Note: Colour coding refers to the risk level in the Project Risk Matrix shown in Table 7.1.3-1.

a) The highest Consequence Severity between Environment and Worker and Public Safety was used to determine the Risk Matrix Priority Level.

n/a = not applicable. An assignment of n/a was included with respect to consequence severity in the table if it was considered that there was no potential or a negligible pathway of effect .

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8.0 SUMMARY OF CUMULATIVE EFFECTS

8.1 Introduction and Approach

The *Canadian Environmental Assessment Act, 2012* requires that each environmental assessment of a designated project consider any cumulative environmental effects that are likely to result from the designated project in combination with the environmental effects of other physical activities that have been or will be carried out (The Agency 2015). The cumulative effects assessment is completed to evaluate the contribution of effects from the In Situ Decommissioning of WR-1 at the Whiteshell Laboratories Site (the Project; i.e., Application Case) in combination with previous, existing, or reasonably foreseeable projects or activities in the region (i.e., Reasonably Foreseeable Developments [RFD] Case) that may overlap spatially (i.e., the same geographic area) and temporally (i.e., over time). Projects or activities in the region that have not yet been approved or developments and activities that are currently under application review, or that have officially entered a regulatory application process, may be considered reasonably foreseeable.

The method for assessment of cumulative effects is outlined in Section 6.1 Environmental Assessment Approach and is consistent with the Canadian Nuclear Safety Commission (CNSC) *Generic Guidelines for the Preparation of an Environmental Impact Statement* (CNSC 2016) and the Canadian Environmental Assessment Agency's *Assessing Cumulative Effects under the Canadian Environmental Assessment Act, 2012* (The Agency 2018). Cumulative effects are assessed using the same approach used for the Project-specific effects analysis. The approach follows the same five general steps outlined in the cumulative effects technical guidance document (The Agency 2018):

- **Step 1: Scoping:**
  - identifying valued components (VCs; see Section 6.1.3 Valued Components);
  - determining spatial boundaries (see Section 6.1.4.1 Spatial Boundaries);
  - determining temporal boundaries (see Section 6.1.4.2 Temporal Boundaries); and
  - examining physical activities that have been and will be carried out (see Section 6.1.4.3 Assessment Cases).
- **Step 2: Analysis** (see Section 6.1.6 Project Interactions and Mitigation and Section 6.1.7 Residual Effects Analysis);
- **Step 3: Mitigation** (see Section 6.1.6 Project Interactions and Mitigation and Section 6.1.7 Residual Effects Analysis);
- **Step 4: Significance** (see Section 6.1.9 Residual Effects Classification and Determination of Significance); and
- **Step 5: Follow-up** (see Section 6.1.10 Monitoring and Follow-up).

The decommissioning approach for the Whiteshell Laboratories (WL) site as described in the Comprehensive Study Report (CSR; AECL 2001) was to remove all facilities with the exception of low level waste trenches in the Waste Management Area (WMA), and existing contaminated river sediments, which would be managed through in situ disposal (ISD). Canadian Nuclear Laboratories (CNL) is proposing a revised approach to the Whiteshell Reactor 1 (WR-1) decommissioning that includes partial dismantling and demolition, along with passive,

permanent disposal of the below-grade portions of the facility. The disposal approach is ISD. In situ disposal is a proven nuclear decommissioning approach that increases worker safety, provides protection of the environment and the public, reduces interim storage and multiple handling, enables permanent nuclear liability reduction and uses fewer resources. Other decommissioning activities for the WL site, documented in the CSR, are unmodified. Removal of the east annex and service wing of the WR-1 Complex were assessed as part of the CSR and are covered under the CNL's existing decommissioning licence for the WL site (Licence No. NRTEDL-W5-8.00/2024). Activities required to prepare for ISD, such as isolation of the WR-1 Complex and targeted remediation of hazardous materials, are also covered under CNL's existing decommissioning licence for the WL site.

The closure phase for the Project includes preparation for ISD, grouting of below-grade structures and systems, removal of above-grade structures and systems, installation of the concrete cap and engineered cover over the grouted below-grade structures, environmental controls, final site restoration and preparation for institutional control. Closure activities last from 2022 to 2027.

The post-closure phase has two discrete periods: institutional control and post institutional control. Institutional control is estimated to last 100 years during which long term monitoring and maintenance activities will continue to demonstrate WRDF performance is in compliance with the safety case assumptions and performance modelling. The 100 year timeframe is not related to the design life of the WRDF barriers. The 100-year active monitoring period was selected to ensure that sufficient opportunity is provided to verify the WRDF is performing as expected. Additionally, beyond 100 years, there is less confidence that institutional controls, like access restrictions, can be relied upon. Although the duration of institutional control is estimated at 100 years, it is recognized that it will continue until the CNSC, or the appropriate authority at the time, agrees it is no longer needed. Post-institutional control occurs after year 2127 and continues indefinitely. The post-closure phase will continue indefinitely; however, the timeframe defined for assessment of potential effects as part of the normal evolution of the Project is 10,000 years. This time period encompasses the phase in which peak effects are anticipated.

Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, scientists, government agencies, Indigenous peoples, or the public (The Agency 2018). The selection of appropriate VCs allows the assessment to be focused on those aspects of the natural and human environment that are of greatest importance to society. The VCs requiring an analysis under the RFD Case are determined by understanding whether the residual effects from the Project and one or more additional developments (or activities) overlap or interact with the temporal or spatial distribution of the VC. For some VCs, there is no potential for cumulative residual effects to environmental components, because there is no overlap with the effects of other developments.

The analysis of cumulative residual effects considers all primary pathways that are likely to result in residual effects on VCs, after implementing environmental design features and mitigation. Pathways determined to have no linkage to a VC or those that are considered secondary (i.e., negligible effect) are not expected to result in significant effects on the assessment endpoint of VCs, individually or cumulatively. Where potential cumulative residual effects from the RFD Case are identified for these VCs, these effects were assessed using the same approach used for the Project-specific effects analysis.

The residual effects classification of primary pathways and the associated predicted changes in measurement indicators provide the foundation for determining the significance of incremental and cumulative residual effects from the Project and reasonably foreseeable developments on VCs. For some VCs, there may be no RFD Case and the assessment is limited to determining the significance of residual effects from the Project and previous

and existing developments (i.e., Application Case). For those VCs that may be influenced by forecasted future developments, the assessment includes classifying and determining the significance of cumulative residual effects from all developments, including the Project (i.e., RFD Case). The significance of incremental (i.e., Application Case) and cumulative (i.e., RFD Case) residual effects are summarized in Section 9.0 Summary of Significance.

Monitoring and follow-up programs are proposed to address the uncertainties associated with the effects predictions and the performance of mitigation. In general, monitoring is used to verify the incremental and cumulative residual effects predictions. Monitoring is also used to identify any unanticipated residual effects and provide the implementation of adaptive management to limit these effects. Monitoring and follow-up programs identified to verify the incremental and cumulative residual effects predictions are summarized in Section 11.0 Summary of Monitoring and Follow-up Programs.

8.2 Reasonably Foreseeable Projects

As described in Section 8.1, the Project has the potential to interact with past, existing and reasonably foreseeable projects or activities in the region. Table 8.2-1 provides a summary of the other projects considered in the RFD Case.

As described in Section 1.0 Introduction, CNL is in the process of executing activities associated with the ultimate decommissioning of the WL site. As such, decommissioning and reclamation activities are the primary RFDs with the potential to act cumulatively with the Project. The CSR (AECL 2001), under the *Canadian Environmental Assessment Act* (1992), was completed for the decommissioning and reclamation of the entire WL site. The environmental assessment decision to approve the Project was announced by the Minister of the Environment in March 2002 and a decommissioning licence was issued to Atomic Energy of Canada Limited (AECL) and subsequently to CNL. Since receiving approval, various decommissioning and reclamation activities at the WL site have either been completed or are currently underway. As such, decommissioning and reclamation activities that have been already completed or that are currently underway at the WL site are considered as part of the Base Case. Future decommissioning and reclamation activities planned to continue and that will overlap spatially and temporally with decommissioning activities for the Project are considered as part of the RFD Case.

Table 8.2-1: Reasonably Foreseeable Developments Considered in the Assessment

Type of Project	Location	Description	Timeframe
Infrastructure Decommissioning	WL site	Decommissioning of remaining infrastructure on the WL site (includes ISD of the low-level waste trenches).	2016 to 2027
Environmental Remediation	WL site	Remediation of affected lands, except for the low-level waste trenches.	2016 to 2027

8.3 Summary of Cumulative Residual Effects

8.3.1 Atmospheric Environment

Potential for cumulative residual effects on air quality is considered at the regional scale, specifically within the atmospheric environment Regional Study Area (RSA). As described in Section 6.2 Atmospheric Environment, there are no RFDs expected in the atmospheric environment RSA other than the decommissioning of the remaining infrastructure and support facilities, and reclamation of affected areas at the WL site, as described in the CSR (AECL 2001).

Results of the air quality assessment completed as part of the CSR indicated that from time-to-time nuisance dust will be generated. Mitigation practices will be implemented to limit potential effects to air quality, including dust control measures (e.g., containment and active suppression [e.g., wetting prior to sidewalk and street sweeping]), curtailment of activities during periods of high winds and maintenance of on-site access routes (see Section 6.3.1 of AECL 2001). In addition, dust monitoring stations have been established on site to collect airborne particulate samples as part of environmental monitoring during decommissioning activities. Special enclosures to cover large areas are currently in use and additional ones may be implemented in the future to contain potential airborne emissions from decommissioning activities (e.g., decommissioning of the WMA). In addition, temporary ventilated enclosures that implement High-Efficiency Particulate Air (HEPA) filtration are used where airborne contamination is a potential hazard during work. This protects workers and the environment. The evaluation of effects to air quality from decommissioning and reclamation activities for the entire WL site concluded that release of air emissions is negligible (AECL 2001).

Project activities will result in emissions associated with the operation of vehicles and equipment, as well as material handling emissions from the demolition and grouting and temporary batch mixing plant or similar equipment. Mitigation practices will be implemented to limit potential effects to air quality, including CNL's *Management and Monitoring of Emissions* (CNL 2018), which includes operational control monitoring, air verification monitoring and environmental monitoring and dust management techniques. Predicted concentrations for the Application Case are below applicable air quality guidelines and/or standards.

The environmental effects of the activities related to the decommissioning of the reactor are expected to be less than those assessed in the CSR (AECL 2001) due to the change in decommissioning strategy from complete removal of the facility to ISD. Consequently, the Project is not anticipated to result in a change in the conclusions of the CSR (AECL 2001) related to air quality (Section 6.2.1 Air Quality). As such, the Project is not expected to contribute cumulatively to the effects of decommissioning of the remaining infrastructure and support facilities at the WL to cause a significant effect.

8.3.2 Physical Environment

Potential for cumulative residual effects on geology and hydrogeology is considered at the regional scale, specifically within the geology and hydrogeology RSA.

8.3.2.1 Geology

As described in Section 6.3.1 Geology, there are no RFDs expected in the RSA other than the continued decommissioning of the remaining facilities at the WL site, as described in the CSR (AECL 2001). The CSR indicated that existing effects on soils are limited to contaminated soils within affected lands on the WL site (see Section 6.3.4 of AECL 2001). Affected lands and associated contaminated soils will be remediated during the WL site decommissioning to meet the WL soil clean-up criteria and the non-radiological and radiological clearance and release criteria.

The assessment of potential pathways of effects for the Application Case in Section 6.3.1 determined there are no primary pathways that would lead to residual effects on geology VCs. Erosion and sediment control practices (e.g., silt fences, runoff management) applicable to the region and already in place at the WL site will be used during decommissioning activities around disturbed areas, where appropriate. The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-state. Overall, cumulative effects from the Project in combination with the decommissioning of the remaining infrastructure and support

facilities, and reclamation of the affected areas at the WL site, are anticipated to positively affect soil. As such, an RFD Case is not presented as part of this assessment.

8.3.2.2 Hydrogeology

As described in Section 6.3.2 Hydrogeology, there are no RFDs expected in the RSA other than the continued decommissioning of the remaining facilities at the WL site, as described in the CSR (AECL 2001). Results of the CSR (see Section 6.3.4 of AECL 2001) indicated that major alterations of groundwater flow regimes from the decommissioning activities are not expected. Following decommissioning of the building sumps, groundwater levels will approach static conditions similar to the local environment. On the WL main campus, groundwater heads indicate downward flow conditions exist. For the closure and post-closure phases, groundwater will flow downwards through the overburden and westward, ultimately discharging at the Winnipeg River. The closure of the WL site may slightly alter the drainage flow patterns to the Winnipeg River for a short period of time, but the changes are expected to be within the natural range of variation. Overall, cumulative effects from the Project in combination with the decommissioning of the remaining infrastructure and support facilities, and reclamation of the affected areas at the WL site, are anticipated to have a negligible effect on groundwater quantity.

The CSR (AECL 2001) indicated that for effects to groundwater quality, the main area of concern was the low-level waste proposed to be managed in situ in the WMA. The evaluation of contaminant migration from the WMA trenches concluded that the nature of groundwater flow in the area around the WMA limits contaminant migration away from the WMA. There is no downward movement of groundwater flow from the WMA to the underlying permeable sandy zone, which has the potential to act as a transmission zone to the Winnipeg River (see Section 6.3.4 and Appendix C of AECL 2001). Generally, the natural hydraulic head at 10 m depth is higher, meaning that the hydraulic head gradient is upward, leading to potential water discharge towards the surface (i.e., artesian conditions).

Contaminant migration, if it were to occur, would be less than 10 cm over 20 years. Testing also provided no evidence of a “bathtub effect” (i.e., flooding of the trenches so that they have a higher conductivity than the trench wall) and associated near-surface lateral movement of contaminants, although further testing was recommended to support a future detailed safety analysis (AECL 2001).

The final safety assessment for the WMA has not been completed. Both the Project and the WMA are subject to the same regulatory requirements, which require that no member of the public receive a dose greater than 1 mSv/a. *REGDOC 2.11.1, Waste Management, Volume III: Assessing the Long-Term Safety of Radioactive Waste Management* (CNSC 2018), specifies a 1 mSv/a limit, and also specifies that a lower dose rate target should be set to account for emissions from other sources. Therefore, a value of 0.3 mSv/a dose limit to public has been established for the WL site. The Project specified a 0.25 mSv/a target dose rate limit for the public and results of the assessment for the normal evolution indicates that the Project is well below this target. The expectation is that the final assessment of the WMA will demonstrate negligible dose rates compared to these targets. Consequently, there are negligible cumulative effects between the Project and previous activities at the WL site (i.e., effects from the WMA). In summary, there is no overlap of effects between WR-1 ISD and previous activities at the WL site (i.e., effects from the WMA) and changes to groundwater quality from the Project.

8.3.3 Surface Water Environment

Potential for cumulative residual effects on surface water is considered at the regional scale, specifically within the surface water RSA.

8.3.3.1 Hydrology

As described in Section 6.4.1 Hydrology, there are no RFDs expected in the surface water RSA other than the continued decommissioning of the remaining facilities at the WL site, as described in the CSR (AECL 2001). The CSR (see Section 6.3.3 of AECL 2001) indicated that alterations of surface water flow regimes from the decommissioning activities are not expected. The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-state. The drainage system for the reclaimed WL site will have physical characteristics similar to natural drainage systems in the general geographic region in terms of dynamic stability, robustness and longevity. The WL site will be graded to promote drainage to the Winnipeg River. Overall, cumulative effects from the Project in combination with the decommissioning of the remaining infrastructure and support facilities, and reclamation of the affected areas at the WL site, are anticipated to have a negligible effect on hydrology.

8.3.3.2 Surface Water Quality

As described in Section 6.4.2 Surface Water Quality, there are no RFDs expected in the RSA other than the continued decommissioning of the remaining facilities at the WL site, as described in the CSR (AECL 2001). Decommissioning and reclamation of the entire WL site, including the Project, may alter drainage rates and flow patterns as current precipitation management is removed. Consequently, the discharge volume to Winnipeg River may change, which may alter surface water quality. The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-states. The drainage system for the reclaimed WL site will have the physical characteristics similar to natural drainage systems in the general geographic region in terms of dynamic stability, robustness and longevity. The contribution to site runoff from the Project is expected to be minor relative to the entire decommissioned WL site. Although closure of the WL site may slightly alter the drainage rates and flow patterns and discharge volume to the Winnipeg River; the changes are expected to be within the natural range of variation. As such, changes to discharge volume to from the closure of the WL site, including the Project, are predicted to have a negligible effect on the surface water quality in Winnipeg River.

The CSR (see Section 6.3.3 of AECL 2001) indicated residual effects on surface water, particularly the Winnipeg River, are related to discharges from the Active Liquid Waste Treatment Centre and the sewage lagoon. These discharges, currently well below applicable standards, will gradually diminish to almost zero following decommissioning. Re-suspension of contaminated sediments is also not expected to lead to a decrease in water quality (Section 7.0 AECL 2001).

The CSR (AECL 2001) also examined the potential for effects via groundwater quality from the low-level waste that may be managed in situ in the WMA, and their potential to affect the Winnipeg River (see also Section 6.3.2.5.2.4 Groundwater Quality). The assessment considered three general exposure pathways: upward migration (with potential contamination of soils and vegetation), near-surface lateral migration (with potential contamination to local discharge in perimeter and roadside ditches) and downward migration and contamination of the sand and gravel aquifer and subsequently the river. Only the near-surface lateral migration scenario was considered in further detail. With respect to downward migration and release to the river, it was determined that the general hydrology of the site limits or eliminates this pathway.

Water concentrations in the ditch were predicted and compared to established guidelines for several of the contaminants in the WMA. Radionuclide modelling in the CSR (Appendix C of AECL 2001) indicated that three radionuclides have the potential to exit the WMA through migration over a 200-year period: tritium, technetium-99

and carbon-14. Only technetium-99 is potentially present in non-zero concentrations in the ditch adjacent to the WMA in as early as 20 years. The carbon-14 and tritium will be lost to the atmosphere. When this is modelled, there is no release of these radionuclides to the perimeter ditch. These predictions were considered further for their potential effect on human health (see Section 6.7.1.7 Residual Effects Analysis [Section 6.7 Human and Ecological Health]). With respect to non-radiological contaminants, some exceedances of applicable standards were predicted. Further refinement of the modelling and potential need for selective remediation to remove the hazard was recommended (AECL 2001).

The final safety assessment for the WMA has not been completed; however, both the Project and the WMA are subject to the same regulatory requirements, which require that no member of the public receive a dose greater than 1 mSv/a. *REGDOC 2.11.1, Waste Management, Volume III: Assessing the Long-Term Safety of Radioactive Waste Management* (CNSC 2018), Section 6.2.1, specifies a 1 mSv/a limit, and also specifies that a lower dose rate target should be set to account for emissions from other sources. Therefore, a value of 0.3 mSv/a dose limit to public has been established for the WL site. The Project specified a 0.25 mSv/a target dose rate limit for the public and results of the assessment for the normal evolution indicates that the Project is well below this target. The expectation is that the final assessment of the WMA will demonstrate negligible dose rates compared to these targets. Consequently, there are negligible cumulative effects between the Project and previous activities at the WL site (i.e., effects from the WMA) and surface water quality in the Winnipeg River.

As part of CNL's licence with the CNSC, environmental monitoring around the WL site will continue for the Project in accordance with the Environmental Assessment Follow-up Program. Follow-up monitoring during the post-closure phase will continue to verify effect predictions and to provide information for use in adaptive management to address potential unforeseen effects. Consequently, changes to surface water quality from the closure of the WL site, are predicted to be negligible.

8.3.4 Aquatic Environment

As described in Section 6.5 Aquatic Environment, there are no RFDs expected in the RSA other than the continued decommissioning of the remaining facilities at the WL site, as described in the CSR (AECL 2001). Potential effects from the Project on the aquatic environment that may overlap spatially with decommissioning activities include activities resulting in changes to surface water quality, sediment quality and hydrology.

The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-states. The drainage system for the reclaimed WL site will have physical characteristics similar to natural drainage systems in the general geographic region in terms of dynamic stability, robustness and longevity. The contribution to site runoff from the Project is expected to be minor relative to the entire decommissioned WL site. Similar to the decommissioning plan for the Project, the WL site will be graded to promote drainage to the Winnipeg River. Although closure of the WL site may slightly alter the drainage rates and flow patterns and discharge volume to the Winnipeg River, the changes are expected to be negligible and within the natural range of variation. As such, changes to hydrology from the closure of the WL site, including the Project, are predicted to have a negligible effect on the maintenance of self-sustaining and ecologically effective fish populations, including species at risk.

The CSR indicated that the potential effects to aquatic biota are also related to changes in surface water quality in the Winnipeg River from the presence of contaminated river sediments. No decrease in water quality is expected and effluent emissions to the Winnipeg River are expected to decline to virtually zero following decommissioning (see Section 7.0 of AECL 2001). Re-suspension of contaminated sediments is also not expected to lead to a

decrease in water quality. Consequently, changes to surface water quality from the closure of the WL site, are predicted to have a negligible effect on the maintenance of self-sustaining and ecologically effective fish populations, including species at risk.

8.3.5 Terrestrial Environment

Potential for cumulative residual effects on the terrestrial environment is considered at the regional scale, specifically within the terrestrial RSA. As described in Section 6.6 Terrestrial Environment, there are no RFDs expected in the terrestrial RSA other than the continued decommissioning of the remaining facilities at the WL site, as described in the CSR (AECL 2001). The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the land use and landscape of the day. Results of the CSR (see Section 6.3.5 of AECL 2001) indicated that no effects were identified for terrestrial biota as natural vegetation will re-establish following completion of decommissioning and reclamation activities. Airborne emissions from decommissioning activities are likely to be less than in the past, and no effect from this exposure pathway is expected (see Section 6.3.5 of AECL 2001).

Overall, cumulative effects from the Project in combination with the decommissioning of the remaining infrastructure and support facilities, and reclamation of the affected areas at the WL site are anticipated to positively affect the terrestrial environment. Once existing infrastructure is removed and the RSA is reclaimed the level of anthropogenic disturbance within RSA will be reduced, benefiting the terrestrial environment of the RSA. Species such as barn swallow may be negatively affected through the loss of anthropogenic habitat on site through the decommissioning of structures; however, implementation of habitat offsetting (e.g., installation of nesting structures for barn swallow in 2018) in advance of additional decommissioning is designed to proactively address this potential. Because cumulative effects from the Project in combination with the decommissioning and reclamation of the affected areas at the WL site are considered through proactive offsetting measures or anticipated to be positive, an RFD Case is not presented as part of this assessment.

8.3.6 Human and Ecological Health

Potential for cumulative residual effects on human and ecological health is considered at the regional scale, specifically within the human and ecological health RSA, as represented by a number of receptor locations (see Figure 6.7.1-1).

8.3.6.1 Human Health

As described in Section 6.7.1 Human Health, there are no RFDs expected in the RSA other than the continued decommissioning of the remaining facilities at the WL site, as described in the CSR (AECL 2001). The CSR (see Section 6.3.8 of AECL 2001) indicated that no public health threats were predicted from the decommissioning and reclamation activities for the WL site. Releases are well within regulatory limits for the protection of human health and regular monitoring provides that any aberrations are detected immediately.

The CSR (AECL 2001) also examined the potential for effects via groundwater quality from the low-level waste that may be managed in situ in the WMA, and their potential to affect the Winnipeg River and human health (see also Section 6.4.2.6.2.2 Project Interactions and Mitigation [surface water quality assessment]). The assessment considered three general exposure pathways: upward migration (with potential contamination of soils and vegetation), near-surface lateral migration (with potential contamination to local discharge in perimeter and roadside ditches) and downward migration and contamination of the sand and gravel aquifer and subsequently the river. Only the near-surface lateral migration scenario was considered in further detail. With respect to

downward migration and release to the river, it was determined that the general hydrology of the site limits or eliminates this pathway.

Water concentrations in the ditch were predicted and compared to established guidelines for several of the contaminants in the WMA. Radionuclide modelling in the CSR (Appendix C of AECL 2001) indicated that three radionuclides have the potential to exit the WMA through migration over a 200-year period, namely tritium, technetium-99 and carbon-14. Only technetium-99 is potentially present in non-zero concentrations in the ditch adjacent to the WMA in as early as 20 years. The carbon-14 and tritium will be lost to the atmosphere, and when this is modelled there is no release of these radionuclides to the perimeter ditch. The preliminary exposure assessment for radiological contamination of the ditch, when these losses were conservatively ignored, resulted in a dose of 0.16 millisieverts per year (mSv/a) at the predicted peak concentration of technetium-99 (Section 6.7.1 Human Health; Appendix C of AECL 2001).

With respect to non-radiological contaminants, some exceedances of applicable standards were predicted. Further refinement of the modelling and potential need for selective remediation to remove the hazard was recommended (AECL 2001). Organic contaminants were also considered; it was concluded that the remaining concentrations of the solvents and dichlorodiphenyltrichloroethane (DDT) are very small and unlikely to present a residual hazard.

The final safety assessment for the WMA has not been completed; however, both the Project and the WMA are subject to the same regulatory requirements, which require that no member of the public receive a dose greater than 1 mSv/a. REGDOC-2.11.1, *Waste Management, Volume III: Assessing the Long-Term Safety of Radioactive Waste Management* (CNSC 2018), Section 6.2.1, specifies a 1 mSv/a limit, and also specifies that a lower dose rate target should be set to account for emissions from other sources. Therefore, a value of 0.3 mSv/a dose limit to public has been established for the WL site. The Project specified a 0.25 mSv/a target dose rate limit for the public, and results of the assessment for the normal evolution indicate that the Project is well below this target. Consequently, there are negligible effects between the Project and previous activities at the WL site (i.e., effects from the WMA) and changes to surface water quality in the Winnipeg River.

Current effects from the existing facilities and operations at the WL site are considered part of the Base Case (i.e., existing conditions), and as such an RFD Case is not applicable to the human health assessment and is not further discussed.

8.3.6.2 Ecological Health

As described in Section 6.7.2 Ecological Health, there are no RFDs expected in the RSA other than the continued decommissioning of the remaining facilities at the WL site, as assessed in the CSR (AECL 2001). The CSR (see Section 6.3.3 of AECL 2001) indicated that no decrease in water quality is expected and effluent emissions to the Winnipeg River are expected to decline following decommissioning. Results of the assessment concluded that no effect on aquatic species is expected as doses were below the limit at which no effects on aquatic populations are expected (see Section 6.3.6 of AECL 2001). Current effects from the existing facilities and operations at the WL site are considered part of the Base Case (i.e., existing conditions). Consequently, cumulative effects of the Base Case and the potential effects from the Project are evaluated in the Application Case. As such, an RFD Case is not presented as part of this assessment.

8.3.7 Land and Resource Use

Section 6.8 Land and Resource Use seeks to understand and characterize the potential residual effects of the Project and past, present, and reasonably foreseeable developments on traditional land and resource use (Section 6.8.1) and other land and resource use (Section 6.8.2). The assessment of traditional land and resource use considers traditional land and resource use activities in proximity to the Project, including hunting, trapping, and gathering by Indigenous Peoples, archaeological and cultural sites, and the overall importance of the Winnipeg River. The assessment of other land and resource use includes consideration of non-Indigenous commercial, municipal, and federal land and resource use activities in proximity to the Project. These activities include agriculture, forestry, mineral claims and leases, water use, and outdoor recreation and tourism, sport fishing, outfitting, hunting, trapping, and other winter activities.

Potential cumulative residual effects on traditional land and resource use (Section 6.8.1) and other land and resource use (Section 6.8.2)were considered at the regional scale (i.e., the RSA). As described in Section 6.8.1 and Section 6.8.2, there are no RFDs expected in the RSA other than the continued decommissioning of the remaining facilities at the WL site, as described in the CSR (AECL 2001). The CSR (Section 6.3.9 of AECL 2001) identified residual effects on land and resource use as a result of the long-term land use restrictions. Land and resource use activities have persisted adjacent to the site, including uses of the Winnipeg River. It is expected that all activities and land uses adjacent to the WL site will be able to continue in the future with the Project as the Project will have no effect on land tenure or usage beyond the site boundaries.

Future use of the WL site will depend on the ability to release parts of the site with no restriction on use upon completion of the Project. Future uses/zoning have not been determined, but the end-state plan for the WL site is to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-state. The criteria developed will prioritize the environment and safety while incorporating Traditional knowledge if provided. Indigenous community priorities will also be included provided they align with environmental and safety priorities. Some lands will have restrictions on the future use so that there are no adverse effects to people and the environment as assessed in the safety assessment and modelling associated with the ISD of infrastructure and facilities, such as WR-1 and the Waste Management Area. These areas will require ongoing controls including institutional control, access restrictions and environmental monitoring. However, the amount of land associated with all of these areas is negligible relative to the size of the WL site that will have no restrictions on land use. CNL will be engaging Indigenous communities in a discussion on future uses for the WL site, with site closure planned for early 2027.

The following are the key roles and responsibilities to determine the future use of the WL site:

- AECL owns the site and has responsibility for all assets and liabilities.
- CNL is the contractor responsible to perform the decommissioning and site remediation of the WL site.
- CNL is preparing a Land-Use and End-State Plan defining the end state criteria in collaboration with stakeholders, Indigenous Nations and the public, and will submit it to the CNSC for acceptance.
- CNL informs and engages the public, Indigenous, and other key stakeholders such as the Province of Manitoba.

Changes in the future uses of the site may affect the Local Government District of Pinawa's desire to develop economic activity at the WL site to offset lost jobs due to closure of the site, including nuclear and non-nuclear developments. As noted in Section 6.9 Socio-economic Environment, the previous decommissioning plan for WL, described in the Comprehensive Study Report (AECL 2001), assumed that radioactive wastes would eventually be removed and placed in permanent disposal facilities with the assumption that a national disposal facility for low level radioactive waste would be available by 2025 and a national disposal facility for intermediate-level waste operational by 2050 (CNSC 2002). Under the previous decommissioning plan for WL, described in the Comprehensive Study Report (AECL 2001), a smaller percentage of the site (the Waste Management Area) would have had restrictions on use than with the Project; however, the area with anticipated restrictions on use under the Project is still small when compared with the remainder of the WL site.

While the Project will change the proportion of the site with restricted access and future uses, decommissioning is designed with the environment and safety as a priority. Future use will incorporate Traditional knowledge and CNL will work with Indigenous Nations so their concerns can be considered and aspirations around the site incorporated where feasible. Since the Project will make the WL site safer when compared to baseline conditions and it will increase the amount of land available for future use in the LSA, this pathway was categorized as secondary for both traditional land and resource use and other land and resource use.

The Project in combination with the decommissioning and reclamation of the WL site is also anticipated to contribute to positive effects on the environment, which will positively affect land and resource use within the RSA (e.g., less industrial activity that could affect outdoor recreation, hunting, fishing, trapping and plant and berry gathering). Consequently, cumulative effects from the Project in combination with the decommissioning of the remaining infrastructure and support facilities, and reclamation of the affected areas at the WL site are anticipated to be negligible for both traditional land and resource use and other land and resource use.

contribute to positive effects on the environment, which will positively affect land and resource use within the RSA (e.g., less industrial activity that could affect outdoor recreation, hunting, fishing, trapping and plant and berry gathering). Consequently, cumulative effects from the Project in combination with the decommissioning of the remaining infrastructure and support facilities, and reclamation of the affected areas at the WL site are anticipated to be negligible for both traditional land and resource use and other land and resource use.

8.3.8 Socio-economic Environment

Similar to the other disciplines, the two potential RFDs to overlap with the socio-economic VCs are:

- Decommissioning of remaining infrastructure on the WL site (includes ISD of the low-level waste trenches); and
- Remediation of affected lands, with the exception of the low-level waste trenches.

No new workforce is required for these activities; therefore, there is no overlap of effects with the Project. As such, an RFD Case is not presented as part of the socio-economic assessment.

8.4 Summary

The Project is in a rural area, and no RFDs are expected to overlap spatially or temporally with the Project other than the continued decommissioning of the remaining facilities at the WL site, as described in the CSR (AECL 2001). The CSR (AECL 2001) indicated that closure of the WL site may slightly alter existing conditions; however, effects were predicted to be within applicable guidelines (e.g., air quality, surface water quality, human and ecological health) or negligible (e.g., hydrology, hydrogeology, aquatic environment, and land and resource use). The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the land use and landscape of the day. Therefore, decommissioning of remaining WL structures is also anticipated to result in positive effects for many VCs (e.g., geology, terrestrial environment and land and resource use).

Overall, cumulative effects predicted are anticipated to be negligible after implementation of mitigation measures. As such, there were no cumulative residual effects predicted for the RFD Case (i.e., no determination of significance). A summary of Sections 8.3.1 to 8.3.8 is provided in Table 8.4-1.

Table 8.4-1: Summary of Cumulative Residual Effects for Discipline Assessments

Discipline	Contributing Project Activity	Phase the Project Effect Occurs in	Proposed Mitigation[(a)]	Cumulative Residual Effect
Atmospheric Environment	Closure activities for the Project will overlap with decommissioning of the remaining infrastructure and support facilities at the WL site per the existing decommissioning licence.	Closure Phase	■ Use of dust control measure (e.g., containment and suppression) to control generation of airborne emissions and nuisance dust. ■ Curtailment of activities during periods of adverse meteorological conditions (e.g., during periods of high winds). ■ Maintenance of on-site access routes. ■ Continued implementation of the Environmental Assessment Follow-up Program for the WL site.	Cumulative effects from the Project in combination with the decommissioning of the remaining infrastructure and support facilities and reclamation of the affected areas at the WL site are anticipated to be negligible. Therefore, there are no cumulative residual effects predicted.

Table 8.4-1: Summary of Cumulative Residual Effects for Discipline Assessments

Discipline	Contributing Project Activity	Phase the Project Effect Occurs in	Proposed Mitigation[(a)]	Cumulative Residual Effect
Physical Environment	Decommissioning and reclamation of the entire WL site, including the Project, may alter groundwater quantity.	Closure Phase	■ The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-states. ■ The drainage system for the reclaimed WL site will have physical characteristics similar to natural drainage systems in the general geographic region in terms of dynamic stability, robustness and longevity. ■ The WL site will be graded to promote drainage from the site to the Winnipeg River.	Cumulative effects from the Project in combination with the decommissioning of the remaining infrastructure and support facilities and reclamation of the affected areas at the WL site are anticipated to have a negligible effect on groundwater quantity. Therefore, there are no cumulative residual effects predicted.

Table 8.4-1: Summary of Cumulative Residual Effects for Discipline Assessments

Discipline	Contributing Project Activity	Phase the Project Effect Occurs in	Proposed Mitigation[(a)]	Cumulative Residual Effect
Surface Water Environment	Decommissioning and reclamation of the entire WL site, including the Project, may alter drainage rates and flow patterns, and consequently the discharge volume to Winnipeg River.	Closure Phase	■ The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-states. ■ The drainage system for the reclaimed WL site will have physical characteristics similar to natural drainage systems in the general geographic region in terms of dynamic stability, robustness and longevity. ■ The WL site will be graded to promote drainage from the site to the Winnipeg River.	Changes to discharge volume to from the closure of the WL site, including the Project, are predicted to have a negligible effect on the surface water quality in Winnipeg River. Therefore, there are no cumulative residual effects predicted.

Table 8.4-1: Summary of Cumulative Residual Effects for Discipline Assessments

Discipline	Contributing Project Activity	Phase the Project Effect Occurs in	Proposed Mitigation[a]	Cumulative Residual Effect
Surface Water Environment	Decommissioning and reclamation of the entire WL site, including the Project, may alter drainage rates and flow patterns as current precipitation management is removed. Consequently, the discharge volume to Winnipeg River may change, which may alter surface water quality.	Closure Phase	■ The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-states. ■ The drainage system for the reclaimed WL site will have physical characteristics similar to natural drainage systems in the general geographic region in terms of dynamic stability, robustness and longevity. ■ The WL site will be graded to promote drainage from the site to the Winnipeg River.	Changes to drainage rates and flow patterns volume to from the closure of the WL site, including the Project, are predicted to have a negligible effect on the surface water quality in Winnipeg River. Therefore, there are no cumulative residual effects predicted.

Table 8.4-1: Summary of Cumulative Residual Effects for Discipline Assessments

Discipline	Contributing Project Activity	Phase the Project Effect Occurs in	Proposed Mitigation[a]	Cumulative Residual Effect
Aquatic Environment	Decommissioning and reclamation of the entire WL site, including the Project, may alter drainage rates and flow patterns, and subsequently fish and fish habitat.	Closure Phase	■ As part of CNL's licence with the CNSC, environmental monitoring around the WL site will continue for the Project. ■ Follow-up monitoring as part of the Environmental Assessment Follow-up Program during the post-closure phase will continue to verify effect predictions and to provide information for use in adaptive management to address potential unforeseen effects.	Cumulative effects from the Project in combination with the decommissioning of the remaining infrastructure and support facilities and reclamation of the affected areas at the WL site are anticipated to have a negligible on fish populations. Cumulative effects to surface water quality from the closure of the WL site, including the Project, are predicted to have a negligible effect on the fish populations, including species at risk. Therefore, there are no cumulative residual effects predicted.
	Release of chemical and radiological contaminants in the long-term from the closure of the entire WL site, in combination with the Project.	Post-closure Phase		
Terrestrial Environment	Decommissioning and reclamation of the entire WL site, including the Project.	Closure Phase	■ Follow-up monitoring as part of the Environmental Assessment Follow-up Program during the post-closure phase will continue to verify effect predictions and to provide information for use in adaptive management to address potential unforeseen effects.	Effects of RFDs in the RSA are expected to be primarily positive, because activities will focus on decommissioning existing infrastructure. Therefore, an RFD Case is not presented as part of the terrestrial environment assessment.

Table 8.4-1: Summary of Cumulative Residual Effects for Discipline Assessments

Discipline	Contributing Project Activity	Phase the Project Effect Occurs in	Proposed Mitigation[a]	Cumulative Residual Effect
Human and Ecological Health	Decommissioning and reclamation of the entire WL site, including the Project.	Closure Phase	■ Follow-up monitoring as part of the Environmental Assessment Follow-up Program during the post-closure phase will continue to verify effect predictions and to provide information for use in adaptive management to address potential unforeseen effects.	Current effects from the existing facilities and operations at the WL site are considered part of the Base Case (i.e., existing conditions), and as such an RFD Case is not applicable to the human and ecological health assessments.
Land and Resource Use	Decommissioning and reclamation of the entire WL site, including the Project, may change the future land tenure and uses of the WL site.	Post-closure Phase	■ The end-state plan for the WL site will be to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria to achieve the planned end-states. ■ Affected areas will be remediated to meet the WL screening soil cleanup and the non-radiological and radiological clearance and release criteria in accordance with the target end state of the associated land-use category.	Cumulative effects from the Project in combination with the decommissioning of the remaining infrastructure and support facilities, and reclamation of the affected areas at the WL site are anticipated to be negligible. Therefore, there are no cumulative residual effects predicted.
Socio-economic Environment	Decommissioning and reclamation of the entire WL site, including the Project.	Not applicable	■ Not applicable	No new workforce is required for these activities; therefore, there is no overlap of effects with the Project. As such, an RFD Case is not presented as part of the socio-economic assessment.

a) Some mitigation efforts are within the scope of the Project, and others are as identified for other projects (e.g., as identified in the CSR).

CNSC = Canadian Nuclear Safety Commission; CSR = Comprehensive Study Report.

9.0 SUMMARY OF SIGNIFICANCE OF RESIDUAL EFFECTS

9.1 Introduction and Approach

The following assessments were completed to evaluate the biophysical and human environment effects of In Situ Decommissioning of WR-1 at the Whiteshell Laboratories Site (the Project) and to satisfy the requirements of the review being undertaken under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012):

- Section 6.2 Atmospheric Environment;
- Section 6.3 Geological and Hydrogeological Environment;
- Section 6.4 Surface Water Environment;
- Section 6.5 Aquatic Environment;
- Section 6.6 Terrestrial Environment;
- Section 6.7 Human and Ecological Health;
- Section 6.8 Land and Resource Use; and
- Section 6.9 Socio-economic Environment.

The approved decommissioning approach for the Whiteshell Laboratories (WL) site, as described in the Comprehensive Study Report (CSR; AECL 2001), was to remove all facilities with the exception of low level waste trenches in the Waste Management Area, and existing contaminated river sediments, which may be managed through on-site in situ disposal (ISD). Canadian Nuclear Laboratories (CNL) is applying for an amendment to the current decommissioning licence to carry out the Project, rather than dismantling and demolition as previously assessed in the CSR. The in situ disposal approach includes partial dismantling and demolition along with passive, permanent disposal of the below-grade portions of Whiteshell Reactor 1 (WR-1). In situ disposal is a proven decommissioning approach that increases worker safety, provides protection of the environment and the public, reduces interim storage and multiple handling, enables permanent nuclear liability reduction, and utilizes fewer resources.

The Project activities are limited to ISD of the WR-1 Building. Other decommissioning activities for the WL site, documented in the CSR, have not changed and do not need to be reassess. Removal of the east annex and south service wing of the WR-1 Complex were assessed as part of the CSR and are covered under the CNL's existing decommissioning licence for the WL site (Licence No. NRTEDL-W5-8.00/2024). Some activities required to prepare for ISD, such as isolation of the WR-1 Complex and targeted remediation of hazardous materials, are also covered under CNL's existing decommissioning licence for the WL site.

The closure phase for the Project includes preparation for and implementation of ESD, which includes grouting of below-grade structures and systems, removal of above-grade WR-1 Building structures and systems, installation of the concrete cap and engineered cover, and environmental controls and final site restoration. These activities last from 2022 to 2027. The post-closure phase has two discrete periods: institutional control and post-institutional control. Institutional control is estimated to last a minimum of 100 years, during which long-term monitoring and maintenance activities will continue, to demonstrate compliance with the safety case assumptions. Although the duration of institutional control is estimated at a minimum of 100 years, it is recognized that it will continue until

the Canadian Nuclear Safety Commission (CNSC) agrees institutional controls are no longer needed. Post-institutional control occurs after year 2127 and continues indefinitely; however, the timeframe defined for the assessment of potential effects, as part of the normal evolution of the Project's safety assessment is 10,000 years. This timeframe (i.e., 10,000 years) encompasses the phase in which peak effects are anticipated.

A residual adverse environmental effect is an effect that remains, or is predicted to remain, after mitigation has been implemented (The Agency 2015). Therefore, they are the expected consequences of the Project for the selected valued components (VCs). Interactions (linkages) between Project components or activities and the corresponding potential effects on VCs are identified by a pathway or screening analysis (see Section 6.1.6 Project Interactions and Mitigation for a more detailed description of the pathway analysis). For some interactions, there are proven effective mitigation or best management practices that would eliminate or reduce the potential effect to a negligible level. These interactions are not advanced for further assessment. Interactions that require further analysis were advanced to the residual effects analysis step (see Section 6.1.7 Residual Effects Analysis for a detailed description). A matrix table is included in Appendix 6.1-1 summarizing Project interactions for each VC that are determined to be no linkage, secondary, or primary, after consideration of environmental design features and mitigation.

The residual effects analysis is based on the Project interactions that are determined to be primary in the pathway analysis. For primary pathways, the concept of assessment cases is applied to estimate the incremental and cumulative effects from the Project, as well as previous, existing and reasonably foreseeable developments. The residual effects analysis is completed for the Application Case and the Reasonably Foreseeable Developments (RFD) Case. This Application Case scenario represents predictions of the cumulative effects of the existing environment combined with the effects that may result from the Project. The RFD Case scenario includes the Application Case plus additional RFDs in the region. Developments and activities that are currently under application review or have officially entered a regulatory application process were considered reasonably foreseeable.

The residual effects classification of primary pathways provide the foundation for determining the significance of incremental and cumulative effects from the Project and other existing, approved and reasonably foreseeable developments on VCs. The purpose of the residual effects classification is to describe the residual incremental and cumulative adverse effects from the Project and other developments on VCs using a common set of criteria. The classification criteria provide definitions that permit a clear, thorough and unambiguous classification of residual effects such that reviewers and readers can follow and apply the logic used in the assessment. Effects are classified using the following criteria, which follows the *Generic Guidelines for the Preparation of an Environmental Impact Statement Pursuant to the Canadian Environmental Assessment Act, 2012* provided by the Canadian Nuclear Safety Commission (CNSC 2016) and the *Operational Policy Statement Determining Whether a Designated Project is Likely to Cause Significant Adverse Environmental Effects under the Canadian Environmental Assessment Act, 2012* (The Agency 2015). The residual effects classification is then used to make significance determinations.

- **Direction –** Direction indicates whether the residual effect on a VC is negative, positive or neutral (i.e., no change). Neutral and positive changes are not assessed for significance.
- **Magnitude –** Magnitude is a measure of the intensity of a residual effect, or the degree of change caused by the Project (and other developments, if applicable) relative to baseline conditions, guidelines or threshold values. Magnitude is typically classified into three scales: negligible to low, moderate and high.

- **Geographic Extent –** This criterion refers to the spatial extent of the effect, and is different from the spatial boundary (i.e., study area) for the residual effects analysis. The geographic extent of residual effects can occur on multiple scales within the spatial boundary of the assessment. Geographic extent is often categorized into three scales: local, regional and beyond regional.
- **Duration –** Duration is defined as the amount of time (usually in years) from the beginning of a residual effect on a VC to when the residual effect is reversed and is expressed relative to Project phases. Duration has two components. It is the amount of time between the start and end of a Project activity or stressor (which is related to Project development phases), plus the time required for the residual effect to be reversed. Duration is often categorized as short-term, medium-term and long-term.
- **Reversibility –** After removal of the Project activity or stressor, reversibility is the likelihood that the Project will no longer influence a VC in a future predicted period. Reversibility usually has only two alternatives: reversible or irreversible. The period is provided for reversibility (i.e., duration) if a residual effect is reversible. Permanent residual effects are considered irreversible.
- **Frequency –** Frequency refers to how often a residual effect will occur and may be expressed as isolated, periodic or continuous. Frequency is explained more fully by identifying when the residual effect occurs (e.g., once at the beginning of the Project). If the frequency is periodic, then the length of time between occurrences and the seasonality of occurrences (if present) is discussed.
- **Likelihood –** Likelihood is the probability of an effect occurring and is described in parallel with uncertainty. This criterion may be influenced by a variety of factors, such as the likelihood of disturbance occurring or the likelihood of mitigation being successful. Four classification categories are typically used: unlikely, possible, likely and highly likely.

The intent of the environmental assessment is to predict if the Project is likely to cause a significant adverse effect on the environment or to cause public concern. Only residual effects that are adverse are considered in the determination of significance under CEAA 2012 (The Agency 2015). Consequently, neutral and positive residual effects are reported; however, they are not assessed for significance.

The classification of residual adverse effects and the determination of significance was completed only for those VCs that have assessment endpoints. Assessment endpoints are qualitative expressions used to assess the significance of residual effects on VCs. Assessment endpoints are typically not quantifiable and require the identification of one or more measurement indicators that can be directly linked to the assessment endpoint. Measurement indicators represent properties of the environment and VCs that, when changed, could result in or contribute to an effect on assessment endpoints. Measurement indicators may be quantitative (e.g., changes to ambient concentrations of criteria air contaminants) or qualitative (e.g., continued sustainability and overall well-being of communities in proximity of the Project). The significance of effects from the Project on VCs was evaluated by linking changes in measurement indicators to effects on the assessment endpoints. For example, changes to ambient concentrations of criteria air contaminants (measurement indicators) were used to assess the Project's performance against criteria and thresholds for the protection of human health and the environment (an assessment endpoint) to identify and classify residual adverse effects of the Project on the air quality VC.

The evaluation of significance for VCs considered the entire set of primary pathways that influence a particular assessment endpoint, which means that the relative contribution of each pathway was used to determine the significance of potential adverse effects of the Project and other developments on an assessment endpoint (see Section 6.1.9.2 Determination of Significance for additional detail on the approach).

All VCs have measurement indicators, but not every VC has an assessment endpoint (e.g., geology, hydrogeology and surface water). Valued components with no assessment endpoint were still analyzed for Project-specific and cumulative (if applicable) changes in measurement indicators, but the classification of residual effects and the determination of significance was not completed for these VCs. Instead, the results of the analysis for these VCs are provided to other disciplines (e.g., aquatic and terrestrial environment, human health) for inclusion in their residual effects analysis, where applicable (see Section 6.1.3 Valued Components and Figures 6.1.3-1 and 6.1.3-2 for additional detail on the approach).

9.2 Summary of the Significance of Residual Effects

9.2.1 Atmospheric Environment

9.2.1.1 Air Quality

Air quality was selected as a VC because there is a potential for the Project activities to release air emissions that could affect the local air quality. The assessment endpoint for air quality is performance against the criteria and thresholds for protection of human health and the environment. The measurement indicators for air quality include changes in ambient concentrations of indicator compounds in comparison to the provincial or federal ambient air quality criteria.

The assessment of effects of the Project on air quality involves two steps, namely the calculation of emission rates (which include the implementation of mitigation), and dispersion modelling to predict the resulting concentrations of indicator compounds. During the Application Case, Project activities will result in emissions associated with the operation of vehicles and equipment, as well as material handling emissions from the demolition and grouting and temporary batch mixing plant or other similar equipment.

Mitigation practices to limit predicted residual effects to air quality during the closure phase are available, including:

- implementation of CNL's Environmental Protection Program and Procedure for Management and Monitoring of Emissions, which includes operational control monitoring, air verification monitoring and environmental monitoring;
- implementation of dust management techniques;
- on-site vehicles and equipment engines will meet a minimum of Tier 3 emission standards, where possible, and be maintained in good working order;
- limit idling of vehicles on-site and limit speed on roads; and
- use of enclosures for raw material handling.

Air quality is predicted to be affected by the Project. Fugitive dust from vehicle movement on roads is the largest contributor to suspended particulate matter, particles nominally smaller than 10 micrometre (µm) in diameter, and particles nominally smaller than 2.5 µm in diameter (Section 6.2.1 Air Quality). Non-road equipment exhaust emissions are the largest contributors to oxides of nitrogen (as nitrogen dioxide) and carbon monoxide emissions. Finally, the largest contributor to sulphur dioxide emissions is fuel combustion for emergency power generators.

For an effect to be deemed significant for air quality, the effect on an indicator compound must be adverse, exceed relevant guideline/standard (high in magnitude), and extend beyond the air quality Local Study Area (LSA), but be contained within the air quality Regional Study Area (RSA; regional in geographic extent) and irreversible or only reversible following completion of the Project phases (long-term in duration). The direction is negative for all

indicator compounds; however, the magnitude of changes to indicator compound emissions are predicted to be low to moderate as the predicted concentrations of each indicator compound from the Application Case are below their relevant guideline/standard. The predicted effects are limited to the air quality RSA, and therefore the geographic extent of changes to all indicator compounds is regional for the Application Case. Although there are planned stages for the closure phase beyond the Application Case (Phases 4 to 6), emissions of indicator compounds during these phases will be lower than the Application Case; therefore, the duration of effect is conservatively considered to be short-term. Criteria air contaminants will be emitted continuously or near-continuously during the Application Case and, therefore, the frequency of effect is frequent. The likelihood of emissions from the Project changing indicator compound concentrations for the Application Case is high.

Based on the low to moderate magnitude, the regional geographical extent of the effect and the short-term duration, the overall residual adverse effect of the Project on air quality is determined to be not significant (Section 6.2.1 Air Quality).

The Project is not anticipated to result in a change in the conclusions of the 2001 Comprehensive Study Report related to air quality. As such, the Project is not expected to contribute cumulatively to the effects of decommissioning of the remaining infrastructure and support facilities at the WL there is no cumulative effect predicted for the RFD case.

Implementation of CNL's *Management and Monitoring of Emissions* (CNL 2018), which includes operational control monitoring, air verification monitoring and environmental monitoring, will continue for the Project. In addition, CNL will implement an Environmental Assessment Follow-up Program for the Project to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented (Section 11.0 Summary of Monitoring and Follow-up Programs). This monitoring will be integrated with that for the existing Environmental Assessment Follow-up Program for the WL site, where practical. CNL will continue to proactively seek, engage, and support meaningful discussions with First Nations and the Manitoba Métis Federation and communities of interest on issues and opportunities related to the Project, including the monitoring and follow-up program.

9.2.1.2 Greenhouse Gases

Climate change was selected as a VC for the greenhouse gas (GHG) assessment as there is a potential for the Project activities to release GHGs that could contribute incrementally to climate change. The assessment endpoint for climate change is comparison to provincial and national totals. The measurement indicators considered in the climate change assessment include changes in concentrations of carbon dioxide, methane, and nitrous oxide. There are no Project activities that are expected to emit sulphur hexafluoride, perfluorocarbons or hydrofluorocarbons; therefore, these compounds are not included in the GHG assessment.

Project activities will result in GHG emissions associated with the operation of vehicles and equipment. Mitigation practices to limit GHG emission during the closure phase are available, including:

- implementation of CNL's Environmental Protection Program and Procedure for Management and Monitoring of Emissions, which includes operational control monitoring, air verification monitoring and environmental monitoring;
- on-site vehicles and equipment engines will meet a minimum of Tier 3 emission standards, where possible, and be maintained in good working order; and
- limit idling of vehicles on-site and limit speed on roads.

Project activities will result in greenhouse gas emissions associated with the operation of vehicles and equipment. The greenhouse gas emissions are estimated to be less than 0.1% of the total provincial greenhouse gas emissions and less than 0.01% of the total national greenhouse gas emissions. Based on the comparison between the estimated annual emission to both the federal and provincial greenhouse gas emissions, the Project will result in minor releases of greenhouse gases, but is predicted to have a negligible effect on climate change and will not impact Canada's emission reduction efforts. In 2015, Canada represented less than 2% of total global greenhouse gas emissions. Therefore, any greenhouse gas emissions from the Project may be considered negligible on a global scale. Based on these estimates, no primary pathways were identified for the GHG assessment (Section 6.2.2 Greenhouse Gases). Subsequently, there is no further residual effects classification and determination of significance of GHG.

9.2.2 Geology and Hydrogeology

9.2.2.1 Geology

Geology, which includes bedrock, soils and geomorphology, is recognized as an important component of the environment that may be affected by the Project. Acknowledging that changes to geology could lead to effects on other VCs, geology is referred to as an intermediate component (i.e., it does not have an assessment endpoint). The measurement indicators for geology include changes in soil quality, soil quantity, bedrock and geomorphology.

Potential effects on geology are limited to changes in soil quantity and quality as a result of construction of temporary supporting infrastructure, and changes to soil quality from air emissions and groundwater transport from the WRDF into the groundwater. The assessment of potential pathways of effects determined there are no primary pathways that would lead to residual effects on geology (Section 6.3.1 Geology). The results of the analysis of changes in measurement indicators for geology are provided to other VCs for inclusion in their assessment.

9.2.2.2 Hydrogeology

Hydrogeology is recognized as an important component of the environment that may be affected by the Project and changes to hydrogeology could, in turn, lead to effects on other VCs selected for assessment. Acknowledging that changes to hydrogeology is an important aspect of the natural and human environment, hydrogeology is referred to as an intermediate component (i.e., it does not have an assessment endpoint). The measurement indicators for hydrogeology include groundwater flow patterns and discharge rates, groundwater table elevations, and peak solute mass loadings of contaminant in groundwater to the Winnipeg River.

Changes to groundwater quality from the Project due to the release of solutes into the groundwater as the grout and reactor components gradually deteriorate over time was identified as having a residual adverse effect on the hydrogeological environment. Environmental design features and mitigation implemented to reduce residual effects on groundwater quality include:

- installation of a concrete cap and engineered cover to mitigate moisture infiltration into the Whiteshell Reactor Disposal Facility (WRDF);
- removal of the service area and infilling in these areas with compacted clay-based soil;
- sealing of open conduits in the building foundation;
- grouting the interior portion of the building (containing the remaining components of WR-1) to ground surface elevation; and

- monitoring will be completed throughout the institutional control period for the Project to confirm that the cover and grout is functioning as intended and to confirm modelling predictions.

Groundwater flow and solute transport modelling was completed to provide estimates of solute mass loadings during the post-closure phase (Section 6.3.2 Hydrogeology). The Winnipeg River was identified by the post-decommissioning groundwater flow model as the principal receptor of groundwater discharge from the geological pathway. The Winnipeg River is also of high importance to Indigenous peoples.

Mass flux rates from 56 radiological parameters, along with 29 non-radiological elements, were simulated in the groundwater flow and transport modelling. The groundwater flow modelling indicated that the mean advective groundwater travel times to the Winnipeg River were an estimated 100 years. The peak total activity level from the simulations occurs after approximately 70 years and is principally related to the migration of tritium from WR-1. Due to dispersion, the finite amount of tritium in the source (grout) and the half-life associated with tritium (approximately 12 years), its peak arrival to the Winnipeg River occurs earlier than the mean advective groundwater travel time.

Because hydrogeology is an intermediate component, the hydrogeology assessment does not include a determination of significance; rather, results of the analysis of changes in measurement indicators for hydrogeology are provided to other disciplines for inclusion in their assessment. Results of the groundwater assessment are used in the surface water quality assessment (Section 6.4.2 Surface Water Quality) and the human and ecological health assessment (Section 6.7 Human and Ecological Health.

CNL will continue to implement the Environmental Assessment Follow-up Program for the WL site to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. CNL will provide First Nations and the Manitoba Métis Federation with the opportunity to participate in the implementation and review of mitigation measures. For monitoring requirements arising from the Project, but not covered in the Environmental Assessment Follow-up Program, appropriate procedures will be developed that will meet or exceed federal and provincial regulatory requirements. A post-closure monitoring program will also be developed that will provide the sampling and analysis objectives and procedures for sampling and testing the groundwater quality in the vicinity of the WR-1 Building.

9.2.3 Surface Water Environment

9.2.3.1 Hydrology

Hydrology, which includes surface water flow and drainage direction, is recognized as an important component of the environment that may be affected by the Project. Acknowledging that changes to hydrology could lead to effects on other VCs, hydrology is referred to as an intermediate component (i.e., it does not have an assessment endpoint).

The assessment considers the potential effects of the Project to the flows and water levels of the Winnipeg River. The WL site will be graded to promote drainage from the site to the Winnipeg River. Natural runoff from the decommissioned WL site will continue to discharge to the Winnipeg River during the post-closure phase. In addition, the overall contribution of WL site drainage to the Winnipeg River flow is negligible, thus no effects are anticipated. The assessment of potential pathways of effects determined there are no primary pathways that would lead to residual effects on hydrology (Section 6.4.1 Hydrology). The results of the analysis of changes in measurement indicators for hydrology are provided to other disciplines for inclusion in their assessment.

9.2.3.2 Surface Water Quality

Surface water quality is recognized as an important component of the environment that may be affected by the Project. Acknowledging that changes to surface water quality could lead to effects on other VCs, surface water quality is referred to as an intermediate component (i.e., it does not have an assessment endpoint). The measurement indicators for surface water quality include changes to ambient levels of surface water contaminants.

During the post-closure phase, groundwater may encounter the Whiteshell Reactor Disposal Facility and then flow to the Winnipeg River, resulting in changes to surface water and sediment quality. The predicted maximum radionuclide concentrations in surface water at both the Nearfield and the Farm A Intake on the Winnipeg River are orders of magnitude lower than background groundwater concentrations. Predicted sediment concentrations of radionuclides are lower than their respective clearance levels.

Predicted maximum non-radionuclide concentrations in surface water and sediment are driven by current river concentrations and some parameters exceed available surface water or sediment guidelines. For example, the background concentration for lead exceeds the lowest available guidelines for surface water and sediment, but the maximum sediment concentrations at both the Nearfield and the Farm A intake in both surface water and sediment show no change from the background level as a result of the Project.

Overall, the assessment of potential effects determined there are negligible residual adverse effects on surface water and sediment quality from changes in groundwater quality (Section 6.4.2 Surface Water Quality). Because surface water quality is an intermediate component, the assessment does not include a determination of significance; rather, results of the analysis of changes in measurement indicators for surface water quality are provided to other disciplines for inclusion in their assessment.

CNL will continue to implement the Environmental Assessment Follow-up Program for the WL site to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. CNL will provide First Nations and the Manitoba Métis Federation with the opportunity to participate in the implementation and review of mitigation measures.

9.2.4 Aquatic Environment

For the aquatic environment, fish and fish habitat was selected as a VC as there is a potential for the Project activities to affect aquatic biota in the Winnipeg River. The fish and fish habitat valued component includes the fish species identified by the First Nations and the Red River Métis that are occurring in the Winnipeg River, as well as habitats supporting life history requirements including spawning, nursery, rearing and foraging. The assessment endpoint for the aquatic environment is the maintenance of self-sustaining and ecologically effective fish populations. The measurement indicators for the aquatic environment include measurable attributes that broadly represent various facets of the aquatic environment, including fish habitat (quality and quantity), benthic invertebrate community structure and fish community structure.

During closure, potential effects to fish and fish habitat include the transport of site surface water runoff to the Winnipeg River in the vicinity of the Whiteshell Laboratories site, changes in drainage rates and flow patterns due to the installation of the concrete cap and engineered cover at the Whiteshell Reactor 1 Building, and deposition of air emissions from demolition activities. The Project is not anticipated to affect the physical habitat of the Winnipeg River. With Implementation of a storm water management plan and Canadian Nuclear Laboratories' *Management and Monitoring of Emissions*, site runoff and air and dust emissions are not predicted to impact the

surrounding aquatic environment. As such, closure activities are predicted to have a negligible residual effect on fish and fish habitat.

An Ecological Risk Assessment was completed and for the post-closure phase, it evaluates the potential for adverse effects on aquatic health associated with exposure to chemical and radiological contaminant releases through the groundwater pathway from the WRDF in the long-term. There are no exceedances of the radiation benchmark for the aquatic biota in the Winnipeg River and all predicted doses are well below this level. Therefore, it is unlikely there would be significant adverse effects on aquatic populations or communities as a result of radionuclide releases in the long-term during the post-closure phase.

There are no exceedances of the hazard quotients identified for exposure of the aquatic receptors to non-radionuclides, with the exception of benthic invertebrates in groundwater. The hazard quotients for cadmium, lead and HB-40 exceeded 1 for the scenario where benthic invertebrates are exposed directly to groundwater. The assessment conservatively assumes the organisms spend their entire lives in the peak discharge zone, and that no dilution of the groundwater occurs in the shallow sediment layers where most benthic organisms reside. Moreover, the seepage area represents a small part of the benthic community habitat, and the maximum groundwater concentration assumed represents the worst-case period. As such, a realistic benthic invertebrate population is not likely to be at risk due to cadmium, lead and HB-40 exposure, and any adverse effects will be spatially and temporally limited. Overall, the changes in water quality and sediment quality are expected to result in a negligible residual effect to the benthic invertebrate population relative to existing conditions.

The assessment of potential pathways of effects determined there are no primary pathways that would lead to residual effects on the aquatic environment VCs. As such, there is no further residual effects classification and determination of significance for the aquatic environment (Section 6.5 Aquatic Environment).

Monitoring and follow-up programs for the aquatic environment are not identified specific to the Project as there are no predicted residual effects to fish and fish habitat. However, CNL will implement an Environmental Assessment Follow-up Program for the Project as identified for other environmental components (e.g., groundwater quality and surface water quality) to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. This monitoring will be integrated with that for the existing Environmental Assessment Follow-up Program for the WL site, where practical.

9.2.5 Terrestrial Environment

Based on the nature of this project and limited pathways of effects on natural terrestrial ecosystems, the focus of this assessment is at a species-level and primarily focuses on wildlife species identified on Schedule 1 of the federal *Species at Risk Act*. All listed wildlife species with the potential to occur within the WL site (or with confirmed occurrence records) were considered as potential VCs at the species level. The VCs assessed for the terrestrial environment include barn swallow, golden-winged warbler, bats and snapping turtle due to their potential to be present within the local area. The assessment endpoint for the terrestrial environment is the maintenance of self-sustaining and ecologically effective populations. Habitat availability, habitat distribution and survival and reproduction were selected as the measurement indicators..

Traditional Knowledge and Land Use Studies and Indigenous engagement identified additional valued components (i.e., white-tailed deer, moose, elk, porcupine, furbearers, grouse, geese, ducks, and waterfowl) for consideration in the terrestrial effects assessment. Project activities occur within the WL site on previously disturbed areas; therefore, there are no direct effects to habitat availability and distribution for the above listed species. In addition, indirect effects of the building demolition works (noise, equipment use) was deemed to be of

low risk to wildlife in natural areas adjacent to the fenced campus, and they were considered to be unlikely to occur within the fenced campus. Although, these species were not selected as valued components for the terrestrial assessment, they (or representative species) were included in the effects assessment for ecological health.

During closure, the Project will generate air and dust emissions from demolition activities. With implementation of CNL's *Management and Monitoring of Emissions*, there is predicted to be negligible effects on the terrestrial environment from the Project as a result of air and dust emissions. Sensory disturbance, road mortality, and loss of nest/roost substrate also have the potential to affect terrestrial VCs during closure. Surveys during the appropriate season, to be undertaken the year prior to initiation of decommissioning activities, will confirm whether nesting and/or roosting activity is occurring in the WR-1 Building. If evidence of nesting or roosting activity is found, appropriate mitigation in the form of deterrents will be implemented, under consultation with Environment and Climate Change Canada and in accordance with habitat protection provisions and the required permitting process under the *Species at Risk Act* and potentially the *Migratory Birds Convention Act*. The objective of the selected mitigation will be to prevent birds and bats from accessing the building during the period when it will be demolished. The potential for road mortality of snapping turtle will be addressed through adaptive management and ongoing monitoring and documentation of road mortalities. If road mortality of snapping turtle occurs, additional mitigation will be enacted, as required. Following implementation of mitigation and monitoring in an adaptive management framework, there is predicted to be negligible effects on the terrestrial environment as a result of the Project.

An Ecological Risk Assessment was completed and for the post-closure phase, it evaluates the potential for adverse effects on terrestrial biota associated with exposure to chemical and radiological contaminant releases in surface water through the groundwater pathway from the WRDF in the long-term. There are no exceedances of the radiation benchmark for terrestrial biota and all predicted doses are well below this level. There are also no exceedances of the hazard quotients identified for exposure of the terrestrial receptors to cadmium, lead, HB-40 and xylene. Therefore, changes in surface water quality through the groundwater pathway are expected to result in negligible residual effect to terrestrial populations or communities in the long-term during the post-closure phase. Because the Ecological Risk Assessment found the predicted doses would be far below any effect level, no significant effects are predicted for the VCs identified by Indigenous peoples.

Overall, the assessment of potential pathways of effects determined there are no primary pathways that would lead to residual effects on terrestrial VCs (Section 6.6 Terrestrial Environment). Although no residual effects on terrestrial VCs are predicted, monitoring programs are described as possible proactive mitigation by CNL and includes consideration of all future decommissioning and building demolition activities that will occur on the WL site. In addition, CNL will implement an Environmental Assessment Follow-up Program for the Project as identified for other environmental components to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. This monitoring will be integrated with that for the existing Environmental Assessment Follow-up Program for the WL site, where practical.

9.2.6 Human and Ecological Health

9.2.6.1 Human Health

Specific to the Project, the human health risk assessment focused on public and Indigenous peoples' health and the health of WL site workers not involved in performing Project activities. Consistent with CSA N288.6-12, Nuclear Energy Workers directly involved in performing Project activities were not assessed because their potential doses are controlled through CNL's Radiation Protection Program. The assessment for public and Indigenous peoples' health considered locations where people are known to be present.

The assessment endpoint is the protection of human health. Measurement endpoints for the human health assessment include changes in air quality, groundwater quality and surface water quality. The receptors for the Human Health Risk Assessment were selected to be appropriate for assessment of both radiological and non-radiological stressors on human health. The most-affected off-site members of the public are defined as the "critical group", which include:

- Farms A and F (year-round occupants with livestock);
- On-site Farm (post-institutional control only); and
- Harvesters (traditional users of the area gathering local foods).

The residual effects analysis methods for the HHRA are different in some notable ways from those used by other VCs. Specifically, the assessment of potential effects to human health VCs results in the generation of risk factors that inherently consider the geographic extent, duration, frequency and other characteristics of the predicted changes to the environment that may result from Project activities. As such, these inherent attributes cannot be used to determine environmental significance, as they can with other components. Instead, significance for human health is evaluated based on: (i) the potential magnitude of the response, as indicated by the comparison to benchmarks and (ii) the degree of conservatism and uncertainty in the analysis.

For the closure phase, the relevant COPCs are expected to be released via atmospheric releases from the WR-1 Building as reactor systems are dismantled, transported off-site or disposed of in situ within the WRDF. The closure activities are well encompassed by existing engineering and administrative controls currently in place at the WL site. The calculated radiological doses for the human receptors during closure (i.e., Farm A, Farm F, and downstream Harvester) are all below the CNSC public dose limit of 1 mSv/a, as well as the dose constraint for the Project of 0.25 mSv/a. Since the dose estimates are a small fraction of the public dose limit, no discernable health effects are anticipated due to exposure to radioactive releases from Project activities. Doses to workers will be monitored and managed as part of CNL's Radiation Protection Program. The application of the Radiation Protection Program ensures that exposures will be kept ALARA and below the effective dose limit of 100 mSv over 5 years, and below 50 mSv in any single year.

The post-closure phase is not expected to result in airborne effluent, as the grouting will have been completed, the above-grade building will have been completely decommissioned and a concrete cap and engineered soil cover will have been installed over the WRDF. The relevant COPCs are expected to be released via groundwater to the surface water. The total radiation dose to human receptors during the post-closure phase (i.e., Normal Evolution Scenario) are below the Canadian Nuclear Safety Commission public dose limit of 1 mSv/a, as well as the dose constraint for the Project of 0.25 mSv/a. Since the dose estimates are a small fraction of the public dose limit, no discernable health effects are anticipated due to exposure of potential critical groups to radioactive releases from the WL site during post-closure.

The doses to human receptors that could be exposed to the non-radiological COPCs (i.e., cadmium and lead) in surface water during post-closure were calculated based on total concentration (background plus Project contribution). The hazard quotients derived for COPCs were below the protective benchmark for all receptors and pathways, other than the river drinking water pathway. If only the Project contribution is considered, the hazard quotients are well below the protective benchmark, indicating the Project contribution to the risk is minimal. Although uncertainties in the assessment exist, conservatism, such as using the highest release rates, has been included in the modelling so that residual effects are not greater than predicted.

A number of disruptive events were assessed to address uncertainties that arose during the definition of scenarios and conceptual models, with three bounding scenarios (disruptive events with the potential for greatest consequence) identified. These were:

- Inadvertent Human Intrusion: an exploration borehole drilled into the WRDF and exposure of wastes;
- Substantial Failure of In Situ Disposal Structure (WRDF Barrier Failure); and
- Well in Plume: an on-site resident drinking groundwater from a well capturing the plume from the WRDF.

For all bounding scenarios, the total radiation dose to human receptors during the post-closure phase are below the IAEA Upper Reference Level for Disruptive Events of 20 mSv/a. For exposure to non-radiological COPCs (i.e., cadmium and lead), the HQ exceeded the target values for some scenarios. However, the assessment was conservatively conducted to predict exposures to human receptors under these future unlikely conditions. Further, controls can be put in place to reduce the probability of the Disruptive Events (e.g., land use restrictions during post-institutional control period to reduce the likelihood of a human intrusion event).

A key concern of Indigenous peoples was effects to the health of harvesters from consuming fish, plants, and wildlife in the vicinity of the WL site. The approaches to exposure and toxicity assessment have ensured that the characterization of dose and risk has been undertaken in a manner that has not underestimated dose or risk. Overall, residual effects from radiological and non-radiological COPCs are considered to be not significant for all human health valued components, including harvesters, during the closure and post-closure phases (Section 6.7.1 Human Health).

As part of the CNL's licence (NRTEDL-W5-8.00/2024), environmental monitoring of the WL site is required. It is anticipated that for closure, the monitoring at the WL site and surrounding area will continue in accordance with CNL's existing Environmental Monitoring Program. The Environmental Assessment Follow-up Program for the Project will be undertaken during the closure and post-closure phases. Once the WL site has been decommissioned, monitoring to support institutional control will continue, as well as any other requirements identified in the Environmental Assessment Follow-up Program for the Project.

CNL has committed to working collaboratively with the First Nations and the Manitoba Métis Federation to support each Indigenous Nation to participate in environmental monitoring at the WL site. Some of the key elements of the initiative may include expansion and evolution of the monitoring program at WL, through incorporation of feedback, recommendations, Traditional Knowledge, capacity development, including training in environmental monitoring, and opportunities for monitors from each First Nation and the Red River Métis to collect samples on site and in the surrounding area.

9.2.6.2 Ecological Health

The scope of the Ecological Health Assessment focuses on evaluating the potential health effects to non-human biota (plants and animals) from Project activities. It is generally an impractical task to assess the effect of radiological and non-radiological emissions on every species of biota within a natural ecosystem, and specifically within the ecosystem around the WL site. Therefore, representative organisms are chosen for dose and risk analysis. These organisms are selected because they are known to exist on site and are representative of major taxonomic groups or exposure pathways or have a special importance or value. CNL verified the list of important species identified by each Indigenous Nation to confirm that each was adequately represented by the selected representative organisms. Based on feedback from Indigenous peoples during engagement activities, moose was added as a VC to the ecological health assessment given the species importance to Indigenous people.

An environmental transport and pathways model was used to evaluate the effects of contaminants on ecological receptors. During closure, the assessment focuses on land animals and birds because releases are only expected via atmospheric pathways. After decommissioning (i.e., post-closure phase), the focus is on the aquatic animals, because releases are expected to be via groundwater to surface water pathways.

The residual effects analysis methods for the EcoRA are different from those used by other VCs. Specifically, the assessment of potential effects to ecological health VCs results in the generation of risk factors that inherently consider the geographic extent, duration, frequency and other characteristics of the predicted changes to the environment that may result from Project activities. As such, these inherent attributes cannot be used to determine environmental significance, as they can with other components. Instead, significance for ecological health is evaluated based on: (i) the potential magnitude of the response, as indicated by the comparison to benchmarks and (ii) the degree of conservatism and uncertainty in the analysis.

Results of the radiological dose assessment for the closure and post-closure phases indicate that doses to ecological health valued components are below their respective benchmark values. In addition, there are no exceedances of the HQs identified for exposure of the ecological receptors to cadmium, lead, HB 40 (with the exception of benthic invertebrates in groundwater) and xylene. Therefore, no significant adverse effects on either aquatic or terrestrial populations or communities as a result of these chemical releases are predicted.

The assessment indicates that there will be exceedances of the HQs for cadmium, lead and HB-40 for benthic invertebrates in groundwater. Benthic invertebrates were modelled assuming the organisms spend their entire lives in the peak discharge zone, and that no dilution of the groundwater occurs in the shallow sediment layers. This is conservative because a diffusion gradient will exist across the sediment-water interface, resulting in some degree of dilution into the top layer of sediment where most benthic organisms reside. Moreover, the seepage area represents a small part of the benthic community habitat, and the maximum groundwater concentration assumed represents the worst-case period. As such, a realistic benthic invertebrate population is not likely to be at risk due to cadmium, lead and HB-40 exposure, and any adverse effects will be spatially and temporally limited, such that the community as a whole is not expected to be significantly affected.

Most of the disruptive events modelled do not have an effects pathway to impact the ecological environment. The WRDF Barrier Failure Disruptive Event is the modelled scenario that demonstrated the greatest effect on the ecological health. For the WRDF Barrier Failure Disruptive Event, all predicted radiological and non-radiological doses are well below their respective protective benchmark values indicating that no adverse residual effects are expected. Therefore, it is unlikely that there would be significant adverse effects on either aquatic or terrestrial populations or communities as a result of radionuclide and non-radionuclide releases under a barrier failure scenario.

A key concern of Indigenous peoples was long-term effects of the Project on fish, plants and wildlife important to Indigenous peoples. The approaches to exposure and toxicity assessment have ensured that the characterization of dose and risk has been undertaken in a manner that has not underestimated dose or risk. Overall, residual effects from radiological and non-radiological COPCs are considered to be not significant for all ecological valued components during the closure and post-closure phases (Section 6.7.2 Ecological Health).

9.2.7 Land and Resource Use

9.2.7.1 Traditional Land and Resource Use

Indigenous Nations have indicated their concerns about potential effects on wildlife, fish and plants and the resultant effect on traditional land and resource use that occurs in close proximity to the WL site. The assessment

of traditional land and resource use considers hunting, trapping, and gathering by Indigenous Peoples, archaeological and cultural sites, and the overall importance of the Winnipeg River. The valued components selected for traditional land and resource use are cultural and archaeological sites, traditional land and resource use by Indigenous peoples, and the Winnipeg River. The assessments of each VC has incorporated the community and/or traditional knowledge provided.

The measurement indicators for each traditional land and resource use valued component include:

Cultural and Archaeological Sites: value, quantity, and quality of cultural and archaeological sites.

Traditional Land and Resource Use by Indigenous Peoples: relative abundance and distribution of fish, vegetation, and wildlife species; changes to vegetation, fish and wildlife habitat; relative abundance and distribution of vegetation and fish and wildlife habitat; changes to opportunities for traditional land use; and perceived and observed changes to the area's suitability for land use and/or quality of harvested resources.

Winnipeg River: changes to ambient levels of surface water parameters; relative abundance and distribution of fish and aquatic plant species; changes to aquatic vegetation and fish habitat; relative abundance and distribution of aquatic plant and fish habitat; expanded opportunities for traditional use; and perceived and observed qualities of water, aquatic plant species, fish, and aquatic habitat by traditional users.

The Project is also located in the homeland of the Red River Métis. The Red River Métis community members live in the region around the WL site and may use the lands nearby for traditional activities.

The tangible history of the Winnipeg River is documented by physical artifacts and features that are distributed over the landscape. Although there are currently no archaeological sites located on the WL site, there is a site located approximately 1,700 m south of the WL site and the Winnipeg River has been an important travel route throughout history. In addition, three important sites can be found approximately 3,500 m south at the confluence of the Whitemouth and Winnipeg Rivers.

The WL site has been operational since the 1960s, with public access generally restricted for safety and security reasons. Exceptions to this restriction include parcels of the WL site on the WL Laboratories site; however, traditional land and resource use activities have persisted adjacent to the site, including uses of the Winnipeg River. It is expected that all activities and land use adjacent to the site will be able to continue in the future as the Project will have no effect on land usage beyond the WL site boundaries.

The Project could affect traditional land use through effects to vegetation, fish and wildlife and their habitats, and surface water quality in the Winnipeg River. Changes to these VC could result from a change in the abundance and distribution of resources, the quality of the resource, and the ability to access resources including fish, wildlife and vegetation. Any of these changes could subsequently affect the ability and the desire to engage in activities in the area of the WL site. Threshold exceedances in harvested receptors through atmospheric releases and waterborne dispersion of contaminants are not anticipated. In addition, the mitigation proposed to minimize Project effects on surface water quality, the aquatic environment, the terrestrial environment, human health and ecological health are anticipated to eliminate or mitigate any potential adverse effects to the resources on which traditional land and resource use are dependent.

In collaboration with the First Nations and the Manitoba Métis Federation, CNL is committed to meaningful and ongoing engagement on the WL site remediation and clean-up activities. Although a small proportion of the WL site will have restrictions on use because of the Project, it is still anticipated that the majority of the site will be safe

and appropriate for unrestricted use. Overall, decommissioning of the WL site will result in an increase in the land available for future use in the LSA. Future uses/zoning have not been determined, but the end-state plan for the WL site is to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria. Consequently, the Project is expected to have a negligible effect on traditional land and resource use VCs .

The assessment of potential pathways of effects determined there are no primary pathways that would lead to residual effects on the traditional land and resource use VCs. As such, there is no further residual effects classification and determination of significance for traditional land and resource use (Section 6.8.1.5.2.2 Traditional Land Use by Indigenous Peoples).

CNL is aware that each Indigenous Nation continues to have concerns about the potential effects of the Project and more broadly the WL site on traditional land and resource use. As such, CNL is committed to involving the First Nations and the Manitoba Métis Federation, and its citizens, in monitoring and to engaging with them over the long-term to address on-going concerns. CNL will implement an Environmental Assessment Follow-up Program for the Project to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. In addition, to mitigate perceptions related to the suitability for use of the WL site and the lands around it, CNL will support robust communication of environmental monitoring results to confirm the safety of the WL site and help address concerns about future uses.

9.2.7.2 Other Land and Resource Use

The assessment of other land and resource use includes consideration of non-Indigenous commercial, municipal, and federal land and resource use activities in proximity to the Project. These activities include agriculture, forestry, mineral claims and leases, water use, and outdoor recreation and tourism, sport fishing, outfitting, hunting, trapping, and other winter activities. The other land and resource use valued components chosen for the Project are land tenure, outdoor recreation and tourism, and the Winnipeg River. The assessments of each VC has incorporated community knowledge where available.

The measurement indicators for each other land and resource use valued component include:

Land Tenure: availability of portions of Whiteshell Laboratories site for alternative future uses; and ability to maintain current land uses/tenures in proximity to the Project.

Outdoor Recreation and Tourism: relative abundance and distribution of fish and wildlife species; changes to fish and wildlife habitat; relative abundance and distribution of vegetation and fish and wildlife habitat; continued opportunity for recreational land use; and perceived suitability of area for outdoor recreation and tourism activities.

Winnipeg River: changes to ambient levels of surface water parameters; relative abundance and distribution of fish species; changes to fish habitat; and relative abundance and distribution of fish habitat.

The Whiteshell Laboratories site has restricted public access. Exceptions to this restriction include parcels of the Whiteshell Laboratories site on the west side of the Winnipeg River that have been continuously used for agricultural purposes under agreements with Atomic Energy of Canada Limited. No outdoor recreation and tourism activities are permitted on the Whiteshell Laboratories site. Land and resource use activities have persisted adjacent to the site, including uses of the Winnipeg River. Land use in the region includes forestry, recreation and tourism, hunting, trapping and fishing and limited agriculture.

The Project could affect outdoor recreation and tourism activities through effects to vegetation, fish and wildlife and their habitats, and surface water quality in the Winnipeg River. Changes to these VCs could result from a

change in the abundance and distribution of resources, the quality of the resource, and the ability to access resources including fish, wildlife and vegetation. Any of these changes could subsequently affect the ability and the desire to engage in activities in the area. There are not anticipated to be any threshold exceedances in human receptors through atmospheric releases and waterborne dispersion of contaminants. In addition, the mitigation proposed to minimize Project effects on surface water quality, the aquatic environment, the terrestrial environment, human health and ecological health are anticipated to eliminate or mitigate any potential adverse effects to the resources on which recreation and tourism activities are dependent.

The WL site has been operational since the 1960s, and no outdoor recreation and tourism activities are permitted on the site. Other land and resource use activities have persisted adjacent to the WL site, including uses of the Winnipeg River. It is expected that all activities and land uses adjacent to the WL site will be able to continue in the future as the Project will have no effect on land tenure or usage beyond the WL site boundaries. Overall, with mitigation and engagement in place, Project effects on other land and resource use are expected to be negligible.

The assessment of potential pathways of effects determined there are no primary pathways that would lead to residual effects on the other land and resource use VCs. As such, there is no further residual effects classification and determination of significance for other land and resource use (Section 6.8.2 Other Land and Resource Use).

CNL will implement an Environmental Assessment Follow-up Program for the Project to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. In addition, to mitigate perceptions related to the suitability for use of the WL site and the lands around it, CNL will support robust communication of environmental monitoring results to confirm the safety of the WL site and help address concerns about future uses.

9.2.8 Socio-economic Environment

Socio-economics refers to the way social and economic factors influence one another in local communities and households. The socio-economic environment assessment considers potential effects of the Project on the people and communities who are part of the existing socio-economic environment in the immediate vicinity of the Project. The socio-economic VCs chosen for the assessment are employment and income, business opportunities, government finances, community infrastructure and services, community well-being and public safety. The assessments of each VC will incorporate community and/or traditional knowledge where available.

The measurement indicators for each socio-economic VC include:

Employment and Income: changes to local employment and income opportunities based on the change in decommissioning strategy for the Project and the ability to create future employment opportunities by attracting new businesses to the WL site.

Business Opportunity: incremental expenditures for procurement requirements created by the Project and implications to the existing industry and business profile in the local and regional study areas.

Government Finances: the continued financial viability of the communities and rural municipalities in proximity to the Project.

Community Infrastructure and Services: traffic volumes and road infrastructure will be considered in relation to employee traffic and waste hauling; and potential change in the municipal revenue stream because of changes in the grant-in-lieu could alter the level of services offered in the Local Government District of Pinawa.

Community Well-being: continued socio-economic sustainability and overall well-being of communities in proximity to the Project, with a particular focus on the Local Government District of Pinawa due to the community's historical ties with the WL site.

Public Safety: public safety for the Project is related to potential hazards associated with decommissioning activities including waste hauling and public access to the site during institutional control.

With in situ disposal, there will be a reduced amount of radioactive waste transported off-site, and thus a reduced amount of traffic generated. The reduction in traffic will limit the potential for transportation incidents and risks to public safety. Considering the small number of additional employees required by the Project and the reduced amount of waste transported off-site, changes traffic volumes associated with Project employment will have a negligible effect on the transportation infrastructure in the local area and reduce the probability that the public may be exposed to radioactive material.

The permanent presence of the WRDF will change the suitability of a small portion of the WL site for future uses due to the restrictive land use categories that will be applied to the Project site. Although a small proportion of the WL site will have restrictions on use because of the Project (i.e., 0.07 ha), it is still anticipated that the majority of the site will be safe and appropriate for unrestricted use, and that future designations will seek to maximize the amount of lands available for other uses.

The availability of land for future uses does not stem directly from environmental effects of the Project, but rather from the indirect effect of zoning restrictions that will be required for the Project site into the distant future. The public expressed concern with the Project because it would limit the types of businesses and industries that could use the WL site for future operations and therefore reduce the number of economic development opportunities available to them. CNL provides support for the Community Regeneration Partnership, which has been established to create a feasible socio-economic plan for the region, facilitate economic development and hopefully provide high quality employment to replace the losses associated with the overall WL site closure. Depending on the future uses and access to the WL site, the plan is expected to help focus recruitment efforts or provide another route for achieving the same economic goals without reliance on the WL site.

The implications of the change in decommissioning activities associated with WR-1 does not necessarily alter the number of new employment and/or contracting opportunities, but rather indirectly changes the nature of the employment and/or contracting opportunities available and timeframe. The proposed change will increase the requirements for engineering and construction, while decreasing the amount of transportation labour required. While the schedule for reducing employment has been accelerated, the Community Regeneration Partnership is working to enhance benefits for area communities and the Indigenous Nations in the local area to the extent possible.

Considering CNL's programming to support current employees in transitioning to new work, CNL's support of fostering economic development in the region, and the potential for siting a small modular reactor on the WL site, the Project's indirect effects on employment and income, and business opportunities are expected to be negligible relative to the overall closure of the site despite the accelerated timeline and change in land use restrictions.

While the Project does not return the WL site to an area completely available for unrestricted use, no residual adverse effects were identified between the Project and the aquatic environment or the terrestrial environment. Similarly, the ecological and human health risk assessment concluded it is unlikely that there would be significant adverse effects on either aquatic or terrestrial populations or communities as a result of maximum potential contaminant releases associated with the Project. Even under an accidents and malfunctions scenario (i.e., a

WRDF Barrier Failure Disruptive Event), all predicted radiological and non-radiological doses are well below their respective protective benchmark values indicating that no adverse residual effects are expected. With negligible effects predicted to the biophysical environments, the assessment does not indicate the potential for direct or indirect effects to the well-being of communities.

The assessment of potential pathways of effects determined there are no primary pathways that would lead to residual effects on the socio-economic environment VCs. As such, there is no further residual effects classification and determination of significance for the socio-economic environment (Section 6.9 Socio-economic Environment).

Indigenous Nations have commented on the ongoing adverse effects the presence of the WL site has had on their well-being since the site's establishment in the 1960s, including ongoing fear and trauma for Sagkeeng First Nation members. The Manitoba Métis Federation, Black River First Nation, Hollow Water First Nation, and Brokenhead Ojibway Nation have also noted that WL site, along with other historical industrial development in the local area, have affected the communities' well-being by adversely affecting the environment. The change in the decommissioning strategy for WR-1 is understood from an Indigenous perspective as having the potential to result in fear, stigma and anxiety associated with the long-term presence of nuclear materials in the region. Given the importance of the topic to Indigenous Nations, CNL acknowledges that efforts to support dialogue and learning are central to the relationship going forward. CNL and Atomic Energy of Canada Limited recognize and acknowledge the cumulative impacts and trauma experienced by Sagkeeng First Nation members in relation to the initial siting of the WL site and are willing and committed to begin addressing this through community-led initiatives facilitated by the Technical Working Group. In addition, CNL, Black River First Nation, and Hollow Water First Nation signed a comprehensive relationship agreement to support greater community involvement in the Project. CNL and the Manitoba Métis Federation have also been working together to develop the draft multi-year relationship agreement that will help to mitigate the Manitoba Métis Federation's concerns on the Project.

The assessment does not indicate the potential for direct or indirect effects to the well-being of Indigenous Nations since the effects documented by local Indigenous Nations are linked to the historical presence of the WL site, there are no predicted changes to the biophysical environment, and CNL and Atomic Energy of Canada Limited are committed to working with the Manitoba Métis Federation and First Nations going forward to develop programs and initiatives that provide meaningful mitigation to Indigenous Nations to address the issues of fear and stigma identified.

9.3 Summary

Residual adverse effects were identified for air quality, hydrogeology, surface water quality, and human and ecological health. Mitigation and environmental design features implemented for the Project are well-understood and include existing practices at the WL site. Based on the evaluation, no significant adverse effects on human health or the environment were identified as a result of the Project.

CNL will implement an Environmental Assessment Follow-up Program for the Project to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented, provide information for use in adaptive management and demonstrate compliance with regulatory requirements. Additional details on the Environmental Assessment Follow-up Program are provided in Section 11.0 Summary of Monitoring and Follow-up Programs.

Table 9.3-1: Summary of Predicted Residual Effects on Valued Components and Significance – Application Case and Reasonably Foreseeable Developments Case

Discipline	Valued Component	Assessment Endpoint	Residual Effect	Project Phase the Effect Occurs in	Contributing Project Activity	Mitigation	Significance	
							Application Case	RFD Case

Atmospheric Environment	Air Quality	Performance against criteria and thresholds for protection of human health and the environment.	Closure activities will alter concentrations of indicator compounds, including:
			■ use of vehicles and equipment that combust fuel and emit indicator compounds;
			■ material handling, for grouting and demolition;
			■ vehicles travelling on roads; and
			■ operation of batch mixing plant or other similar equipment for grout production.
				Closure Phase	■ Stage 1: Preparation for In Situ Disposal
					■ Stage 2: Grouting of below-grade structures and systems
					■ Stage 3: Removal of above-grade WR-1 structures and systems
						■ Implementation of CNL's *Environmental Protection* (CNL 2021) and *Management and Monitoring of Emissions* (CNL 2018), which includes operational control monitoring, air verification monitoring and environmental monitoring.
						■ Implementation of dust management techniques to control dust generated by the Project, consistent with the current Environmental Assessment Follow-up Program.
						■ Use of contamination immobilization agents, containment, ventilation and HEPA filters to control generation of airborne emissions during decontamination or removal of contaminated systems or structures.
						■ Use of dust suppression methods during building demolition or soil remediation activities to control airborne emissions and nuisance dust during building demolition or soil remediation. Methods may include:
						  ▪ wetting techniques during demolition to limit mobility of dust;
						  ▪ wind restrictions during demolition to stop work or apply wetting techniques; and
						  ▪ hydro seeding during backfilling and landscaping to reduce soil erosion.
						■ Road watering and chemical dust suppressant when necessary. Dust suppressant is already used annually at the site for select unpaved roads.
						■ Removal of accumulations of particulates (e.g., dirt) on road as soon as possible.
						■ On-site vehicles and equipment engines will meet Tier 3 emission standards, where possible, and be maintained in good working order.
						■ Limit idling of vehicles on site and speed on roads.
						■ Use of tarps or 3-sided enclosures for raw material storage.
							Not Significant	Not applicable – no cumulative effect is predicted

Table 9.3-1: Summary of Predicted Residual Effects on Valued Components and Significance – Application Case and Reasonably Foreseeable Developments Case

Discipline	Valued Component	Assessment Endpoint	Residual Effect	Project Phase the Effect Occurs in	Contributing Project Activity	Mitigation	Significance	
							Application Case	RFD Case
Geological and Hydrogeological Environment	Hydrogeology (Groundwater Quality)	Intermediate component (i.e., it does not have an assessment endpoint).	Release of solutes into the groundwater as the grout and reactor components gradually deteriorate over time may cause changes in groundwater quality.	Post-closure Phase	Post-closure Performance – Grout and reactor components gradually deteriorate over time	■ Installation of a concrete cap and engineered cover to mitigate moisture infiltration into the WRDF and hence limit release of solutes into the groundwater. ■ The planned decommissioning of the WR-1 Building includes: ▪ removal the service area and infilling in these areas with compacted clay-based soil; ▪ sealing of open conduits in the building foundation; and ▪ grouting the interior portion of the building (containing the remaining components of WR-1) to ground surface elevation. ■ Monitoring will be integrated into the overall CNL WL Groundwater Monitoring Program.	Significance is not determined as VC does not have an assessment endpoint.	Significance is not determined as VC does not have an assessment endpoint.
Surface Water Environment	Surface Water Quality	Intermediate component (i.e., it does not have an assessment endpoint).	Release of chemical and radiological contaminants in the long term during the post-closure phase from the Project, which can surface water and sediment quality.	Post-closure Phase	Post-closure Performance – Grout and reactor components gradually deteriorate over time	■ The planned decommissioning of the WR 1 Complex includes: ▪ removal the service area and infilling in these areas with compact soil; ▪ sealing of open conduits in the building foundation; and ▪ grouting the interior portion of the building (containing the remaining components of WR 1) to ground surface elevation. ■ As part of CNL's licence with the Canadian Nuclear Safety Commission (CNSC), environmental monitoring around the WL site is required and will continue for the Project during institutional control. ■ Follow up monitoring during institutional control will be completed to verify effect predictions and to provide information for use in adaptive management to address potential unforeseen effects.	Significance is not determined as VC does not have an assessment endpoint.	Significance is not determined as VC does not have an assessment endpoint.

Table 9.3-1: Summary of Predicted Residual Effects on Valued Components and Significance – Application Case and Reasonably Foreseeable Developments Case

Discipline	Valued Component	Assessment Endpoint	Residual Effect	Project Phase the Effect Occurs in	Contributing Project Activity	Mitigation	Significance	
							Application Case	RFD Case
Human and Ecological Health	Public Health	Protection of human health.	Closure activities will result in the atmospheric release of radiological and non-radiological compounds from the WR-1 Building, which can affect public health.	Closure phase	■ Stage 1: Preparation for In Situ Disposal ■ Stage 2: Grouting of below-grade structures and systems ■ Stage 3: Removal of above-grade WR-1 structures and systems	■ same as Air Quality VC	Not significant	An RFD Case is not applicable to the human health assessment
Human and Ecological Health	Public Health	Protection of human health.	Release of solutes into the groundwater as the grout and reactor components gradually deteriorate over time may cause changes in groundwater quality; which could migrate towards the Winnipeg River, and affect public health.	Post-closure phase	Post-closure Performance – Grout and reactor components gradually deteriorate over time	■ same as Surface Water Quality VC	Not significant	An RFD Case is not applicable to the human health assessment
Human and Ecological Health	Earthworm American Robin Loggerhead Shrike Grass and Shrubs Berries Meadow Vole Common Shrew Snowshoe Hare White-tailed Deer Red Fox Little Brown Myotis	Viability of populations	Closure activities will result in the atmospheric release of radiological and non-radiological compounds from the WR-1 Building, which can affect public health.	Closure phase	■ Stage 1: Preparation for In Situ Disposal ■ Stage 2: Grouting of below-grade structures and systems ■ Stage 3: Removal of above-grade WR-1 structures and systems	■ same as Air Quality VC	Not significant	An RFD Case is not applicable to the human health assessment
Human and Ecological Health	Barn Swallow Little Brown Myotis Moose Carmine Shiner Lake Sturgeon Walleye Aquatic Plants Benthic Invertebrates Horned Grebe Trumpeter Swan Mallard Mink	Viability of populations	Release of solutes into the groundwater as the grout and reactor components gradually deteriorate over time may cause changes in groundwater quality; which could migrate towards the Winnipeg River, and affect public health.	Post-closure phase	Post-closure Performance – Grout and reactor components gradually deteriorate over time	■ same as Surface Water Quality VC	Not significant	An RFD Case is not applicable to the human health assessment

RFD = Reasonably Foreseeable Development; CNSC = Canadian Nuclear Safety Commission; WRDF = Whiteshell Reactor Disposal Facility; VC = Valued Component.

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10.0 ASSESSMENT OF EFFECTS OF THE ENVIRONMENT ON THE PROJECT

This section of the Environmental Impact Statement (EIS) discusses the effects of the environment on the In Situ Decommissioning of WR-1 at the Whiteshell Laboratories Site (the Project), in a manner consistent with Section 2(1) (c) of the *Canadian Environmental Assessment Act, 2012* (CEAA 2012), which defines "environmental effects," in part, as "any change to the Project that may be caused by the environment, whether any such change or effect occurs within or outside Canada." Accordingly, this section focuses on the effects of natural hazards (i.e., extreme weather events, forest fires and seismic events) and climate change on the Project. It summarizes the risks associated with each kind of environmental change, along with environmental design features, management practices and other mitigation to reduce the risks. Additional information on the mitigation actions is reported elsewhere in the EIS, as referenced. Whiteshell Reactor 1 (WR-1) is currently in a storage with surveillance period and protected by the WR-1 Building. Demolition of the above-grade WR-1 Building will be completed after the below-grade section of the building has been grouted, allowing the contaminants to be fully isolated and immobilized within the remaining Whiteshell Reactor Disposal Facility (WRDF).

10.1 Indigenous Engagement Feedback – Key Interests and Concerns

Interests and concerns raised specifically by Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations during engagement related to the assessment of effects of the environment on the Project are summarized in Table 10.1-1. Other general concerns and questions raised during the engagement are documented in Section 4 Indigenous Engagement and Section 5 Public Engagement.

Table 10.1-1: Summary of Key Interests and Concerns Raised During Indigenous Engagement Activities Related to the Effects of the Environment on the Project

Interest and Concern	Inclusion Status	Additional information and Rationale
Concern about the potential for climate change and natural disasters to affect the integrity of the grouted encapsulation. How would it be constructed to ensure that it is safe?	Already included in the assessment of effects of the environment on the Project.	Potential effects of climate change on the Project are evaluated in Section 10.5.2. Potential effects of earthquakes on the Project are evaluated in Section 10.4.

10.2 Extreme Weather Events

Weather events can produce extreme conditions affecting the performance of facilities and management systems. These events include extreme temperature fluctuations, thunderstorms, flooding and tornadoes. In this section potential effects from extreme weather events and the associated mitigation to be implemented, are described. Potential effects from shifts in the frequency and/or intensity of extreme weather events due to climate change are discussed in Section 10.5 Climate Change.

10.2.1 Temperature Fluctuations

Temperature fluctuations and the effects of freeze-thaw cycles could damage the components of the WRDF, the end-state of the Project. The concrete cap and engineered cover for the WRDF will be designed to limit damage due to natural freeze-thaw cycles. To limit damage from freeze-thaw cycles, the engineered cover includes layers of granular/soil materials of sufficient thickness above the concrete cap to effectively avoid frost penetration. Meteorological records will be reviewed annually to confirm that performance of the concrete cap and engineered cover is not overloaded during the institutional control period (i.e., from 2027 to 2127). Annual review of meteorological records will be included in the Environmental Assessment Follow-up Program for Whiteshell Laboratories (CNL 2018).

10.2.2 Extreme Rainfall Events, Snowmelts and Flooding

During decommissioning, extreme rainfall events could result in worker safety issues, such as slippery surfaces, reduced visibility and increased electrical hazards. Consequences of potential extreme rainfall events, such as a power outage, are encompassed by Canadian Nuclear Laboratories (CNL's) Emergency Preparedness Program (CNL 2020). Heavy downpours and runoff could increase the probability of a vehicle accident, as a result of reduced visibility and poor road conditions. During extreme rainfall events, activities will be carried out in accordance with CNL's existing Occupational Safety and Health Program and Environmental Protection Program to ensure risks are managed and may include suspension of decommissioning activities during extreme rainfall events when necessary to limit associated risks.

The end-state plan for the WL site, which includes the WRDF, will be to return lands disturbed by site activities to a condition that is physically stable, safe, and in keeping with the post-closure land use classification and release criteria to achieve the planned end-states. The drainage system for the reclaimed WL site will have the physical characteristics similar to natural drainage systems in the general geographic region in terms of dynamic stability, robustness and longevity.

Extreme rainfall events could result in an increase in surface water runoff and subsequently, erosion of the concrete cap and engineered cover. Snowmelt events could also lead to soil erosion on the engineered cover. The concrete cap and engineered cover system have been designed to cover the entire footprint surface of the WRDF and the engineered cover will be graded to promote drainage from the site to the Winnipeg River, similar to the rest of the WL site. The concrete cap and engineered cover were also designed to limit water infiltration, to direct infiltration water away from the grouted structure and to resist degradation by surface geologic processes and biotic activity (e.g., deters intrusion by burrowing animals).

Flooding of the WL site due to a rise in the Winnipeg River is remote and has been previously evaluated in the Comprehensive Study Report for the WL Decommissioning Project (AECL 2001). A failure of the Seven Sisters Dam, which is upstream of the WL site, is considered a bounding scenario for a potential rise in river levels due to extreme rainfall events (1 in 100-year precipitation event). Flood levels of the Winnipeg River at the WL site following a failure of the Seven Sisters Dam were estimated to take 1.5 hours to reach a peak at 7 m above normal water levels (AECL 2001, Section 6.5). As such, a flooding incident of this magnitude would affect the shoreline of the Winnipeg River adjacent to the WL site, but it would not flood the WL site. The risk to the Project from flooding is therefore considered to be of low probability and of low consequence (negligible physical or biological effects). Consequences of potential flooding, such as a power outage, are encompassed by CNL's Emergency Preparedness Program (CNL 2020).The assessment work concluded that B100/the WL site would not be flooded.

During Closure Phase, decommissioning activities are encompassed by the existing Emergency Preparedness and Response plan, and the site design event (e.g., water conveyance structures and collection sumps) is a 1 in 100-year 24-hour precipitation event. The detailed design of the concrete cap and engineered cover have been prepared using the site design event consistent with that of recent, similar projects and commensurate with the 100 year design lifespan of the concrete cap and engineered cover. A rise in river level in response to ice jams or extreme rainfall events is considered a possible – occasional event (1 in 100 years to 1 in 1,000 years) based on historical occurrence data. Further, Manitoba Hydro has contingency plans for comprehensive notification, warning, and response systems in case an emergency condition is detected.

10.2.3 Heavy Snowfall

Heavy snowfall due to severe snowstorms are primarily a concern related to worker safety during the closure phase and throughout the institutional control period where workers will be occasionally present for environmental monitoring. Heavy snowfall and severe snowstorms are already encompassed by CNL's Emergency Preparedness Program. Heavy snowfall could affect vehicle operation at the site because of reduced traction and visibility and increase the probability of vehicle accidents. Safety procedures are in place to address worker safety including reduced traffic speeds, increased following distances, addressing road conditions (e.g., snow removal, sanding) as quickly as possible and, if necessary, issuing work stop orders. Consequences of potential heavy snowfalls, such as a power outage, are encompassed by CNL's Emergency Preparedness Program.

10.2.4 Tornado/Extreme Wind

Tornadoes are recognized as a hazard to the facilities on the WL site, including the Project. Between 1868 and 1990 at least 75 tornadoes or tornado groups have occurred in Manitoba with two of these tornadoes passing near the WL site in 1978 (AECL 2001, Section 6.5). Between 1980 and 2009 there were 283 confirmed tornadoes in Manitoba, two of which passed within 10 km of the WL site (2005 at Lac du Bonnet and 2007 at Seven Sisters Falls). Based on the most recent period of data available (1980 to 2009), the frequency for a tornado strike on the property is estimated to be 5.4×10^{-5} per year and a return period of 2×10^{5} years (Cheng et al. 2013). There is, therefore, a low probability of a tornado affecting the WL site. There is concern that climate change will increase the frequency and severity of summer storms, including tornadoes, hailstorms and lightning events (Peterson et al 2008). While it appears that these storms have already become more frequent (comparing the 1868 to 1990 and 1980 to 2009 data), reporting of tornadoes has increased significantly with increasing population density, resulting in a higher reporting rate than was previously possible (Government of Canada 2015). It is therefore uncertain, at this time, if the perceived increase in reported tornadoes is due to increased storm frequency or due to improved detection and reporting. Extreme storms are treated as moderately probable events and encompassed by CNL's Emergency Preparedness Program.

High winds, atmospheric pressure changes and wind induced missiles have the potential to cause structural damage and/or failure of infrastructure. In 2005, the 1995 National Building Code of Canada (NBCC) was updated to include provisions for basic structural resilience under low end tornadic loads in areas of Canada defined as "tornado prone" (NBCC 2005). Environment Canada has also recently compiled an updated 30-year national tornado database (Cheng et al. 2013).

Tornadoes and extreme winds are primarily a concern related to worker safety during the closure phase and throughout the institutional control period, when workers will occasionally be present for environmental monitoring. During closure, the main hazards associated with tornadoes and extreme winds include flying debris, slippery surfaces and conditions and the collapse of the partially decommissioned WR-1 Building. Another hazard is the

spread of contamination from the partially decommissioned WR-1 Building. Post-closure, it is unlikely that a tornado would have an effect on the concrete cap and engineered cover but it could damage the intrusion control infrastructure (e.g., fencing). This and other risks associated with tornadoes and extreme winds will be managed through CNL's management practices. For instance, during closure, when wind gusts are greater than 30 km/hr, CNL will stop work associated with higher risk activities (e.g., handling of hazardous materials) or activities where dust suppression techniques are not being used. When sustained wind speeds exceed 30 km/h, all demolition work will stop. Consequences of potential tornadoes and extreme winds, such as a power outage, are encompassed by CNL's Emergency Preparedness Program.

10.3 Forest Fires

The Project is located in an area that is primarily under treed cover (approximately 83% of the Terrestrial Environment Regional Study Area), representing a potential fire hazard; however, there is minimal treed cover in the immediate vicinity of the Project. Historical data for the 1980 to 2015 period from Natural Resources Canada (the most recent period for which data are available [NRCan2017]) indicate that southern Manitoba is generally at lower risk of forest fires than more northerly parts of the province. Mapping from the Province of Manitoba indicates that wildfires occurred from 2015 to 2019 in areas nearby to the Project and the WL site, including Brookfield, Lee River and Lac du Bonnet. However, no wildfires occurred from 2015 to 2019 in the immediate vicinity of the Project or the WL site (Manitoba Sustainable Development 2019a,b). The closest fire to the WL site reported in the last five years occurred in 2018 approximately 2.5 km to the northeast of the WL site, covering an area of 3.3 ha (Manitoba Sustainable Development 2019a).

During closure, an effective response to fires will be facilitated through CNL's Emergency Preparedness Program and the Fire Protection Program. Risks associated with wildfires during closure (e.g., low visibility due to smoke) would continue to be managed through existing procedures and design criteria in the long-term. Based on regional conditions and historical data, the probability of such an event has been assessed as likely due to the occurrence of fires nearby the Project and the WL site per the Province of Manitoba data (Manitoba Sustainable Development 2019a,b), however, with a low consequence severity (i.e., short-term local effects) in consideration of the rapid fire-response procedures in the province and CNL's on-site fire protection services.

CNL's on-site fire protection services include trained firefighting staff and firefighting equipment to respond to fires. In addition, CNL has an existing Fire Protection Program at the WL site, which will continue to be implemented during closure phase. The Fire Protection Program is dedicated to providing the highest level of fire and life safety to all CNL employees and facilities, which subsequently also provides protection to the surrounding areas. The objectives of the Fire Protection Program include preventing fire losses, providing responsible fire protection management, demonstrating compliance to applicable fire protection codes and standards and providing reliable facilities from a fire protection perspective. The Fire Protection Program provides services including developing fire prevention processes and conducting fire safety inspections. Fire hazard analyses, code compliance reviews and fire protection screenings are also conducted as part of the program. Consequences of a fire, such as a power outage and system failure, are encompassed by CNL's Emergency Preparedness Program and evaluated previously in in Section 7.0 Accidents and Malfunctions.

10.4 Seismic Events

Major earthquakes (i.e., seismic events) are related to movements at tectonic plate boundaries. The province of Manitoba is the least earthquake-prone area in Canada (AECL 2001). Seismic activity in the prairie region south of 60 degree north (°N) is predominantly confined to southern Saskatchewan in a zone that continues into Montana (AECL 2001). Furthermore, the Canadian Nuclear Fuel Waste Management Program studied seismic stability in Northwest Ontario and Eastern Manitoba and found, based on a detection level of 2.5 on the Richter scale that the WL site and the southern two-thirds of Manitoba are aseismic (Wetmiller et al. 1996). The conclusion was based on data collected by the Geological Survey of Canada and the AECL through the operation of a network of seven seismograph stations in eastern Manitoba and northern Ontario from 1982 to 1995.

Detailed information on earthquakes that have occurred in Canada is contained in publications of Earthquakes Canada of Natural Resources Canada and their predecessor organizations. A seismic zoning map for Canada has been developed on the basis of these studies and is used in the NBCC 2015 (NRCan 2019).

A seismic hazard analysis was completed for the WL site. In 1995, the NBCC placed the WL site (and all of Manitoba) within a Seismic Zone 0, a zone that has a probability of exceedance of 0.0021. The peak ground acceleration (PGA; i.e., the maximum acceleration that a rigid structure would experience if it was located on bedrock) data from NBCC was considered for the years 2005, 2010 and 2015. The trend since 2005 is that for every probability of exceedance, the seismic hazard at the WL site has decreased (NBCC 2015). For the 1 in 10,000-year probability of exceedance, the PGA is approximately 0.10 g. Comparatively, the 0.10 g PGA represents a light (almost moderate) earthquake for which one wouldn't normally expect structural damage for NBCC designed buildings and components (CNL 2022).

Liquefaction occurs when vibrations or water pressure within a mass of soil cause the soil particles to lose contact with one another. As a result, the soil behaves like a liquid, has an inability to support weight and can flow down very gentle slopes. This condition is usually temporary and is most often caused by an earthquake vibrating water-saturated fill or unconsolidated soil. Liquefaction most often occurs when three conditions are met: loose, granular sediment or fill; saturation by groundwater and strong shaking. A similar process can occur in some types of low plasticity silts and clays termed cyclic loading for strong earthquakes. Liquefaction is possible for cohesionless soils for M=4 to 6 earthquakes, which can produce ground shaking levels up to VIII on the Modified Mercalli Intensity. Therefore, liquefaction is not seen as an issue for the WL site due to the essentially aseismic conditions of Eastern Manitoba, and the consolidated nature of the overburden geology (CNL 2022). Furthermore, the WR-1 Building was constructed directly on bedrock, which further reduces the risk of liquefaction having an effect on the Project. Cone penetration testing has been completed at site to assess the liquefaction potential of the overburden soils at the WL site. In general, the high plastic clayey overburden soils present at the site are not susceptible to cyclic liquefaction (KGS Group 2019).

10.5 Climate Change

Changes in the global and regional climate could affect the Project during the closure and post-closure phases. The Canadian Nuclear Safety Commission (CNSC) requires that effects assessments take into account any potential effects of climate change on a project, including an assessment of whether the Project might be sensitive to changes in climate condition during its life span (CNSC 2017). As such, an effect assessment of climate change was originally completed that follows the guidance provided by the Federal Provincial Territorial Committee on Climate Change and Environmental Assessment (FPTCCCEA). This general guidance document is for practitioners incorporating climate change issues into an environmental assessment (FPTCCCEA 2003).

Since the original assessment using the FPTCCCEA, the *Strategic Assessment of Climate Change, Revised October 2020* (ECCC 2020) (SACC) has been issued. The SACC requires that a climate change resiliency assessment be conducted that takes into account the vulnerabilities under both the mean climate conditions and extreme climate events over project's lifetime from construction to decommissioning and includes more details than the FPTCCCEA. The resiliency assessment should be based on future climate projections and associated impacts, and identifies how the project is resilient to the future climate. The general approach for conducting a climate change resiliency assessment can follow Infrastructure Canada's *Climate Lens - General Guidance* (Infrastructure Canada 2019).

Based on this new guidance, the effects assessment has been updated with a climate change resiliency assessment conducted for the Project based on the requirements of SACC 2020. The following sections provide a summary of the climate change trends used to support the climate change resiliency assessment as well as the climate change resiliency assessment.

10.5.1 Summary of Climate Change Trends

10.5.1.1 Climate Change Effects on the Project

Climate change may result in shifts in the frequency and/or intensity of the extreme weather events and forest fires. When evaluating the potential effects from climate change, Project design features and mitigation as well as management and monitoring practices are also considered. The effects of climate change are typically measured over longer periods, with the potential for climate change effects increasing as the period over which they are measured increases.

Shifts in the frequency and/or intensity of extreme weather events are expected to accompany the general warming of surface air temperatures. Increased evaporation will result in more moisture in the air and warmer air can hold more moisture, therefore, more intense precipitation events (i.e., rainstorms and snowmelts) are expected. The drainage system for the reclaimed WL site will have physical characteristics similar to natural drainage systems in the general geographic region in terms of dynamic stability, robustness and longevity. A multi-component concrete cap and engineered cover system will be designed over the entire surface of the decommissioned WR-1 Building, which will be graded to promote positive drainage from the site to the Winnipeg River, similar to the rest of the WL site. The annual snowfall for Canada has increased by about 4% over the time period of 1950 to 2009 (Mekis and Vincent 2011) and the current climate General Circulation Models for the Project indicate that snowfall is increasing further.

Climate change has the potential to greatly influence forests, since even small changes in temperature and precipitation can affect forest growth and survival. A small increase in temperature can result in a longer growing season, increased plant growth and a shift in tree species occurrence and abundance (NRCan 2004). None of these biological changes could directly affect the Project; however, the probability of forest fires increases with dry conditions due to the warming of surface air temperatures and probability of lightning strike. A forest fire could affect the Project infrastructure and workers' safety during closure (see Section 10.3 Forest Fires).

During the closure phase and institutional control period of the post-closure phase, monitoring will be incorporated into the existing Environmental Assessment Follow-up Program for WL to help identify potential future climate change effects beyond what has been considered in the assessment. This would include evaluating long-term monitoring results, documented changes in the local climate and up-to-date climate change predictions.

Changes in temperature and precipitation, as well as frequency or magnitude of extreme events and erosion will be tracked through the existing Environmental Assessment Follow-up Program for WL to inform the need for adaptive management. Adaptive management to be integrated into post-closure planning could be a result of:

- climate changes (e.g., increased erosion rates) affecting the concrete cap and engineered cover system design;
- changes to temperature and precipitation affecting hydrology and subsequently hydrogeology (i.e., changes in water table) and surface geology (i.e., erosion) affecting the drainage system; or
- changes to temperature and precipitation affecting the vegetation used in the rehabilitation of the site affecting final site restoration.

The following sections provide further descriptions of the projected future climate change trends at the global, regional and site level. These more detailed projections, in addition to the climate discussion in this section, are used to support the climate resilience assessment presented in Section 10.5.2.

10.5.1.2 Global Climate Change Trends

The world's climate is changing due to a combination of natural and anthropogenic factors, and the changes over the 20th century can largely be attributed to human activities (AMAP 2011; IPCC 2021; Bush and Lemmen 2019). Human activities affect climate by changing the land surface and altering the composition of the atmosphere. Human influence on the climate system has resulted in an increase in global surface temperatures ranging from 0.8°C to 1.3°C with a best estimate of 1.07°C from 1850-1900 to 2010-2019. (IPCC 2021). Over the Canadian landmass the annual average surface air temperature warmed 1.7°C between 1948 and 2016 (Bush and Lemmen 2019). Also, Canada has generally become wetter in recent decades with an increase in annual precipitation of about 20% over the period from 1948 to 2012 (Vincent et al. 2015). Even if considerable measures to reduce greenhouse gas emissions are introduced today, it is projected that climate change will continue to have an environmental effect for centuries. It is recognized that these effects will not occur uniformly across the country, but will vary regionally (Bush and Lemmen 2019).

Climate change projections are provided by mathematical models based on the physical laws governing the behaviour of the climate. Climate change scenarios, as summarized by the Intergovernmental Panel on Climate Change (IPCC), predict that mean global temperatures are likely to increase by 1.0°C to 5.7°C for the period of 2081 to 2100 as compared to the reference period from 1986 to 2005 (IPCC 2021). The IPCC is generally considered to be the definitive source of information related to past and future climate change, as well as climate science.

The Canadian Prairies are projected to have a greater warming trend than the Canadian average as well as all other Canadian regions excluding the north where the warming signal is most predominant (CCCS 2019). This warming is expected to vary on a seasonal basis, being greater in the winter than the other seasons, and nights warming more than days. As warm air can hold more moisture, changes in precipitation patterns and shifts in the frequency and intensity of extreme climate events are expected to accompany this warming (CSA 2019). Mean results for Canada show that even under lowered emission scenarios, summer and winter temperatures by the middle of the century are anticipated to warm by about 1.5°C to 2.5°C and 3°C to 7°C, respectively (NRCAN 2014).

10.5.1.3 Current Climate Trends

The current climate is based on available long-term daily meteorological observations from a climate station in the vicinity of the Project. In general, the current climate normals and trends indicate a current climate that has likely become warmer and wetter over time. The analysis of climate station data shows that temperatures are increasing, with the exception of spring, and the total seasonal precipitation show increasing trends for all seasons (Golder 2017).

An analysis of the Pinawa Whiteshell Nuclear Research Establishment (WNRE; Climate ID 5032162; ECCC 2016) climate station data were completed illustrating:

- increasing trend in total precipitation;
- increasing trend in spring total precipitation;
- increasing trend in summer total precipitation;
- increasing trend in winter total precipitation;
- increasing trend in total rainfall;
- increasing trend in the number of days with greater than 20 mm of rainfall; and
- increasing trend in average fall temperatures.

10.5.1.4 Future Climate Conditions

The projected future climate conditions provided within this section are updated from *Environmental Impact Assessment for the Whiteshell Laboratories Closure Project WR-1 In Situ Decommissioning, Appendix 10.0-1, Climate Change* (Golder 2017) to reflect the most recent available climate projections. These climate projections are provided to support the climate change resilience assessment, which is summarized in Section 10.5.2.3.

The key climate variables include identifying changes to temperature and precipitation along with associated indices, which were derived using an ensemble of 24 General Circulation Models (GCMs) and 3 emission pathways, i.e., Representative Concentration Pathways or RCPs (RCP 2.6, RCP 4.5, RCP 8.5), available from *Climate Data for a Resilient Canada* (ClimateData 2021). An ensemble approach is used for this work by taking the mean projected changes from all models and emission pathways available to provide a more robust estimate of projected changes in climate. Two future time periods are used to estimate projected changes relative to a current period of 1991 through 2020, as recommended by the World Meteorological Organization (WMO 2017). The Mid Term (2041 through 2070) represents near the beginning of the post-closure institutional control phase (2027 onwards) and the Far Term (2070 through 2100) represents the continuation of the post-closure institutional control phase (Golder 2017). Climate projections were also considered for the Long Term (2100 through 3000) described using publicly available literature (Golder 2017).

The projected changes in temperature for the Near Term and the Far Term, compared to the 1991-2000 are provided in °C, while the projected changes in precipitation are provided in %. Providing the precipitation in terms of % accounts for variability in total precipitation between models, where the variability is related to representation of the climate system and not necessarily a change in climate (e.g., some climate models are more “wet” or have more precipitation than others). Both temperature and precipitation are projected to increase in the Mid Term and Far Term, compared to the current conditions (1991-2000, as represented in the climate models), as shown in Tables 10.5.1-1 and 10.5.1-2 below.

Table 10.5.1-1: Modelled Baseline and Future Mean for Project for the Mid Term (2041 – 2070)

Period	Projected Change in Temperature (°C)	Projected Change in Precipitation (%)
Annual	+2.3 (+1.2 to +3.5)	+4.1 (+2.4 to +4.3)
Spring	+2.0 (+1.4 to +2.9)	+7.6 (+7.1 to +10.0)
Summer	+2.1 (+0.9 to +3.3)	0.0 (-5.0 to +2.2)
Fall	+2.2 (+1.3 to +3.1)	+3.5 (-7.2 to +4.1)
Winter	+3.0 (+3.0 to +4.2)	+10.7 (+3.8 to +13.0)

Note: Values before parentheses are the average across all available projections for the selected time period. Values within the parentheses provide the lowest and highest available values to capture the range of available projections from ClimateData (2021).

Table 10.5.1-2: Modelled Baseline and Future Mean for Project for the Far Term (2071 – 2100)

Period	Projected Change in Temperature (°C)	Projected Change in Precipitation (%)
Annual	+3.4 (+1.1 to +6.4)	+4.1 (+1.7 to +10.0)
Spring	+2.9 (+1.1 to +5.2)	+12.6 (+7.0 to +23.0)
Summer	+3.1 (+0.9 to +6.1)	0.0 (-11.8 to +3.3)
Fall	+3.2 (+1.2 to +5.8)	+5.0 (+2.7 to +11.8)
Winter	+4.2 (+4.2 to +7.2)	+14.3 (+8.5 to +24.5)

Note: Values before parentheses are the average across all available projections for the selected time period. Values within the parentheses provide the lowest and highest available values to capture the range of available projections from ClimateData (2021).

For the Long Term, based on Representative Concentration Pathways described in IPCC's fifth assessment report, global temperatures are predicted to rise between 0.6°C and 7.8°C by the year 3000 (see Table 10.5.1-3 below; Golder 2017). The majority of the warming will occur before 2300. Changes in precipitation distribution and variability are anticipated to increase after 2100, with an estimated increase in global precipitation of 1% to 3% per degree Celsius of increase in temperature over the period from 2100 to 3000 (IPCC 2013).

Table 10.5.1-3: Projected Climate for the Mid Term, Far Term and Long Term

Period	Temperature (°C)	Precipitation
Current Climate Normal (1981 – 2010)	2.8	588.60 mm
Mid Term Projected Change (2041 – 2070)[a]	2.3	18.9 mm
Far Term Projected Change (2071 – 2100)[a]	3.3	25.9 mm
Long Term Projected Changes (2101 – 3000)[b]	0.6 to 7.8[b]	1 to 3%/°C[l]

a) Please note that projected changes represent changes above the current climate normal (1991 – 2020) for the Project region.

b) Please note that these projected changes represent the changes above the reference period of 1986 – 2005 and are global values. Project-specific information is not available.

c) Absolute change not provided by literature. Projected change in precipitation is dependent on the projected warming experienced.

Projected changes in climate extremes of temperature and precipitation can result in climate change effects on the Project and are an important consideration in a climate change resilience assessment. Projected changes in climate extreme indices were obtained from ClimateData (2021), and have been extracted for the Project location. Each of the climate extreme indices are described in Table 10.5.2-4 with projected changes for the Mid Term and Far Term periods relative to the modelled baseline presented in Table 10.5.1-4. The climate extreme indices considered in this assessment are important as they can be associated with climate events such as extreme temperature and precipitation events, growing season length, forest fires, and drought, which can have potential impacts on the Project. Evaluation of climate extreme indices require daily climate projections which are not available beyond 2100 from ClimateData (2021). Beyond 2100, the degree of uncertainty prevents reasonable projections for climate extreme indices.

Table 10.5.1-4: Model Projected and Reference Mean Climate Extreme Indices

Climate Extreme Indices	Description	Units
Very Cold Days	Annual count of days where daily minimum temperature is less than -25°C.	Days
Very Hot Days	Annual count of days where daily maximum temperature is greater than 30°C.	Days
Growing Degree Days (Base 5°C)	Annual (1st Jan to 31st Dec in the northern hemisphere) count between first span of at least 6 days with ground temperatures greater than 5°C and first span after July 1 of 6 days with ground temperatures less than 5°C.	Days
Heavy Precipitation Days (10mm)	Annual count of days when precipitation is greater than or equal to 10 mm).	Days
Freeze-Thaw Cycles	Annual count of days when the air temperature fluctuates between freezing (less than or equal to 0°C) and non-freezing (greater than 0°C) temperatures.	Days
Frost Days	Annual count when the daily minimum temperature is less than 0°C.	Days
Ice Days	Annual count when the daily maximum temperature is less than 0°C.	Days
Warmest Maximum Temperature	The highest temperature of the year.	°C
Coldest Minimum Temperature	The very coldest temperature of the year.	°C
Summer Days	Annual count when the daily maximum temperature is greater than 25°C.	Days

Table 10.5.1-4: Model Projected and Reference Mean Climate Extreme Indices

Climate Extreme Indices	Description	Units
Wet Days	Annual count of days where the daily precipitation is greater than or equal to 1 mm.	Days
Consecutive Dry Days	Maximum number of consecutive days with daily precipitation amount less than 1 mm.	Days
Max 1-Day Precipitation	Annual maximum 1-day precipitation.	mm
Max 5-Day Precipitation	Annual maximum consecutive 5-day precipitation.	mm

Table 10.5.1-5: Model Projected and Reference Mean Climate Extreme Indices

Climate Extreme Indices	Modelled Baseline	Median Projected Changes	
		Mid Term	Far Term
Very Cold Days (Days)	30.8 (17.1 – 44.9)	18.4 (4.1 – 36.4)	14.5 (0.0 – 36.1)
Very Hot Days (Days)	11.7 (2.7 – 22.1)	27.1 (7.6 – 52.3)	36.5 (6.4 – 81.7)
Growing Degree Days (Base 5°C) (Days)	1835.4 (1629.5 – 2053.3)	2228.9 (1820.5 – 2689.3)	2435.3 (1807.8 – 3327.3)
Heavy Precipitation Days (10mm) (Days)	13.1 (8.2 – 17.9)	14.0 (8.8 – 19.4)	14.2 (8.4 – 20.7)
Freeze-Thaw Cycles (Days)	60.1 (46.4 – 74.5)	55.9 (40.7 – 72.5)	54.7 (37.2 – 71.2)
Frost Days (Days)	183.1 (168.9 – 197.2)	163.8 (138.7 – 185.4)	155.2 (115.7 – 185.4)
Ice Days (Days)	111.4 (94.7 – 128.0)	97.4 (72.6 – 119.7)	90.5 (51.1 – 119.0)
Warmest Maximum Temperature (°C)	33.6 (31.2 – 36.1)	36.1 (32.6 – 40.0)	37.2 (32.2 – 43.2)
Coldest Minimum Temperature (°C)	-36.8 (-40.5 – -33.1)	-33.3 (-38.6 – -27.3)	-31.3 (-38.6 –-22.1)
Summer Days (Days)	52.4 (34.4 – 70.8)	75.8 (47.2 – 103.7)	85.9 (45.4 – 128.5)
Wet Days (Days)	95.5 (82.2 – 108.3)	97.0 (83.1 – 111.3)	97.3 (82.2 – 112.5)
Consecutive Dry Days (Days)	23.5 (16.0 – 32.8)	23.4 (15.8 – 32.7)	23.1 (15.6 – 32.6)
Max 1-Day Precipitation (mm)	38.9 (22.8 – 60.0)	41.1 (23.5 – 66.6)	41.7 (23.8 – 67.2)
Max 5-Day Precipitation (mm)	65.8 (41.1 – 96.5)	69.4 (41.9 – 104.2)	70.7 (42.3 – 111.7)

Note: Values before parentheses are the average across all available projections for the selected time period. Values within the parentheses provide the lowest and highest available values to capture the range of available projections from ClimateData (2021).

The projected changes in climate extreme indices are consistent with projected changes in mean temperature and precipitation (Table 10.5.1-5, in that future climate at the Project location is projected to become warmer and wetter, while also indicating the potential for more frequent and extreme precipitation and temperature events in the future. This is illustrated by fewer very cold days, freeze-thaw cycles, frost and ice days, greater warmest and coldest temperatures, and more summer days, along with more heavy precipitation and wet days, fewer consecutive dry days, and greater maximum 1- and 5-day precipitation depths. Projected changes in extreme climate indices could impact the Project through increased physical damage to infrastructure components and impacts to on-site water management and revegetation. Impacts to the Project due to climate change are further described in Section 10.5.2.3.

10.5.2 Climate Change Resilience Assessment

CNL plans to start the decommissioning activities (closure phase) in 2023 which would last till 2027. Following that the institutional control period will last at least for 100. Post-institutional control will occur indefinitely; however, the timeframe defined for the assessment of potential effects, as part of the normal evolution of the Project's safety assessment is 10,000 years.

As the closure phase has a shorter time frame (2023-2027), it has a smaller potential for meaningful interactions with the climate trends outside of the normal seasonal variation experienced in the region. The climate change resilience assessment includes identifying the effects of climate change on Project infrastructure during the institutional control period and post-institutional control period.

Though climate projections for mean temperature and mean precipitation are available till 2300, climate projections for extremes (e.g., extreme rainfall events, freeze-thaw cycles) are only available till 2100. Hence, the mid-century likelihood rankings represent the closure phase and early institutional control period, while the end-of-century rankings represent the post-closure phase in the long run. The climate projections between 2100 and 3000 indicate that temperatures will stabilize before 3000. In the absence of further projections, these projections could be applied qualitatively for the 10,000-year time frame of the Project's risk assessment. As climate science continues to progress, projections further into the future will become available with decreased uncertainty (e.g., past 2100 or 3000). As part of a continual improvement process, this updated climate science could be considered to identify risks to the Project beyond 3000 or for the post-institutional control period.

10.5.2.1 Approach for the Climate Change Resilience Assessment

The climate change resilience assessment employs a risk management approach that anticipates the future climatic conditions for the Project region, and anticipates how climate change related impacts may affect the Project. A qualitative approach has been used based on the available design information. For the assessment, the high-level principles of Infrastructure Canada's *Climate Lens - General Guidance* (Infrastructure Canada 2019) and Mining Association of Canada's *Guide on Climate Change Adaptation in the Mining Sector* (MAC 2021) have been used. The following methodology was used to complete the assessment:

Future Climate Projections: A review of the current and future projected changes in climate is completed to identify potential climate hazards relevant to the Project region.

Climate-Infrastructure Interactions: Inventory of on-site infrastructure components (concrete cap and engineered cover, drainage system, and final site restoration) which may interact with various climate hazards are identified. Based on the site infrastructure and identified hazards, a list of climate-infrastructure interactions is developed for further consideration.

Risk Ranking Assessment: Likelihood and consequence rankings of climate-infrastructure interactions are then estimated to identify climate risks under future climate conditions. Likelihood rankings are estimated under two future periods, mid-century (2050s) and end-of-century (2080s). The mid-century likelihood rankings represent the closure and early post-closure institutional control phase, while the end-of-century rankings represent the post-closure institutional control phase in the long run. In absence of projections past 3000, these projections could be applied qualitatively and reviewed as part of a continual improvement process when updated climate projections become available. The current mitigation measures identified for the Project have been considered for the likelihood rankings.

Current Mitigation Measures: Using available Project information, current mitigation measures that would be implemented are identified and used in the risk ranking process.

10.5.2.2 Likelihood, Consequence and Risk Ranking Scales

Climate-infrastructure interactions include any potential interaction of a climate event (e.g., heavy rainfall, extreme temperature, high winds, storms and lightning, snow) with a given infrastructure component. The likelihood in which the interaction may occur, and the consequence associated with this interaction are then assigned qualitatively using a categorical numeric scale. The likelihood rankings for this assessment have a scale from Very Low (1) to Very High (5) and are summarized in Table 10.5.2.2-1. The consequence rankings for this assessment have a scale from Very Low (1) to Very High (5) and are summarized in Table 10.5.2.2-2.

Table 10.5.2.2-1: Likelihood Scale for Climate Infrastructure Interactions [Modified from Climate Lens - General Guidance (Infrastructure Canada 2019)]

Qualitative Descriptor	Description
Very Low	Less than 1% annual probability of the event occurring, event is not likely to occur
Low	Between 1 to 10% annual probability of the event occurring
Moderate	Between 10% to 50% annual probability of the event occurring
High	Between 50% to 90% annual probability of the event occurring
Very High	More than 90% annual probability of the event occurring, event may occur multiple times a year

Table 10.5.2.2-2: Consequence Scale for Climate Infrastructure Interactions [Modified from Climate Lens - General Guidance (Infrastructure Canada 2019)]

Qualitative Descriptor	Description
Very Low	■ Likely to cause no impacts on the Project. ■ No damage to infrastructure.
Low	■ Likely to cause few to no impacts on the Project. ■ Minimal damage or repair costs.
Moderate	■ Likely to cause disruptions to facility, or manageable damage to infrastructure but repair costs would be higher than previously budgeted.
High	■ Likely to cause impacts that would disrupt the facility operations leading to closures, or damage infrastructure that would require replacement and high repair costs.
Very High	■ Likely to cause impact that may require full replacement of infrastructure.

The consequence and likelihood of climate interactions are used to identify key climate risks. If an interaction has a high consequence, but very low likelihood, the overall risk would be assessed as low. Conversely, if an interaction has a very low consequence but its likelihood is very high, the risk is assessed as a moderate. A risk matrix has been identified which illustrates this concept and is summarized in Table 10.5.2.2-3. This table has been used to identify climate risk based on the likelihood and consequence of an interaction. The risk rating descriptors are summarized in Table 10.5.2.2-4.

Table 10.5.22-3: Climate Risk Matrix Based on Consequence and Likelihood Scales [Source: Climate Lens - General Guidance (Infrastructure Canada 2019)]

Likelihood	Consequence				
	Very Low	Low	Moderate	High	Very High
Very High	Moderate	High	High	Extreme	Extreme
High	Low	Moderate	High	High	Extreme
Moderate	Low	Low	Moderate	High	High
Low	Negligible	Low	Low	Moderate	Moderate
Very Low	Negligible	Negligible	Low	Low	Low

Table 10.5.2-4: Risk Rating Definitions [Modified from Climate Lens - General Guidance (Infrastructure Canada 2019)]

Qualitative Description	Descriptor
Negligible Risk	An identified interaction between the climate hazard and Project component has a negligible risk if the hazard has: ▪ A very low/low likelihood of occurrence and a very low consequence; or ▪ A very low likelihood of occurrence and a low consequence. Negligible risk includes no permanent damage. Risks do not require further consideration.
Low Risk	An identified interaction between the climate hazard and Project component has a low risk if the hazard has: ▪ A moderate/high likelihood of occurrence and a very low consequence; ▪ A low/moderate likelihood of occurrence and a low consequence; ▪ A very low/low likelihood of occurrence and a moderate consequence; or ▪ A very low likelihood of occurrence and a high/very high consequence. Low risk includes minor damage. Actions might not be required.

Table 10.5.2-4: Risk Rating Definitions [Modified from Climate Lens - General Guidance (Infrastructure Canada 2019)]

Qualitative Description	Descriptor
Moderate Risk	An identified interaction between the climate hazard and Project component has a medium risk if the hazard has: ▪ A very high likelihood of occurrence and a very low consequence; ▪ A high likelihood of occurrence and a low consequence; ▪ A moderate likelihood of occurrence and a moderate consequence; or ▪ A low likelihood of occurrence and a high/ very high consequence. Medium risk includes limited damage to infrastructure/operations. Some adaptation actions might be required.
High Risk	An identified interaction between the climate hazard and Project component has a high risk if the hazard has: ▪ A very high likelihood of occurrence and a low/moderate consequence; ▪ A high likelihood of occurrence and a moderate/high consequence; or ▪ A moderate likelihood of occurrence and a high/very high consequence. High risk may result in permanent damage to infrastructure, assets, operations. High priority adaptation actions need to be implemented.
Extreme Risk	An identified interaction between the climate hazard and Project component has an extreme risk if the hazard has: ▪ A very high likelihood of occurrence and a high/very high consequence; or ▪ A high likelihood of occurrence and a very high consequence. Extreme risk may result in permanent damage or loss of asset and operations. Immediate adaptation actions need to be implemented.

10.5.2.3 Climate-Infrastructure Interactions

Identifying potential interactions between site infrastructure and climate is an important step in assessing climate risk. Future climate projections indicate changes in temperature, precipitation, and extreme events, potentially interacting with different components of the Project. The closure phase takes place during a short time frame (6 years), which has a smaller potential for meaningful interactions with the climate trends outside of the normal seasonal variation experienced in the region. There is a larger potential for changes in both the climate mean and extreme weather events during the post-closure institutional control phase.

Table 10.5.2.3-1 identifies the potential climate events and change factors that may interact with the infrastructure components. The presence of a climate interaction for a given infrastructure category is denoted by a checkmark. Through this process, it is demonstrated that each infrastructure category may be affected by various climate related events having an impact on different aspects of site operation.

Increase in freeze-thaw cycles and extreme weather events such as droughts and forest fires could cause physical damage to the concrete cap and engineered cover. Changes in precipitation, including extreme rainfall events could cause changes to the on-site hydrology including increase in surface run-off leading to erosion of the concrete cap and engineered cover. Increased snowmelt events could also cause increase in the run-off events causing erosion of the concrete cap and the engineered cover. Changes to temperatures, precipitation, and extreme events such as drought could affect the on-site hydrology and the hydrogeology, impacting the drainage system and causing on-site erosion. Lastly, changes to temperature, precipitation, and extreme events such as drought could impact the selections of plant species for revegetation programs during the post-closure phase. Increase in mean annual temperatures and extreme heat could impact selection of plant species, and more drought-resilient plant species might have to be selected for revegetation. Interactions with wind/ tornadoes are not considered as it is unlikely that they could affect the concrete cap and engineered cover and the drainage system.

Table 10.5.2.3-1: Climate-Infrastructure Interactions Matrix

Infrastructure Components	Potential Climate Events and Change Factors							
	Temperature				Precipitation		Extreme Events	
	Extreme Heat	Extended Cold Spell	Growing Season Length	Freeze-Thaw Cycles	Frequency/ Amount of Heavy Rainfall Events	Changes in Snowfall	Forest Fires	Droughts
Concrete Cap and Engineered Cover				✓	✓	✓	✓	
Drainage System	✓		✓		✓	✓		✓
Final Site Restoration (Planting/ Landscaping over the Site)	✓	✓	✓		✓		✓	✓

10.5.2.4 Climate Change Resilience Profile

A qualitative climate risk assessment based on likelihood and consequence rankings has been conducted and summarized in Table 10.5.2.4-1. The likelihood of climate-infrastructure interactions occurring are evaluated qualitatively using the likelihood scale presented in Table 10.5.2.2-1. The resulting likelihood rankings are provided for near-term (2050s) and far-term (2080s) time periods, that represent the closure and the post closure institutional control time frame for the Project. Due to the projected increasing frequency of temperature, precipitation, and extreme events, the likelihood rankings generally reflect an increase in likelihood from 2050s to 2080s. The consequence of climate-interactions is independent to their likelihood of occurrence and represent the severity of impacts if an interaction were to occur and are based on the consequence scales presented in Table 10.5.2.2-2. The likelihood and consequence rankings consider the mitigation measures that would be implemented for the Project to reduce the climate impacts. Risk rankings are then derived by combining the likelihood and consequence rankings for each climate-infrastructure interaction.

In the near future (2050s) and far future (2080s), most interactions seem to have a negligible to moderate risk due to changes to temperature, precipitation, and extreme events. Overall, the lower level of risk is due to the existing mitigation measures and the monitoring and surveillance plans that would be in place during the post-closure phase.

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Table 10.5.2.4-1: Qualitative Climate Risk Assessment

Infrastructure	Climate Variable	Interaction Description	Current Mitigation Measures	Climate Rankings					
				Near-term (2050s)			Far-term (2080s)		
				Likelihood	Consequence	Risk	Likelihood	Consequence	Risk
Concrete Cap and Engineered Cover	Temperature	Increase in freeze-thaw cycles might cause physical damage to the concrete cap and engineered cover.	Changes in temperature will be tracked through the Environmental Assessment Follow-up Program for WL to inform the need for adaptive management. The concrete cap and engineered cover for the WRDF will be designed to limit damage due to natural freeze-thaw cycles. To limit damage from freeze-thaw cycles, the engineered cover includes layers of granular/soil materials of sufficient thickness above the concrete cap to effectively avoid frost penetration.	**Low**	**Low**	**Low**	**Very Low**	**Low**	**Negligible**
	Precipitation	Extreme rainfall events and increased snowfall could result in an increase in surface water runoff and subsequently cause erosion of the concrete cap and engineered cover.	The concrete cap and engineered cover system will be designed to minimize water infiltration, to direct infiltration away from the grouted structure and to resist degradation by surface geologic processes and biotic activity (e.g., deter intrusion by burrowing of animals). The concrete cap and engineered cover system have been designed to cover the entire footprint surface of the WRDF and the engineered cover will be graded to promote drainage from the site to the Winnipeg River, similar to the rest of the WL site.	**Very Low**	**Moderate**	**Low**	**Low**	**Moderate**	**Low**
	Extreme events	Forest fires could cause erosion of the soil cover and cause physical damage to the concrete cap and the engineered cover.	A Fire Protection Program would be implemented for the closure phase activities that would include preventing fire losses, providing responsible fire protection management, demonstrating compliance to applicable fire protection codes and standards and providing reliable facilities from a fire protection perspective. During post-closure, protection from forest fires will be provided by the 2.7 metres thick soil cover over the concrete cap, and it is unlikely for the forest fires to cause complete erosion of the soil cover. Period maintenance during institutional control period will be provided to control vegetation growth and erosion of the soil cover. Changes in extreme events, will be tracked through the Environmental Assessment Follow-up Program for WL to inform the need for adaptive management.	**Low**	**Low**	**Low**	**Low**	**Low**	**Low**

Table 10.5.2.4-1: Qualitative Climate Risk Assessment

Infrastructure	Climate Variable	Interaction Description	Current Mitigation Measures	Climate Rankings					
				Near-term (2050s)			Far-term (2080s)		
				Likelihood	Consequence	Risk	Likelihood	Consequence	Risk
Drainage System	Temperature	Extreme heat could affect hydrology and subsequently hydrogeology (i.e., changes in water table). Increase in the growing season length could cause overgrowth in the ditches and impact the drainage system.	Changes in groundwater elevation will be tracked through the Environmental Assessment Follow-up Program for WL to inform the need for adaptive management.	**Low**	**Low**	**Low**	**Moderate**	**Low**	**Low**
	Precipitation	Extreme precipitation events and changes in snowfall could affect hydrology and subsequently hydrogeology (i.e., changes in water table) and surface geology (i.e., erosion).	Changes in precipitation will be tracked through the Environmental Assessment Follow-up Program for WL to inform the need for adaptive management.	**Low**	**Moderate**	**Low**	**Moderate**	**Moderate**	**Moderate**
	Extreme events	Increase in droughts could affect the site hydrology and subsequently hydrogeology (i.e., changes in water table).	Changes in groundwater elevation will be tracked through the Environmental Assessment Follow-up Program for WL to inform the need for adaptive management.	**Low**	**Moderate**	**Low**	**Moderate**	**Moderate**	**Moderate**
Final Site Restoration	Temperature	Extreme heat or extended cold spells could impact the type of species selected for the restoration during the post-closure phase. Changes to the length of the growing season could impact the species selection and rehabilitation of vegetation.	Changes in temperature will be tracked through the Environmental Assessment Follow-up Program for WL to inform the need for adaptive management. Meteorological data will be collected on an annual basis to track local changes to hydrogeological and climatological processes during the institutional control period.	**Low**	**Low**	**Low**	**Moderate**	**Low**	**Low**
	Precipitation	Changes in extreme precipitation could impact the final site restoration and the type of species selected for the restoration during the post-closure phase.	Changes in precipitation, will be tracked through the Environmental Assessment Follow-up Program for WL to inform the need for adaptive management.	**Low**	**Low**	**Low**	**Moderate**	**Low**	**Low**
	Extreme events	Increased drought-like conditions could impact the type of species selected for the restoration during the post-closure phase. Forest fires could cause damage to the restored areas.	As identified in Section 10.3, CNL has an existing Fire Protection Program at the WL site, which will continue to be implemented during closure phase. The Fire Protection Program is dedicated to providing the highest level of fire and life safety to all CNL employees and facilities, which subsequently also provides protection to the surrounding areas. Changes in extreme events, will be tracked through the Environmental Assessment Follow-up Program for WL to inform the need for adaptive management.	**Low**	**Moderate**	**Low**	**Moderate**	**Moderate**	**Moderate**

10.5.2.5 Summary of Climate Change Resilience

A climate change resilience assessment was conducted for the Project to meet the requirements of the *Strategic Assessment of Climate Change, Revised October 2020* (Government of Canada 2020). The assessment follows the approach outlined in Infrastructure Canada's *Climate Lens - General Guidance* (Infrastructure Canada 2019). The assessment includes identifying climate-infrastructure interactions of the Project infrastructure with a range of climate variables for near term (2050s) and far term (2080s). The risk rankings assigned for the far term (2080s) would be applicable to the risks associated beyond 2100.

All the climate risks associated with the Project have negligible to moderate risks under the future climate. To ensure ongoing resiliency for the Project and reduce the climate impacts, ongoing monitoring will be implemented to monitor the performance of the infrastructure under the changing climate. Hence, based on the existing Project design and the monitoring and surveillance plans, the Project is resilient in the near term (2050s) and the far term (2080s) for a range of different climate variables.

10.6 Glaciation

Typically, glacial cycles are assumed to be approximately 100,000 years, with the glaciation phase lasting approximately 90,000 years and the deglaciation phase lasting approximately 10,000 years (Peltier 2011; Clark et al. 2009). The earth is currently in an interglaciation period, meaning that it is between ice ages. It is estimated that the current period, called the Holocene, began approximately 11,700 years ago (Clark et al. 2016). Records suggest that previous interglaciation periods have lasted anywhere from 10,000 to 20,000 years (Berger et al. 2003).

Global warming is anticipated to elongate the interglacial period and postpone the next glacial event by tens of thousands of years. The global warming projected until the year 2300 (0.6 to 7.8°C) represents a much higher warming rate than the rate seen at the end of the last glacial period (4°C over an estimated 8,000 years). This corresponds to a higher rate of increase in atmospheric carbon dioxide (CO_2) concentration than observed in previous periods (Clark et al. 2009; Berger et al. 2003). Coupling of climate change models and glaciation models predicts a relatively long interglacial period of about 55,000 years (Berger et al 2003) to 100,000 (Peltier 2011). Peltier (2011) also notes that if the concentrations of greenhouse gases remains similar to the present, another glacial event is unlikely due to the increased surface warmth. However, projections for atmospheric concentrations beyond 3,000 years let alone 100,000 after present are uncertain.

As the current climate trend will likely delay the interglacial period until 100,000 years after present, the scenario of human inhabitants returning to the area after the glacial retreat is projected to occur 140,000 years from the present. The assessment timeframe for the Decommissioning Safety Assessment Report (Golder 2021) is 10,000 years. The timeframe was determined using the criteria within *REGDOC-2.11.1, Waste Management: Volume III: Assessing the Long-Term Safety of Radioactive Waste Management* (CNSC 2018). The 10,000-year assessment timeframe encompasses the phase in which peak effects are anticipated. Glaciation may occur 100,000 years into the future, far beyond the timeframe that the facility is hazardous. Therefore, the Project is not expected to adversely affect human health or the environment following the next glaciation event. A detailed assessment of glaciation can be found in Section 5.4.3.2.6 of the Decommissioning Safety Assessment Report (Golder 2021).

10.7 Summary of Project Design Features and Mitigation

Table 10.7-1 summarizes the design features and mitigation implemented to reduce or eliminate potential effects of the environment on the Project components and activities.

Table 10.7-1: Environmental Factors That Can Affect the Project and Associated Mitigation

Project Component or Activity	Factors	Mitigation
Multi-component concrete cap and engineered cover	■ Rain ■ Extreme events	Extreme rainfall events could result in an increase in surface water runoff and subsequently, erosion of the concrete cap and engineered cover. The multi-component concrete cap and engineered cover system will be designed to cover the entire footprint of the decommissioned WR-1 Building and will be graded to promote drainage from the site to the Winnipeg River, similar to the rest of the WL site. The concrete cap and engineered cover will also be designed to minimize water infiltration, to direct infiltration away from the grouted structure and to resist degradation by surface geologic processes and biotic activity (e.g., deter intrusion by burrowing of animals). Meteorological records will be reviewed annually to confirm that performance of the concrete cap and engineered cover is not overloaded during the institutional control period. This will be included in the Environmental Assessment Follow-up Program for WL.
Decommissioning activities	■ Extreme events ■ Forest fires	Implementation of CNL's Emergency Preparedness Program and the Fire Protection Program will mitigate the consequences of a forest fire and other extreme events (e.g., storms, extreme rainfall and snow).
Long-term environmental monitoring	■ Temperature and precipitation ■ Extreme events ■ Climate change	Changes in temperature and precipitation, as well as frequency or magnitude of extreme events and erosion will be tracked through the Environmental Assessment Follow-up Program for WL to inform the need for adaptive management. Meteorological data will be collected on an annual basis to track local changes to hydrogeological and climatological processes during the institutional control period. This will be included in the Environmental Assessment Follow-up Program for WL.

11.0 SUMMARY OF MONITORING AND FOLLOW-UP AND PROGRAMS

11.1 Integrated Environmental Monitoring Program

Whiteshell Laboratories' (WL) Integrated Environmental Monitoring Program (CNL 2020) is designed to track radiological and non-radiological contaminants throughout the different compartments of the geosphere, atmosphere, and biosphere and consists of three distinct programs: the Effluent Verification Monitoring Program (EVMP), the Environmental Monitoring Program (EMP), and the Groundwater Monitoring Program (GWMP). The Management and Monitoring of Emissions, Environmental Protection Programs, Protection and Monitoring of Groundwater, and WL Environmental Assessment Follow-up Program outline the general requirements of each of the three monitoring programs (i.e., EVMP, GWMP, EMP). Implementation of these three programs under the Integrated Environmental Monitoring Program achieves the following main tasks:

- Direct release monitoring via the (EVMP);
- Contaminant pathways monitoring (via the EVMP, GWMP, and EMP); and
- Biological effects monitoring (via the EMP).

This integrated approach to environmental monitoring means that the evaluation of impacts on the environment from WL facilities and operations is carried out in a logical, comprehensive manner and is used to demonstrate compliance and protection of the environment and health and safety of the public.

The basis for the Integrated Environmental Monitoring Program is the WL CSR (AECL 2001) along with the associated WL Site's Dose Model. The Environmental Assessment Follow-Up Program described in Section 11.2 is used to confirm the effects predictions made in the CSR. The Integrated Environmental Monitoring Program is dynamic in nature meaning that it is continually evolving based on various sources of information received, such as:

- findings and conclusions from the WL Site-Wide Environmental Risk Assessment;
- results of the Environmental Assessment Follow-Up Program;
- data generated from the routine monitoring itself (e.g., a trend of interest is identified resulting in the need to increase monitoring in that location);
- outcomes of both integrated and annual program reviews (e.g., the need for an additional monitoring location based on site past or present operations);
- changes made to regulatory documents and/or standards;
- findings identified through internal or external audits (e.g., recommendation for the use of a different analysis method);
- changes in the routine operations of the site which are periodically reviewed through the Environmental Aspect Assessment process (e.g., a new process is implemented resulting in a change to a facility's routine emissions; and
- reviews of non-routine operations through an environmental review and/or EA (such as this Project).

11.1.1 Environmental Assessment Follow-up Program

The existing Environmental Assessment Follow-up Program for the WL site (CNL 2018a) is being implemented under Licence No. NRTEDL-W5-8.00/2024. The Program serves to evaluate the risk to relevant human and non-human biota receptors resulting from exposure to contaminants and stressors related to the WL site and its activities, and recommends further monitoring (i.e., through the EVMP, GWMP, and EMP) or assessment as needed based on the results, to clarify risks or reduce uncertainties.

The overall objectives of the Environmental Assessment Follow-up Program for the WL site are to:

- Verify the accuracy of the Environmental Assessment (CSR and this EIS);
- Determine the effectiveness of any mitigations measures that have been implemented;
- optimize the monitoring (i.e., EVMP, GWMP, EMP) and surveillance programs already in place at the WL site;
- verify/confirm that appropriate mitigation measures are implemented;
- verify effects predictions;
- identify effects of the Project that may not have been predicted;
- develop appropriate responses to unforeseen events;
- offset loss of potential nesting habitat of species at risk and monitor use of compensatory habitat;
- monitor wildlife mortality (including birds, reptiles and mammals) and use information for adaptive management; and
- communicate risks and other relevant information to First Nations, the Red River Métis and Stakeholders in meaningful ways.

The current Environmental Assessment Follow-up Program for the site has been updated with *"Work Package #10 Whiteshell Reactor Disposal Facility (WRDF) Enhanced Monitoring"* that includes work tasks for review and integration of WR-1 Project groundwater, environmental, and effluent monitoring requirements into the WL Integrated Environmental Monitoring Program, development of WR-1 specific monitoring and surveillance plan, and the preparation of remedial action plans for the Project in alignment with Environmental Protection Program Environmental Incident Reporting, Investigation and Mitigation (CNL 2018c). This will provide remedial actions that can be executed in a timely manner in case of unexpected monitoring results.

CNL will develop a Monitoring and Surveillance Plan for the In Situ Decommissioning of WR-1 at the WL Site (the Project) and integrate it into the existing Environmental Assessment Follow-up Program for the WL site. The Monitoring and Surveillance Plan will document the Environmental Assessment Follow-up activities for the Project and will include sufficient information on the type, quantity and quality of information required to reliably verify effects predicted by the environmental assessment and confirm the effectiveness of mitigations. Wherever possible, existing programs (i.e., EMVP, GWMP, and EMP) will be adapted to meet the objectives of monitoring the prediction in the environmental assessment for the Project.

The Monitoring and Surveillance Plan and the Environmental Assessment Follow-up activities for the Project will be prepared consistent with the Canadian Standards Association's Standards, as applicable:

- N288.4-10 (Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills [CSA Group 2010]);
- N288.5-11 (Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills [CSA Group 2011]); and
- N288.7-15 (Groundwater Protection Programs At Class I Nuclear Facilities and Uranium Mines and Mills [CSA Group 2015]).

The current compliance and monitoring programs for the WL site are listed below (CNL 2018d):

- Radiation Protection Program;
- Environmental Protection Program;
- Waste Management Program;
- Occupational Safety and Health Program;
- Emergency Preparedness Program;
- Nuclear Criticality Safety Program;
- Physical Security Program;
- Nuclear Materials and Safeguards Management Program;
- Fire Protection Program;
- Quality Assurance Program; and
- Environmental Assessment Follow-up Program for the WL site.

In the discipline assessments undertaken in Section 6.0 (Environmental Effects) of the Environmental Impact Statement (EIS), CNL has proposed monitoring and follow-up activities to be undertaken during the closure and post-closure stages of the Project. The Environmental Assessment Follow-up activities presented in this section provides a preliminary description of the activities and the framework for monitoring proposed for the Project. Each of the discipline-specific assessments presented in Sections 6.2 Atmospheric Environment through 6.9 Socio-economic Environment of the EIS proposes conceptual monitoring to be undertaken by CNL during the closure phase and the post-closure phase (i.e., institutional control period) of the Project, which are summarized in Table 11.1-1 in this Section. The monitoring activities are defined by the relevant project phase, consisting of:

- **Closure Phase**: Preparation and implementation of in situ disposal (ISD) includes grouting of below-grade structures and systems, removal of above-grade Whiteshell Reactor 1 (WR-1) building structures and systems, installation of the concrete cap and engineered cover, and environmental controls and final site restoration. These activities last from 2022 to 2027. During the closure phase, CNL will be responsible for implementing the commitments made in the Environmental Assessment Follow-up Program.

- **Post-closure Phase:** The post-closure phase has two discrete periods: institutional control and post-institutional control. Institutional control is estimated to last 100 years during which long-term monitoring and maintenance activities will continue to demonstrate compliance with the safety case assumptions. Passive controls such as access restrictions (e.g., physical barriers/fencing, signage, and land title instruments/deed restrictions) will remain in place until the end of the institutional control period. Although the duration of institutional control is estimated at 100 years, it is recognized that it will continue until the CNSC, or the appropriate authority at the time, agrees it is no longer needed.

  Post-institutional control occurs after year 2127 and continues indefinitely. The post-closure phase will continue indefinitely; however, the timeframe defined for assessment of potential effects as part of the normal evolution of the Project is 10,000 years. This time period encompasses the phase in which peak effects are anticipated.

Table 11.1-1 summarizes the conceptual monitoring to be included in the Monitoring and Surveillance Plan for the Project. If the environmental assessment produces a positive decision on the Project, CNL will work with the CNSC to enhance and finalize the Monitoring and Surveillance Plan for the Project and integrate it into the existing, wider WL Site Environmental Assessment Follow-up Program. CNL will also engage local municipal governments and regulators such as the Province of Manitoba, Fisheries and Oceans and Environment and Climate Change Canada. The CNSC, as the regulatory authority for the Project, will coordinate the review of the follow-up monitoring program with the interested Federal and Provincial agencies.

CNL will also engage with First Nations and the Manitoba Métis Federation on the inclusion of traditional knowledge in the Environmental Assessment Follow-up Program (Section 11.4). CNL has received interest from six Indigenous Nations on being involved in development of the program and execution of the monitoring and reporting. CNL will work with each Nation to determine how they choose to participate in the work.

As the proponent of the Project, CNL will be responsible for implementing and managing the proposed follow-up monitoring program. AECL, as the owner of the site, is responsible for providing funding to CNL for the management and operation of its sites as per contractual arrangement, including funding for the follow-up monitoring program, with these costs included in CNL's submission of a decommissioning financial guarantee and accompanying cost estimate that has been submitted to the CNSC as per the WL site licence. CNL will be responsible for the delegation of resources to develop, implement and integrate the programs identified in Table 11.1-1. The development and implementation of mitigations identified for the Project and housed in the monitoring and follow-up programs, are tracked in relevant management plans, with roles and responsibilities clearly defined in each plan.

Table 11.1-1: Environmental Assessment Follow-up and Monitoring Programs Proposed for the Project

EIS Section	Valued Component	Project Phase, Potential Effect and Conceptual Monitoring Program	Monitoring Program Objective	Suggested Duration	Implementing Program
Section 6.2 Atmospheric Environment	Air Quality	**Potential Source(s) of Effects:** ■ Closure activities will result in fugitive dust emissions. **Proposed Monitoring:** ■ Application of aggregate to unpaved roads – a record will be kept of the date of each application of aggregate to unpaved roads. ■ Dust Control on Roads – a record will be maintained of dust control treatment for roads. ■ Site inspection – during periods of high dust susceptibility, regular inspections will be carried out to monitor the efficacy of dust mitigation and any potential concerns with regards to fugitive dust, and if required implementation of mitigation will be recommended. Environmental conditions will be recorded. ■ Confirmatory monitoring of total suspended particulates (PM_{10}) and radioactivity will be conducted during demolition and other dust generating activities. **Trigger for Further Action:** ■ Investigation if parameters above predictions, applicable guidelines, thresholds or limits, or if actual number of vehicles/kilometres travelled exceeds the prediction on which emission estimates were based. ■ If high levels of dust are identified (qualitative), adjust dust suppression measures accordingly.	■ Verify that the following mitigation is being incorporated as planned and are effective. ■ Verify predictions are within air quality criteria. ■ Demonstrate compliance with regulatory requirements.	■ Throughout the closure phase.	■ Project air quality monitoring will be integrated into CNL's WL Effluent Verification and WL Environmental Monitoring Programs.
	Greenhouse Gases	**Potential Source(s) of Effects:** ■ Closure activities will result in increased greenhouse gas (GHG) emissions. **Proposed Monitoring:** ■ Fuel Usage – a record will be kept of the fuel usage related to the Project. **Trigger for Further Action:** ■ Investigation if parameters above applicable guidelines, thresholds or limits, or if actual number of vehicles/km travelled exceeds the prediction on which emission estimates were based.	■ Verify that GHG emission rates used in the assessment are reasonable, but conservative. Monitoring results will be used for GHG reporting requirements.	■ Annual estimations and GHG reporting, as required during the closure phase.	■ Monitoring of GHG emissions is already completed as part of CNL's WL Effluent Verification and WL Environmental Monitoring Programs. No new monitoring is required for Project-specific GHG emissions.

Table 11.1-1: Environmental Assessment Follow-up and Monitoring Programs Proposed for the Project

EIS Section	Valued Component	Project Phase, Potential Effect and Conceptual Monitoring Program	Monitoring Program Objective	Suggested Duration	Implementing Program
Section 6.3 Geological and Hydrogeological Environment	Geology	■ Monitoring and follow-up programs are not identified as there are no predicted residual effects to geology; rather, monitoring will be implemented for other disciplines (i.e., air quality and groundwater) to verify effects predictions for soil quality. For example, environmental monitoring will be completed throughout the institutional control period to confirm that the WRDF barriers are functioning as intended. This monitoring will be integrated into the overall CNL WL Groundwater Monitoring Program to verify that changes to soil quality as a result of groundwater are negligible. In addition, CNL's *Management and Monitoring of Emissions* will include monitoring objectives air quality to verify that air emissions during closure have a negligible effect on soil quality.			
	Hydrogeology	**Potential Source(s) of Effects:** ■ Changes to groundwater quality from the release of solutes into the groundwater as the grout and reactor components gradually deteriorate during post-closure phases. **Proposed Monitoring:** ■ Water elevation measurements to determine groundwater flow direction and gradients. ■ Sampling to confirm groundwater quality to detect potential releases of constituents from the WRDF. ■ Initial sampling frequency will likely be twice per year (spring and fall). **Trigger for Further Action:** ■ If groundwater parameters above applicable guidelines or upgradient groundwater, conduct soil and/or sediment sampling and analysis for contaminants of concern. ■ If significant unexpected changes to groundwater flow, employ geophysical methods to confirm integrity of the concrete cap and engineered barrier.	■ Verify effects predictions on groundwater from the Project. ■ Verify the effectiveness of mitigation. ■ Demonstrate compliance with regulatory requirements.	■ Groundwater monitoring will continue through closure and post-closure. Semi-annual water level measurement and water quality measurements will be completed; however, the frequency of recurrence of water sampling will be reviewed based on performance data. The number and location of wells, and parameters measured, may change based on an annual review of the data.	■ Project groundwater monitoring will be integrated into the overall CNL WL Groundwater Monitoring Program and will be compliant with *CSA N288.7-15: Groundwater Protection Programs at Class 1 Nuclear Facilities and Uranium Mines and Mills* (CSA Group 2015).
Section 6.4 Surface Water Environment	Hydrology	■ Monitoring and follow-up programs are not identified as there are no predicted residual effects to hydrology.			
	Surface Water Quality	**Potential Source(s) of Effects:** ■ Changes to surface water quality from the release of solutes into the groundwater as the grout and reactor components gradually deteriorate over time during the post-closure phases. **Proposed Monitoring:** ■ Monitor the quality of water in the Winnipeg River to evaluate whether the quality of the water is affected by the WRDF. ■ Monitor the quality of water in on-site ditches to verify the hydrogeological model. **Trigger for Further Action:** ■ Investigation (e.g., sediment analyses) if parameters above predictions, applicable guidelines, or indication of poor maintenance.	■ Verify effects predictions related to surface water quality. ■ Demonstrate compliance with regulatory requirements.	■ Surface water and ditch system water will be sampled on a semi-annual basis at one upstream and two downstream locations. Frequency of recurrence will be assessed based on performance data. ■ Water quality monitoring will continue through closure phase and post-closure phase (i.e., during institutional control).	■ Surface water monitoring in the receiving environment is already completed through CNL's WL Environmental Monitoring Program, which is compliant with *CSA N288.4-10: Environmental Monitoring Programs at Class 1 Nuclear Facilities and Uranium Mines and Mills* (CSA Group 2010). No new surface water quality monitoring is proposed for the Project.
Section 6.5 Aquatic Environment	Fish and Fish Habitat	■ Monitoring and follow-up programs for the Project specific to fish and fish habitat are not identified as there are no predicted residual effects to fish and fish habitat; rather, monitoring will be implemented for other disciplines (i.e., air quality, groundwater quality, and surface water quality) to verify effects predictions for fish and fish habitat. For example, environmental monitoring will be completed throughout the institutional control period to confirm that the WRDF barriers are functioning as intended. This monitoring will be integrated into the overall CNL WL Groundwater Monitoring Program to verify that changes to surface water quality, and subsequently fish and fish habitat, as a result of groundwater are negligible. In addition, CNL's *Management and Monitoring of Emissions* will include monitoring objectives air quality to verify that air emissions during closure have a negligible effect on surface water quality, and subsequently fish and fish habitat. ■ Although not required for the Project specifically, current Environmental Assessment Follow-up Program for the WL site includes water monitoring and collecting fish flesh at one location upstream and two locations downstream of the WL site. This monitoring will also verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implementedCNL will continue to carry out the existing Environmental Assessment Follow-up Program for the WL site as it is a requirement of CNL's current licence (NRTEDL-W5-8.00/2024) with the CNSC.			

Table 11.1-1: Environmental Assessment Follow-up and Monitoring Programs Proposed for the Project

EIS Section	Valued Component	Project Phase, Potential Effect and Conceptual Monitoring Program	Monitoring Program Objective	Suggested Duration	Implementing Program
Section 6.6 Terrestrial Environment	Vegetation	■ Monitoring and follow-up programs are not identified as there are no predicted residual effects to vegetation. ■ Although not required for the Project specifically, current Environmental Assessment Follow-up Program for the WL site includes collection of vegetation within the vicinity of the WL site and garden crop samples upstream and downstream from the site. This monitoring will also verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. CNL will continue to carry out the existing Environmental Assessment Follow-up Program for the WL site as it is a requirement of CNL's current licence (NRTEDL-W5-8.00/2024) with the CNSC.			
	Barn swallow	**Potential Source(s) of Effects:** ■ Closure and Post-Closure: If barn swallow are confirmed to be using the WR-1 Building as habitat through pre-disturbance surveys, there will be incremental contribution of the Project and all future decommissioning activities to the loss of potential nesting habitat in the RSA. There is predicted to be negligible effects on barn swallow, if determined to be nesting in the WR-1 Building, through the implementation of habitat compensation. **Proposed Monitoring:** ■ Barn swallow nest structures were installed in 2018 at the WL site proactively in consideration of potential loss of barn swallow nesting habitat from future decommissioning activities. ■ Effectiveness monitoring of compensatory barn swallow nest structures will be conducted to determine if the compensatory nest habitat is being used. ■ This compensation model and follow-up monitoring would be consistent with what has been designed by the Ontario Ministry of Natural Resources and Forestry. Barn swallows are designated as "Threatened" on the Ontario *Endangered Species Act*'s Species at Risk in Ontario list. An equivalent protocol has not been developed for Manitoba (barn swallow are not currently designated on the provincial *Endangered Species and Ecosystems Act*). Barn swallow are designated as "Threatened" under the federal *Species at Risk Act*. **Trigger for Further Action:** ■ If effectiveness monitoring shows that the barn swallow nest structure is not being used, it would be relocated to other suitable habitat on the site.	■ Offset the incremental contribution of the Project and all future decommissioning activity to the loss of potential nesting habitat in the RSA using compensatory nesting habitat. ■ Determine number of individuals using compensatory nesting habitat on an annual basis.	■ Annually for three years following installation.	■ Monitoring for barn swallow will be integrated into CNL's existing Environmental Protection Program. ■ A Biodiversity Plan will be developed and included in the Environmental Assessment Follow-up Program for the WL site.

Table 11.1-1: Environmental Assessment Follow-up and Monitoring Programs Proposed for the Project

EIS Section	Valued Component	Project Phase, Potential Effect and Conceptual Monitoring Program	Monitoring Program Objective	Suggested Duration	Implementing Program
Section 6.6 Terrestrial Environment	Bats	**Potential Source(s) of Effects:** ■ Closure and Post-Closure: If bats are confirmed to be using the WR-1 Building as habitat through pre-disturbance surveys, incremental contribution of the Project and all future decommissioning activity to the loss of potential anthropogenic maternity roosting habitat in the RSA. There is predicted to be negligible effects on bats, if determined to be roosting in the WR-1 Building, through the implementation of habitat compensation. **Proposed Monitoring:** ■ In consultation with CNL biologists on other CNL sites to be decommissioned in the future, and in consideration of future losses of anthropogenic structures that may provide roosting habitat at the WL site, offsetting in the form of bat boxes may be required if bats are confirmed to be using the WR-1 Building as habitat. ■ Criteria for appropriate siting, if required, may include: accessibility of box locations for installation and future monitoring of utilization/effectiveness, avoidance of areas with radiological contamination in surface water features and appropriate distance to anthropogenic disturbances to avoid sensory effects (i.e., noise). Immature forested areas adjacent to larger waterbodies (i.e., Winnipeg River) and wetlands are high priority locations, because these forest types do not currently provide high quality tree roosting habitat and would be most benefited by installation of bat roost boxes to expand the spatial coverage of potential roosting habitat within the RSA. Final site selection would be at the discretion of CNL biologists. ■ Effectiveness monitoring may be conducted to determine if boxes are being used for three years post-installation. **Trigger for Further Action:** ■ If effectiveness monitoring shows that the bat boxes are not being used by the target species, they would be relocated to other suitable habitat on the site.	■ Offset the incremental contribution of the Project and all future decommissioning activity to the loss of potential anthropogenic maternity roosting habitat across the RSA. ■ Install bat boxes and determine number of individuals and species using bat boxes on an annual basis.	■ Bat boxes should remain in place throughout the Closure Phase at minimum. Monitoring should take place annually for three years post-installation.	■ Monitoring for bats will be integrated into CNL's existing Environmental Protection Program. ■ A Biodiversity Plan will be developed and included in the Environmental Assessment Follow-up Program for the WL site.

Table 11.1-1: Environmental Assessment Follow-up and Monitoring Programs Proposed for the Project

EIS Section	Valued Component	Project Phase, Potential Effect and Conceptual Monitoring Program	Monitoring Program Objective	Suggested Duration	Implementing Program
Section 6.6 Terrestrial Environment	Snapping turtle	**Potential Source(s) of Effects:** ■ Closure: Minor increase in mortality risk on snapping turtle as a result of vehicle collisions, and negligible residual effect, if mitigation is implemented. ■ CNL will implement a follow-up monitoring program to address the uncertainty regarding the effectiveness of proposed mitigation for protecting snapping turtle populations. **Proposed Monitoring:** ■ Implementation of routine annual wildlife road surveys using protocols for road surveys available from other Canadian jurisdictions for similar species (e.g., Survey Protocol for Blanding's Turtle in Ontario [MNRF 2015]), to be conducted when snapping turtles are likely to cross (i.e., terrestrial life history period from May 1 to September 30). ■ Any road mortality or injury of snapping turtle (or other reptile species) will be reported and data will be compiled in a database that can be used to inform adaptive management for the site. **Trigger for Further Action:** ■ If, after mitigation and operational measures are shown to be ineffective and any mortality or injury of snapping turtle occurs, further mitigation will be considered in an adaptive management framework. This mitigation may take the form of: surveys of high-risk road crossing locations to determine if they are being used by turtles for crossing, potential upgrade of existing crossing culverts to enhance snapping turtle passage, consideration of the potential need to re-design or lengthen the existing amphibian and reptile fencing at the three most likely turtle crossings on Ara Mooradian Way, or consideration of the need to add fencing on any other roads where injuries or mortality of snapping turtle is recorded. ■ Based on results of routine wildlife road mortality surveys, evaluate implementation of traffic calming measures during the season when snapping turtles are expected to cross the road (i.e., terrestrial life history period from May 1 to September 30). These may include options such as further reduction of posted speed limit, installation of speed bumps, or other measures.	■ Track turtle observations during routine wildlife road surveys and use information for adaptive management.	■ Ongoing reporting and monitoring should take place annually over the active decommissioning period (until the start of institutional control).	■ Monitoring for snapping turtle will be integrated into CNL's existing Environmental Protection Program. ■ A Biodiversity Plan will be developed and included in the Environmental Assessment Follow-up Program for the WL site ■ Continuation of WL staff reporting of incidental wildlife observations.

Table 11.1-1: Environmental Assessment Follow-up and Monitoring Programs Proposed for the Project

EIS Section	Valued Component	Project Phase, Potential Effect and Conceptual Monitoring Program	Monitoring Program Objective	Suggested Duration	Implementing Program
Section 6.7 Human and Ecological Health	Human health and Ecological health	**Potential Source(s) of Effects:** ■ Closure activities will result in the release of airborne effluent from the WR-1 Building which could affect human and ecological health. ■ Release of solutes into the groundwater as the grout and reactor components gradually deteriorate over time during the post-closure phase may cause changes in groundwater quality, which could migrate towards the Winnipeg River and affect receptors along the Winnipeg River. **Proposed Monitoring:** ■ Monitoring for air quality as noted above (i.e., for dust, gross alpha, beta and gamma radiation monitoring of the filters). ■ Verification monitoring for tritium in air (post venting through WR-1 stack). ■ Passive tritium in air network monitoring (semi-annual change out) will be included as part of the Environmental Assessment Follow-up Program for the Project. Monitoring locations (approximately 4 of them) will be selected to be within the main upriver and downriver windrose sectors, at the site boundary and on-site mainly to monitor airborne tritium plumes potentially originating from the WRDF. ■ Estimate combustible gases (e.g., based on project-related traffic and equipment), as per atmospheric environment above. ■ Monitor contaminants of concern (e.g., lead, asbestos, tritium) in air displaced from grouting the below-grade structure, as per the atmospheric environment above. ■ Groundwater monitoring surrounding the WRDF, as noted above. **Trigger for Further Action:** ■ Investigation if parameters are above applicable guidelines identified.	■ Verify effects predictions related to air quality, groundwater quality and surface water quality to confirm no health effects are anticipated as a result of exposure to COPCs from the Project.	■ Dust monitoring would be carried out during the closure phase. ■ Monitoring of tritium in air will be initiated when the stack monitoring system is discontinued. This monitoring would be on-going during post-closure. The need for and duration of monitoring will be assessed based on annual review of monitoring data. ■ Groundwater and surface water quality monitoring would be on-going during closure and post-closure. The need for and duration of monitoring will be assessed based on an annual review of monitoring data. ■ WL currently conducts industrial hygiene assessments of lead, asbestos and mould within facilities as part of the decommissioning planning process.	■ Air quality monitoring for the Project will be captured through the implementation of CNL's WL Effluent Verification and WL Environmental Monitoring Programs. ■ Groundwater monitoring for the Project will be integrated into the overall CNL WL Groundwater Monitoring Program. ■ Surface water monitoring in the receiving environment is already completed through CNL's WL Environmental Monitoring Program. No new surface water quality monitoring is proposed for the Project.
Section 6.8 Land and Resource Use	■ Monitoring and follow-up programs are not specifically identified for land and resource use; rather, monitoring for environmental pathways noted above (i.e., air quality, groundwater quality, and surface water quality) will be implemented to verify effects predictions for land and resource use. ■ CNL is aware First Nations and the Manitoba Métis Federation have continuing concerns about the potential effects of the Project and more broadly the WL site and the potential effect on traditional land and resource use, and more specifically on water, wildlife, fish and plants upon which such use is based, and cultural and archaeological sites. As such, CNL is committed to involving First Nations and the Red River Métis in monitoring and will engage with them over the long-term to address on-going concerns. Beginning in 2019 the Manitoba Métis Federation had an Environmental Monitor observing CNL's environmental monitoring program. CNL has initiated discussions to also have First Nations and Métis Environmental Monitors who will report back to their communities. CNL will provide communication support to committee members, to help disseminate monitoring results. ■ CNL will continue to engage with local communities, municipalities and Indigenous peoples during the closure and post-closure phases.				

Table 11.1-1: Environmental Assessment Follow-up and Monitoring Programs Proposed for the Project

EIS Section	Valued Component	Project Phase, Potential Effect and Conceptual Monitoring Program	Monitoring Program Objective	Suggested Duration	Implementing Program
Section 6.9 Socio-economics	Government Finances Community Infrastructure and Services Community Well-being	There are no monitoring and follow-up programs specific to socio-economics; rather, concerns with respect to the Project are addressed through social commitments made by CNL. ■ CNL will proactively seek, engage and support meaningful discussion on issues and opportunities related to the Project. ■ CNL will work with each Indigenous Nation to ensure that relationships endure, grow and adapt to future activities. CNL is currently working on establishing an Indigenous Advisory Committee and relationship agreements with each engaged Indigenous Nation, which include liaison positions and create mechanisms to develop and implement initiatives that will help address each Nation's unique interests and concerns related to the Project and the Whiteshell Laboratories Closure overall. ■ CNL is committed to sharing information and working collaboratively with the Whiteshell Laboratories Community Regeneration Partnership1 (the Partnership), First Nations and the Red River Métis to help develop a feasible socio-economic plan and development of robust communication plan to convey and confirm the Project's safety. ■ Specifically for Sagkeeng First Nation, CNL has committed to co-developing a Community Environmental Monitoring Program (CEMP) through the Technical Working Group. Public information activities required as part of CNL's Public Information Program (2021) will be part of the Environmental Assessment Follow-up Program for the Project and will be summarized as part of the annual Environmental Assessment Follow-up Program progress report			

CNL = Canadian Nuclear Laboratories; ISD = in situ decommissioning; CNSC = Canadian Nuclear Safety Commission; GHG = greenhouse gas; $PMR_{10}R$ = particles nominally smaller than 10 micrometres (µm) in diameter; NPRI = National Pollutant Release Inventory; WRDF = Whiteshell Reactor Disposal Facility; RSA = Regional Study Area; LSA = Local Study Area; COPC = contaminant of potential concern; LGD = Local Government District; the Partnership = Whiteshell Laboratories Community Regeneration Partnership; RM = Rural Municipality; EIS = Environmental Impact Statement; CEAA 2012 = *Canadian Environmental Assessment Act, 2012*.

[1] The mandate of the Whiteshell Laboratories Community Regeneration Partnership is to develop a Socio-economic Plan for the region by the WL decommissioning activities, to subsequently implement the plan and to review, update and report on the plan annually (Skinner 2016).

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11.2 Adaptive Management

CNL is committed to achieving continual improvement in environmental performance through its management systems. CNL manages environmental-related matters through an existing Environmental Protection Program. The Environmental Protection Program is registered within the requirements of the International Organization for Standardization 14001:2015 standard (ISO 2015). The Environmental Protection Program includes compliance and improvement systems to evaluate areas for improvement or trending. The Environmental Protection Program will continue to be implemented during the Project's closure and post-closure phases, and will be updated, as needed, as part of an annual management review process.

The development and implementation of mitigations identified for the Project and housed in the Environmental Assessment Follow-up Program for the Project, will be tracked in relevant existing CNL plans. CNL's approach to adaptive management is defined in each plan. As site conditions and monitoring dictate, or as new technology emerges, CNL will adaptively manage site practices and monitoring programs to meet the defined objectives. For some programs, this involves regular evaluation of predictive models; which are clearly defined in each applicable plan.

Environmental monitoring of the entire WL site will continue as part of the Environmental Assessment Follow-up Program for the WL site. For the Environmental Assessment Follow-up Program for the Project, CNL will determine the initial monitoring locations and frequency of sampling based on the EIS, the WR-1 Environmental Risk Assessment and the Decommissioning Safety Assessment Report. The monitoring data will be assessed against established limits for concentrations of contaminants of potential concern. These concentration limits are well below established benchmarks for the protection of humans and the environment.

If the Environmental Assessment Follow-up Program for the Project identifies that adverse environmental effects are greater than predicted or results for any monitored contaminants of potential concern are above the established limits, then CNL will investigate the results, which may include additional sampling and analysis to help determine/confirm the source and extent of the contamination. CNL would also evaluate whether they result in changes to the conclusions in this EIS. If changes are confirmed, then CNL will evaluate the need for revised mitigation actions and management practices to manage effects, with engagement with First Nations and the Manitoba Métis Federation for openness and transparency. Any proposals on modifications to the monitoring program will be communicated to the CNSC. Where the need for revised mitigations is identified, they will be developed and implemented on a case-by-case basis by CNL staff, and may include soil removal and/or treatment of groundwater. As part of the Environmental Assessment Follow-up Program for the Project, CNL will prepare remedial action plans for responses to unexpected results as per the Environmental Protection Program Incident Reporting, Investigation and Mitigation (CNL 2018c). This will ensure that remedial actions can be executed in a timely manner.

In addition to incorporating the monitoring actions of this EIS into the Environmental Assessment Follow-up Program for the site, CNL is committed to reviewing and adapting the existing Environmental Assessment Follow-up Program for the WL site to incorporate Traditional Knowledge that has been collected through the environmental assessment for the Project, as well as through ongoing engagement and relationship building, in order to provide each community with the information that is relevant and important to them. In particular, the program will be modified to include monitoring of traditional foods as identified by Indigenous peoples. For example, a recommendation on CNL's environmental protection program was to include mushroom collection into the sampling program. CNL has since adjusted its environmental protection program to include mushroom

collection and CNL continues to look for additional ways to improve their monitoring program. CNL will continue to work with First Nations and the Red River Métis as the Environmental Assessment Follow-up Program for the Project evolves to address concerns and incorporate them into the program as appropriate.

A progress report will be prepared each year and will include a summary of the environmental monitoring results and the safety considerations of the waste left in situ. As part of CNL's engagement with the local municipal governments and regulators, the CNSC and First Nations and the Manitoba Métis Federation, CNL will incorporate their feedback on the monitoring program and expand it where appropriate.

Institutional controls are proposed to be in place for at least 100 years post closure, and the continuation of these controls would be based on regulatory input. Stopping a monitoring activity would occur once it can be shown that an effect has stabilized or has been reduced to a level where it is no longer considered significant by regulatory requirements or community concerns. Any proposals on modifications to the monitoring program will be communicated to the CNSC.

11.3 Data Management

The development and implementation of mitigations identified for the Project and housed in the monitoring and follow-up programs, are tracked in relevant management plans, where data management, including collection, storage, standards and responsible roles, are defined. Data collected will meet the required guidelines for collection and quality assurance and control. CNL will store information generated from the environmental assessment monitoring and follow-up program in a robust database for future analysis and reporting. Analysis of results from the monitoring and follow-up program will be reported and submitted to the relevant regulatory agencies as required.

11.4 Indigenous Engagement and Participation in Environmental Monitoring

The sections above outline the proposed monitoring activities required by the CNSC to verify the outcomes of the environmental assessment for the Project. CNL has also explained how the monitoring activities for the Project will be incorporated into the WL Integrated Environmental Monitoring Program for the overall WL Closure project. CNL will be updating this existing monitoring program to suit the ongoing needs of the Project, stakeholders and First Nations and the Red River Métis. During Project engagement activities (Section 4.0 Indigenous Engagement), the First Nations and the Manitoba Métis Federation expressed concerns about the potential long-term effects of the Project on the environment. They indicated that the health of the environment, species relied on for fishing and harvesting, and the risk to people in the area of the WL site are of great concern. They also expressed an interest in being actively involved in the development and implementation of an ongoing monitoring program and made a number of recommendations on how the current monitoring program could be amended to include components significant to the First Nations and the Manitoba Métis Federation. The following section outlines ongoing engagements and commitments to support meaningful discussion of and participation in future environmental monitoring and follow-up programs (CNL 2022) for the Project and the WL site.

CNL recognizes that the First Nations and the Red River Métis are stewards of the land and holders of Traditional knowledge who have a great interest in participating in monitoring at the WL site. CNL has thus committed to:

- Engaging with each Nation and the Manitoba Métis Federation on their specific interest and concerns regarding monitoring for the Project and the existing WL site Environmental Assessment Follow-up Program;
- Engaging with each First Nation and the Manitoba Métis Federation to on their specific interest and concerns regarding future land use ad end state criteria; and
- Working collaboratively with the engaged First Nations and the Manitoba Métis Federation to develop an initiative for Indigenous Nations to participate in environmental monitoring at the WL site.

The goal of the initiative is to help address concerns regarding protection of the environment, health of people, confidence in the health of country foods, and reduction of stigma associated with the Project. In general, key elements of the initiative may include:

- Expansion and evolution of the monitoring program at WL, through incorporation of feedback, recommendations, and Traditional knowledge.
- Opportunities for community monitors, youths and Elders from each First Nation and the Red River Métis to collect samples on site and in the surrounding area, including capacity development and training in environmental monitoring; and
- Collaborate on ecological restoration and address specific interests and concerns related to monitoring at the site.

Each Nation may have different preferences for how to participate in the initiative and CNL commits to development of a program that is flexible to the needs of each Nation. Some communities may be satisfied with CNL's annual reporting, while others may wish to participate by observing CNL monitoring or may wish to develop their own community-led monitoring programs, separate from CNL's program. CNL will encourage cooperation between communities to minimize redundancy and unnecessary duplication of effort and cost.

The initiative will also have a reporting and risk communication component to increase the level of awareness and participation from the wider community members and citizens. CNL currently provides updates on environmental monitoring activities to all First Nations and the Red River Métis and invites them to observe and participate. Further, CNL shares all the results of their annual environmental monitoring reports with all the communities and is in the process of developing a user-friendly document to share with Indigenous Nations. CNL will continually evaluate both the process and the outcome of the ongoing engagement and communication activities, to address and manage issues as they arise. Annual progress reports on the Environmental Assessment Follow-up Program for the WL site are prepared and will include a summary of the environmental monitoring results for the Project, as well as the safety considerations of the waste left in situ. The need for maintaining communication mechanisms during institutional control is recognized as being important. Public and Indigenous information activities required as part of CNL's Public Information Program will be part of the Environmental Assessment Follow-up Program for the Project and will be summarized as part of the annual progress report.

CNL has already been engaging with the First Nations and the Manitoba Métis Federation on this initiative, including participation in monitoring at the WL site and engagement on the Environmental Assessment Follow-up Program for the Project, to provide interested Nations with a demonstration of how comprehensive the program is, and to identify gaps in monitoring that may be best filled through the initiative. Through their participation, CNL continues to improve their Environmental Monitoring Program based on community feedback. CNL has had discussions with First Nations and the Manitoba Métis Federation on how future monitoring on the WL site could incorporate Indigenous interests, such as fish species of interest, and Traditional knowledge. In addition, CNL will be modifying its environmental protection program to include monitoring for traditional foods as identified by Indigenous peoples. For example, as a result of engagement on the Project's follow-up monitoring program thus far, CNL has committed to adding additional ground monitoring well(s) between the WR-1 reactor and the Winnipeg River as requested by the Manitoba Métis Federation , and has incorporated the sampling and monitoring of country harvested foods.

CNL has had discussions on participation in monitoring activities by First Nations and the Red River Métis and is providing the opportunity and funding for an environmental monitor from each community to observe CNL's environmental monitoring program in action, including collection of water, soil, and plant samples for analysis. CNL has also provided the communities with a list of upcoming monitoring activities and invited them to participate. CNL worked with each First Nation and the Red River Métis to support their involvement in the 2021 sampling collection.

Specifically for Sagkeeng, Sagkeeng, CNL, and AECL have signed a Collaboration Agreement to support an independent Community Environmental Monitoring Program (CEMP), that considers monitoring for country foods and community-driven risk communication plan. The CEMP would increase Sagkeeng's participation in monitoring of the WL site and surrounding areas, supporting the reduction of fear and stigma at and around the WL site. CNL will work collaboratively with AECL and Sagkeeng First Nation to develop the CEMP through the Technical Working Group.

12.0 CONCLUSIONS

12.1 Introduction

Canadian Nuclear Laboratories (CNL) is performing the decommissioning of the Whiteshell Laboratories (WL) nuclear research facility with site closure expected by 2027. CNL is licensed to perform this work under a Canadian Nuclear Safety Commission (CNSC) decommissioning licence (Licence No. NRTEDL-W5-8.00/2024). A Comprehensive Study Report (CSR) under the *Canadian Environmental Assessment Act* (1992) was completed for the decommissioning project in 2001.

CNL is applying for an amendment to the current decommissioning licence to carry out In Situ Decommissioning of Whiteshell Reactor-1 at the Whiteshell Laboratories Site (the Project), rather than dismantling and demolition as previously assessed in the CSR. The in situ disposal (ISD) approach includes partial dismantling and demolition along with passive, permanent disposal of the below-grade portions of Whiteshell Reactor 1 (WR-1). In situ disposal is a departure from the end-state defined in the CSR, and as a result, the Project qualifies as a designated project under Section 37(b) of the *Regulations Designating Physical Activities* (SOR/2012-147) of the *Canadian Environmental Assessment Act, 2012* (CEAA 2012), related to “the long-term management or disposal of irradiated fuel or nuclear waste”. A key element of the regulatory approvals process is the completion of an environmental assessment under the CEAA 2012, the results of which are documented in this Environmental Impact Statement (EIS).

The EIS includes an analysis of alternatives, a description of the process of public and Indigenous engagement, the results of studies of baseline conditions and a description and assessment of effects of the Project on the environment. The assessment was completed to demonstrate that proposed activities can be safely completed in compliance with the prescribed protective limits, including radiological doses to workers and members of the public, and the releases of radioactive material to the surrounding environment. The environmental assessment considers the closure phase (which includes decommissioning and site reclamation) and long-term monitoring during the post-closure phase of the Project. The EIS includes an assessment of likely cumulative effects of the Project in combination with other past, present or reasonably foreseeable projects. It describes the effects for normal conditions and as a result of accidents and malfunctions. The EIS also describes and assesses the likely effects of the environment on the Project.

12.2 Alternatives Analysis

The assessment considers only alternatives that can safely achieve the Project goals and are technically feasible. The recommended alternative for the decommissioning of WR-1, based on the alternatives analysis, is in situ disposal. In situ disposal allows CNL to decommission WR-1 and the WR-1 Building in a safe, cost effective manner, in a shorter timeframe and without interim storage of the resulting waste. In situ disposal is a safe option, reducing the risk to workers compared to full dismantling and providing long-term safety to the public and the environment. The in situ disposal approach also has the least reliance on undefined future disposal options or technologies.

CNL recognizes that Indigenous Nations would prefer to see other alternatives selected for the Project. All engaged First Nations and the Manitoba Métis Federation have expressed a varying level of concern over ISD or have expressed a preference for immediate dismantling and removal in order that the waste is taken out of their traditional territory. Sagkeeng First Nation provided the most extensive feedback of all Indigenous Nations,

including conducting their own alternative means analysis using their community values criteria and weighting. CNL has strongly considered First Nations and the Manitoba Métis Federation views, opinions and interests and have ongoing engagements and commitments that reflect their input on Alternative Means; especially in the area of trauma informed engagement and risk-informed communications to address psychosocial effects. CNL has invested and is committed to ongoing engagement with Indigenous Nations to discuss and resolve, where possible, their issues and concerns regarding the Project.

Based on an understanding of the hazards associated with WR-1, CNL believes that the Whiteshell Reactor Disposal Facility (WRDF) can be built to meet CNSC regulations, considering the recommendations from the international Atomic Energy Agency (IAEA) related to radiological waste disposal. CNL also believes that the safety case has been made that this dedicated facility can be used to permanently dispose of the waste with effective containment and isolation, rather than temporarily store it.

12.3 Project Description

For the Project, the concept for long-term waste management is based on the passive containment and isolation of the waste within the WRDF. The primary pathway for release of contamination from the WRDF is by groundwater that has infiltrated into the sub-surface structure, picked up contamination and then carried it out of the sub-surface structure to the surrounding environment. The WRDF is designed to provide passive containment and isolation of the wastes. Containment is achieved through robust design based on multiple barriers that includes using combined inherent natural and engineered barriers to provide safety following the decommissioning of WR-1. Systematically, the natural and engineered barriers include the reactor core and bioshield, grout fill, building foundation, concrete cap and engineered cover, and finally the geologic surround. Combined, the barriers form a rigorous system to provide long-term safety to the public and the environment, with environmental monitoring to be conducted to verify the effectiveness of the barriers.

The decommissioning activities for the Project include:

- preparation for ISD;
- grouting of below-grade structures and systems;
- removal of above-grade structures and systems;
- installation of a concrete cap and engineered cover;
- final site restoration; and
- preparation for institutional control.

CNL plans to start preparation and implementation of ISD in 2022, which includes grouting of below-grade structures and systems, removal of above-grade WR-1 structures and systems, installation of the concrete cap and engineered cover, and environmental controls and final site restoration (pending approval by the CNSC). The WRDF will be turned over to institutional control in 2027, which is assumed to last for a minimum of 100 years during which environmental monitoring and surveillance activities will be carried out. However, it is recognized that institutional control will continue until the CNSC agrees it is no longer needed.

12.4 Indigenous Engagement

Indigenous engagement is a key component of the environmental assessment process. As part of its corporate, environmental, and social responsibility, CNL encourages ongoing engagement and relationship building with the First Nations and the Manitoba Métis Federation throughout the course of the environmental assessment process for the Project and ongoing Whiteshell Laboratories closure and monitoring work.

Engagement with Indigenous Peoples for the Project began in 2016 and is ongoing. CNL has reached out to and/or engaged with Sagkeeng First Nation, the Manitoba Métis Federation, Black River First Nation, Brokenhead Ojibway Nation, Hollow Water First Nation, Wabaseemoong Independent Nations, Shoal Lake No.40 (Treaty No.3), Iskatewizaagegan No.39 Independent First Nation (Shoal Lake No.39 First Nation) (Treaty No.3), Northwest Angle No. 33 (Treaty No.3), and Grand Council Treaty #3. Although effort was made to reach out to all of the First Nations, the Manitoba Métis Federation, and Indigenous organizations identified, particular effort was placed on outreach to the Nations and organizations who expressed interest in the Project or that live and practice traditional activities in closest proximity to the WL site. These Nations are Sagkeeng First Nation, Black River First Nation, Brokenhead Ojibway Nation, Hollow Water First Nation, Wabaseemoong Independent Nations and the Red River Métis.

Feedback CNL has received during engagement with Indigenous Nations has been considered during the environmental assessment process. Key themes of the issues and concerns provided through feedback received to date on the Project include:

- relationship building;
- the ISD approach;
- alternative means assessment;
- psychosocial impacts;
- waste management;
- historical siting and operations of the WL site;
- valued components (VCs);
- accidents and malfunctions;
- incorporation of Traditional Knowledge;
- business and employment opportunities;
- future land use and tenure for the WL site; and
- participation in environmental monitoring;

The feedback on issues and concerns was incorporated into the EIS where applicable. CNL has taken steps to verify that issues and concerns expressed by First Nations and the Manitoba Métis Federation have been correctly documented and that information provided by the Nations, and the Nations' positions are correctly described and captured in the revised EIS and supporting documents. CNL appreciates all feedback received to date on the Project and remains committed to continuing discussions with First Nations and the Manitoba Métis Federation

after submission of the updated EIS, throughout the remaining environmental assessment steps, and during the remediation of the WL site.

12.5 Inclusion of Traditional Knowledge and Influence of Indigenous Engagement Feedback on the Environmental Assessment

Traditional knowledge influenced the environmental assessment for the Project. Traditional knowledge includes both traditional knowledge and feedback gathered through engagement and community-led studies. Traditional knowledge was primarily gathered through the Traditional Knowledge and Land Use Studies that were completed to further enable opportunities to capture and include traditional knowledge into the environmental assessment and the EIS by better understanding modern and traditional land and resource use near the WL site. Four Traditional Knowledge, Land Use and Occupancy Studies for the WL site were completed and shared with CNL for inclusion in the EIS. Examples include identification of VCs, defining spatial boundaries, descriptions of the environment, and identification and evaluation of Project interactions, and modification of and participation in the environmental monitoring programs.

The key interests and concerns raised by Sagkeeng First Nation; the Manitoba Métis Federation; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations have been assembled from a number of sources provided by the community to Canadian Nuclear Laboratories. Sources of information include formally submitted comments to the Canadian Nuclear Safety Commission as part of the environmental assessment process, comments and questions sent to Canadian Nuclear Laboratories regarding the Project, summaries of topics that have been discussed between Canadian Nuclear Laboratories and each Indigenous Nation at meetings, site tours, workshops, benchmarking trips, and the Traditional Knowledge and Land Use Studies. For each interest and concern, CNL has included references to sections of the EIS relevant to addressing the Nation's interest or concern.

12.6 Public Engagement

Engagement with the public and stakeholder representatives is a key component of the environmental assessment process. CNL operates a Public Information Program to inform the public (i.e., general public, as well as stakeholder representatives) about ongoing activities at CNL sites and the potential effects of these activities on the public. Engagement activities for the Project have been completed under the guidance of this program. This Public Information Program forms the basis of communication efforts with the public and helps to direct the establishment of long-term, mutually beneficial working relationships with their communities in proximity to CNL sites.

Key topics of the feedback received to date on the Project include:

- regulatory process;
- alternative means assessment;
- lessons learned;
- design and engineering details;
- effectiveness of the grout;

- radiological inventory;
- VCs;
- protecting the Winnipeg River;
- effects of the environment on the Project;
- contingency planning;
- environmental monitoring; and
- future land use and economic opportunity.

CNL appreciates all feedback received to date on the Project and remains committed to continuing discussions with the general public and stakeholder representatives after submission of the updated EIS, throughout the remaining environmental assessment steps, and during the remediation of the WL site.

12.7 Scope of the Environmental Assessment and Approach

The Project activities assessed in this EIS are limited to in situ disposal of the below-grade portion of the WR-1 Building. Other decommissioning activities for the WL site, documented in the CSR, have not changed and do not need to be reassessed.

The environmental assessment approach for the Project was developed to meet the requirements of Canadian Environmental Assessment Act, 2012 and the Generic Environmental Impact Statement Guidelines developed by the CNSC. The overall assessment approach includes the following steps:

- define the scope of the assessment (including VCs, spatial and temporal boundaries, and assessment cases);
- describe the existing environment;
- evaluate Project interaction and mitigation;
- conduct an analysis for each VC to predict residual effects from the Project;
- evaluate and describe the level of certainty in the assessment;
- classify and determine the significance of predicted residual effects; and
- identify monitoring and follow-up programs.

The following sections summarize the findings of the environmental assessment completed for each of the VCs.

12.8 Atmospheric Environment

12.8.1 Air Quality

The scope of the air quality assessment focuses on predicting changes in indicator compounds emissions (as a result of the Project) and comparison of these changes to the applicable guidelines and standards. The indicator compounds emissions from the Project include suspended particulate matter (SPM), particles nominally smaller than 10 micrometres (µm) in diameter (PM_{10}), particles nominally smaller than 2.5 µm in diameter ($PM_{2.5}$), carbon monoxide (CO), sulphur dioxide (SO_2) and nitrogen oxides (NO_x) expressed as nitrogen dioxide (NO_2). Emissions of particulates (SPM, PM_{10} and $PM_{2.5}$), CO, SO_2 and NO_x have the potential to affect aquatic, human and terrestrial

wildlife health. Particulate emissions, which are also referred to as fugitive dust, can also be a nuisance issue over which the public or Indigenous peoples are concerned. Air Quality focused on predicting changes in the concentrations of above-mentioned indicator compounds emissions; radiological and non-radiological hazardous parameters are considered in the Human and Ecological Health assessment.

Project activities will result in emissions associated with the operation of vehicles and equipment, as well as material handling emissions from above-grade building demolition, grouting, and temporary batch mixing plant or similar equipment operations. Project mitigations will be implemented to limit potential effects to air quality including the application of measures from CNL's Environmental Protection Program and Procedure for Management and Monitoring of Emissions, which includes operational control monitoring, air verification monitoring and environmental monitoring.

Fugitive dust from vehicle movement on paved roads is the largest contributor to suspended particulate matter emissions, PM_{10} and $PM_{2.5}$. Non-road equipment exhaust emissions are the largest contributors to NO_x and CO emissions. Finally, the largest contributor to SO_2 is fuel combustion for emergency power generators. Predicted concentrations of these indicator compounds are below applicable air quality guidelines and/or standards. Consequently, the residual effects from the Project on air quality was determined to be not significant.

12.8.2 Greenhouse Gases

Project activities will result in greenhouse gas (GHG) emissions (i.e., carbon dioxide, methane, and nitrous oxide) associated with the operation of vehicles and equipment. The GHG emissions are estimated to be less than 0.1% of the total provincial GHG emissions and less than 0.01% of the total national GHG emissions. Based on the comparison between the estimated annual emission to both the federal and provincial GHG emissions, the Project will result in minor releases of GHG, but is predicted to have a negligible residual effect on climate change and will not impact Canada's emission reduction efforts. In 2015, Canada represented less than 2% of total global GHG emissions. Therefore, any GHG emissions from the Project may be considered negligible on a global scale.

12.9 Geological and Hydrogeological Environment

12.9.1 Geology

The scope of the assessment focuses on geology, which includes bedrock, soils and geomorphology. Potential effects on geology are limited to changes in soil quantity and quality as a result of construction of temporary supporting infrastructure, and changes to soil quality from air emissions and groundwater transport from the WRDF into the groundwater. Temporary infrastructure will be located within the WL main campus, which is previously disturbed and developed, limiting potential effects to soil quality and quantity. Concentration of air emissions are predicted to be lower than applicable air quality guidelines/standards, thus negligible changes to soil quality are anticipated. The concrete cap and engineered cover will be designed to mitigate moisture infiltration into the WRDF and hence limit leakage through the WRDF to groundwater and subsequent changes in soil quality. Overall, the assessment of potential effects determined there are negligible residual adverse effects on geology.

12.9.2 Hydrogeology

The scope of the hydrogeology assessment focuses on changes to groundwater quality and quantity. Changes to groundwater quality from the Project due to the release of solutes into the groundwater as the grout and reactor components gradually deteriorate (post-closure) was identified as having a residual effect on the hydrogeological environment.

The Winnipeg River was identified by the post-decommissioning groundwater flow model as the principal receptor of groundwater discharge. The groundwater flow modelling indicates that the mean groundwater travel times from the WRDF to the Winnipeg River are an estimated 100 years. Overall, the residual adverse effects on hydrogeology are anticipated to be negligible.

Based on the Comprehensive Study Report, it was determined that the likelihood of contaminant transport beyond the Waste Management Area was very low and no effects on groundwater were anticipated from in situ decommissioning of the trenches; therefore, no overlap with the Project is expected.

12.10 Surface Water Environment

12.10.1 Hydrology

The scope of the hydrology assessment considers the potential effects of the Project to the flows and water levels of the Winnipeg River. Following the completion of closure activities, the WL site will be graded to promote drainage from the site to the Winnipeg River. In addition, run-off control for the engineered cover is designed to limit erosion and infiltration of water into the grouted structure. This is achieved by sloping the cover surface to maintain a slope toward the edges and the collection of water by the surface water management systems at the WL site. Natural runoff from the decommissioned WL site will continue to discharge to the Winnipeg River during the post-closure phase. Although the installation of the concrete cap and engineered cover at the WR-1 Building is expected to slightly alter the drainage rates and flow patterns; the changes are expected to be within the natural range of variation of flow in the Winnipeg River. Overall, the assessment of potential effects determined there are negligible residual adverse effects on hydrology.

12.10.2 Surface Water Quality

The scope of the surface water quality assessment considers the potential effects of the Project on surface water quality within the Winnipeg River. During the post-closure phase, groundwater may encounter the WRDF and then flow to the Winnipeg River, resulting in changes to surface water and sediment quality. The predicted maximum radionuclide concentrations in surface water at both the Nearfield (i.e., 50 m from the upstream edge of the groundwater seep) and the Farm A intake (i.e., 3,150 m downstream from the upstream edge of the groundwater seep) on the Winnipeg River are orders of magnitude lower than background groundwater concentrations. Predicted sediment concentrations of radionuclides are lower than their respective clearance levels.

Predicted maximum non-radionuclide concentrations in surface water and sediment are driven by current river concentrations and some parameters exceed available surface water or sediment guidelines. For example, the background concentration for lead exceeds the lowest available guidelines for surface water and sediment, but the maximum sediment concentrations at both the Nearfield and the Farm A intake in both surface water and sediment show no change from the background level as a result of the Project. Overall, the assessment of potential effects determined there are negligible residual adverse effects on surface water and sediment quality from changes in groundwater quality.

12.11 Aquatic Environment

The scope of the aquatic assessment focuses on the potential effects of the Project on the physical aspects of the aquatic environment. During closure, potential effects to the aquatic environment (which includes fish and fish habitat) include the transport of surface water runoff to the Winnipeg River in the vicinity of the WL site, changes in drainage rates and flow patterns due to the installation of the concrete cap and engineered cover at the WR-1

Building, and deposition of air emissions from demolition activities. The Project during the closure phase is not anticipated to affect the physical habitat of the Winnipeg River. With Implementation of a storm water management plan and CNL's *Management and Monitoring of Emissions*, site runoff and air and dust emissions are not predicted to impact the surrounding aquatic environment. As such, closure activities are predicted to have a negligible residual effect on fish and fish habitat.

An Ecological Risk Assessment was completed and for the post-closure phase, it evaluates the potential for adverse effects on aquatic health associated with exposure to chemical and radiological contaminant releases through the groundwater pathway from the WRDF in the long-term. There are no exceedances of the radiation benchmark for the aquatic biota in the Winnipeg River and all predicted doses are well below this level. Therefore, it is unlikely there would be significant adverse effects on aquatic populations or communities as a result of radionuclide releases in the long-term during the post-closure phase.

There are no exceedances of the hazard quotients identified for exposure of the aquatic receptors to non-radionuclides, with the exception of benthic invertebrates in groundwater. The hazard quotients for cadmium, lead and HB-40 exceeded 1 for the scenario where benthic invertebrates are exposed directly to groundwater. The assessment conservatively assumes the organisms spend their entire lives in the peak discharge zone, and that no dilution of the groundwater occurs in the shallow sediment layers where most benthic organisms reside. Moreover, the seepage area represents a small part of the benthic community habitat, and the maximum groundwater concentration assumed represents the worst-case period. As such, a realistic benthic invertebrate population is not likely to be at risk due to cadmium, lead and HB-40 exposure, and any adverse effects will be spatially and temporally limited. Overall, the changes in water quality and sediment quality are expected to result in a negligible residual adverse effect to the benthic invertebrate population relative to existing conditions.

12.12 Terrestrial Environment

The scope of the assessment focuses on potential effects of the Project on the terrestrial environment, including potential effects on the ecological and biological processes that connect species with each other and their physical environment. During closure, the Project will generate air and dust emissions from demolition activities. With Implementation of CNL's *Management and Monitoring of Emissions*, there is predicted to be negligible effects on the terrestrial environment from the Project as a result of air and dust emissions. Sensory disturbance, road mortality, and loss of nest/roost substrate also have the potential to affect terrestrial valued components during closure. Surveys to confirm whether nesting and/or roosting activity is occurring in the WR-1 Building will be conducted during the appropriate season the year prior to the initiation of decommissioning activities. If evidence of nesting or roosting activity is found, appropriate mitigation in the form of deterrents will be implemented under consultation with ECCC and in accordance with habitat protection provisions and the required permitting process under Species at Risk Act and potentially the Migratory Bird Conservation Act. The objective of the selected mitigation will be to prevent birds and bats from accessing the building during the period when it will be demolished. The potential for road mortality of snapping turtle will be addressed through adaptive management and ongoing monitoring and documentation of road mortalities. If road mortality of snapping turtle occurs, additional mitigation will be enacted, as required. Following implementation of mitigation and monitoring in an adaptive management framework, there is predicted to be negligible effects on the terrestrial environment during the closure phase as a result of the Project.

An Ecological Risk Assessment was completed and for the post-closure phase, it evaluates the potential for adverse effects on terrestrial biota associated with exposure to chemical and radiological contaminant releases in surface water through the groundwater pathway from the WRDF in the long-term. There are no exceedances of

the radiation benchmark for terrestrial biota and all predicted doses are well below this level. There are also no exceedances of the hazard quotients identified for exposure of the terrestrial receptors to cadmium, lead, HB-40 and xylene. Therefore, changes in surface water quality through the groundwater pathway are expected to result in a negligible residual effect to terrestrial populations or communities in the long-term during the post-closure phase.

12.13 Human and Ecological Health

12.13.1 Human Health Assessment

Specific to the Project, the human health risk assessment focused on public and Indigenous peoples' health and the health of WL site workers not involved in performing Project activities. Consistent with CSA N288.6-12, Nuclear Energy Workers directly involved in performing Project activities were not assessed because their potential doses are controlled through CNL's Radiation Protection Program. The assessment for public and Indigenous peoples' health considered locations where people are known to be present.

The receptors for the Human Health Risk Assessment were selected to be appropriate for assessment of both radiological and non-radiological stressors on human health. The most-affected off-site members of the public are defined as the "critical group", which include:

- Farms A and F (year-round occupants with livestock);
- On-site Farm (post-institutional control only); and
- Harvesters (traditional users of the area gathering local foods).

For the closure phase, the relevant COPCs are expected to be released via atmospheric releases from the WR-1 Building as reactor systems are dismantled, transported off-site or disposed of in situ within the WRDF. The closure activities are well encompassed by existing engineering and administrative controls currently in place at the WL site. The calculated radiological doses for the human receptors during closure (i.e., Farm A, Farm F, and downstream Harvester) are all below the CNSC public dose limit of 1 mSv/a, as well as the dose constraint for the Project of 0.25 mSv/a. Since the dose estimates are a small fraction of the public dose limit, no discernable health effects are anticipated due to exposure to radioactive releases from Project activities. Doses to workers will be monitored and managed as part of CNL's Radiation Protection Program. The application of the Radiation Protection Program ensures that exposures will be kept ALARA and below the effective dose limit of 100 mSv over 5 years, and below 50 mSv in any single year.

The post-closure phase is not expected to result in airborne effluent, as the grouting will have been completed, the above-grade building will have been completely decommissioned and a concrete cap and engineered soil cover will have been installed over the WRDF. The relevant COPCs are expected to be released via groundwater to the surface water. The total radiation dose to human receptors during the post-closure phase (i.e., Normal Evolution Scenario) are below the Canadian Nuclear Safety Commission public dose limit of 1 mSv/a, as well as the dose constraint for the Project of 0.25 mSv/a. Since the dose estimates are a small fraction of the public dose limit, no discernable health effects are anticipated due to exposure of potential critical groups to radioactive releases from the WL site during post-closure.

The doses to human receptors that could be exposed to the non-radiological COPCs (i.e., cadmium and lead) in surface water during post-closure were calculated based on total concentration (background plus Project

contribution). The hazard quotients derived for COPCs were below the protective benchmark for all receptors and pathways, other than the river drinking water pathway. If only the Project contribution is considered, the hazard quotients are well below the protective benchmark, indicating the Project contribution to the risk is minimal. Although uncertainties in the assessment exist, conservatism, such as using the highest release rates, has been included in the modelling so that residual effects are not greater than predicted.

A number of disruptive events were assessed to address uncertainties that arose during the definition of scenarios and conceptual models, with three bounding scenarios (disruptive events with the potential for greatest consequence) identified. These were:

- Inadvertent Human Intrusion: an exploration borehole drilled into the WRDF and exposure of wastes;
- Substantial Failure of In Situ Disposal Structure (WRDF Barrier Failure); and
- Well in Plume: an on-site resident drinking groundwater from a well capturing the plume from the WRDF.

For all bounding scenarios, the total radiation dose to human receptors during the post-closure phase are below the IAEA Upper Reference Level for Disruptive Events of 20 mSv/a. For exposure to non-radiological COPCs (i.e., cadmium and lead), the HQ exceeded the target values for some scenarios. However, the assessment was conservatively conducted to predict exposures to human receptors under these future unlikely conditions. Further, controls can be put in place to reduce the probability of the Disruptive Events (e.g., land use restrictions during post-institutional control period to reduce the likelihood of a human intrusion event).

A key concern of Indigenous peoples was effects to the health of harvesters from consuming fish, plants, and wildlife in the vicinity of the WL site. The approaches to exposure and toxicity assessment have ensured that the characterization of dose and risk has been undertaken in a manner that has not underestimated dose or risk. Overall, residual effects from radiological and non-radiological COPCs are considered to be not significant for all human health valued components, including harvesters, during the closure and post-closure phases.

12.13.2 Ecological Health Assessment

The scope of the Ecological Health Assessment focuses on evaluating the potential health effects to non-human biota (plants and animals) from Project activities. An environmental transport and pathways model was used to evaluate the effects of contaminants on ecological receptors. During closure, the assessment focuses on land animals and birds because releases are only expected via atmospheric pathways. After decommissioning (i.e., post-closure phase), the focus is on the aquatic animals, because releases are expected to be via groundwater to surface water pathways.

Results of the radiological dose assessment for the closure and post-closure phases indicate that doses to ecological health valued components are below their respective benchmark values. In addition, there are no exceedances of the HQs identified for exposure of the ecological receptors to cadmium, lead, HB 40 (with the exception of benthic invertebrates in groundwater) and xylene. Therefore, no significant adverse effects on either aquatic or terrestrial populations or communities as a result of these chemical releases are predicted.

The assessment indicates that there will be exceedances of the HQs for cadmium, lead and HB-40 for benthic invertebrates in groundwater. Benthic invertebrates were modelled assuming the organisms spend their entire lives in the peak discharge zone, and that no dilution of the groundwater occurs in the shallow sediment layers. This is conservative because a diffusion gradient will exist across the sediment-water interface, resulting in some

degree of dilution into the top layer of sediment where most benthic organisms reside. Moreover, the seepage area represents a small part of the benthic community habitat, and the maximum groundwater concentration assumed represents the worst-case period. As such, a realistic benthic invertebrate population is not likely to be at risk due to cadmium, lead and HB-40 exposure, and any adverse effects will be spatially and temporally limited, such that the community as a whole is not expected to be significantly affected.

Most of the disruptive events modelled do not have an effects pathway to impact the ecological environment. The WRDF Barrier Failure Disruptive Event is the modelled scenario that demonstrated the greatest effect on the ecological health. For the WRDF Barrier Failure Disruptive Event, all predicted radiological and non-radiological doses are well below their respective protective benchmark values indicating that no adverse residual effects are expected. Therefore, it is unlikely that there would be significant adverse effects on either aquatic or terrestrial populations or communities as a result of radionuclide and non-radionuclide releases under a barrier failure scenario.

A key concern of Indigenous peoples was long-term effects of the Project on fish, plants and wildlife important to Indigenous peoples. The approaches to exposure and toxicity assessment have ensured that the characterization of dose and risk has been undertaken in a manner that has not underestimated dose or risk. Overall, residual effects from radiological and non-radiological COPCs are considered to be not significant for all ecological valued components during the closure and post-closure phases.

12.14 Land and Resource Use

12.14.1 Traditional Land and Resource Use

The assessment of traditional land and resource use considers hunting, trapping, and gathering by Indigenous Peoples, archaeological and cultural sites, and the overall importance of the Winnipeg River. The Project could affect traditional land use through effects to vegetation, fish and wildlife and their habitats, and surface water quality in the Winnipeg River. Changes to these VCs could result from a change in the abundance and distribution of resources, the quality of the resource, and the ability to access resources including fish, wildlife and vegetation. Any of these changes could subsequently affect the ability and the desire to engage in activities in the area of the WL site.

Threshold exceedances in harvested receptors through atmospheric releases and waterborne dispersion of contaminants are not anticipated. In addition, the mitigation proposed to minimize Project effects on surface water quality, the aquatic environment, the terrestrial environment, human health and ecological health are anticipated to eliminate or mitigate any potential adverse effects to the resources on which traditional land and resource use are dependent.

In collaboration with First Nations and Manitoba Métis Federation and the public, CNL is committed to meaningful and ongoing engagement on the WL site remediation and clean-up activities. Although a small proportion of the WL site will have restrictions on use because of the Project, it is still anticipated that the majority of the site will be safe and appropriate for unrestricted use. Overall, decommissioning of the WL site will result in an increase in the land available for future use in the local area. Future uses/zoning have not been determined, but the end-state plan for the WL site is to return lands disturbed by site activities to a condition that is physically stable, safe and in keeping with the post-closure land use classification and release criteria. Consequently, the Project is expected to have a negligible effect on traditional land and resource use VCs.

CNL is aware that the First Nations and the Manitoba Métis Federation have continuing concerns about the potential effects of the Project and more broadly the WL site on traditional land and resource use. As such, CNL is committed to involving First Nations and the Red River Métis in monitoring and to engaging with them over the long-term to address on-going concerns. CNL will implement a WR-1 Environmental Assessment Follow-up Program to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. In addition, to mitigate perceptions related to the suitability for use of the WL site and the lands around it, CNL will support robust communication of environmental monitoring results to confirm the safety of the WL site and help address concerns about future uses.

12.14.2 Other Land and Resource Use

The assessment of other land and resource use includes consideration of non-Indigenous commercial, municipal, and federal land and resource use activities in proximity to the Project. These activities include agriculture, forestry, mineral claims and leases, water use, and outdoor recreation and tourism, sport fishing, outfitting, hunting, trapping, and winter activities.

The Project could affect outdoor recreation and tourism activities through effects to vegetation, fish and wildlife and their habitats, and surface water quality in the Winnipeg River. Changes to these valued components could result from a change in the abundance and distribution of resources, the quality of the resource, and the ability to access resources including fish, wildlife and vegetation. Any of these changes could subsequently affect the ability and the desire to engage in activities in the area.

There are not anticipated to be any threshold exceedances in human receptors through atmospheric releases and waterborne dispersion of contaminants. In addition, the mitigation proposed to minimize Project effects on surface water quality, the aquatic environment, the terrestrial environment, human health and ecological health are anticipated to eliminate or mitigate any potential adverse effects to the resources on which recreation and tourism activities are dependent.

The WL site has been operational since the 1960s, and no outdoor recreation and tourism activities are permitted on the site. Other land and resource use activities have persisted adjacent to the WL site, including uses of the Winnipeg River. It is expected that all activities and land uses adjacent to the WL site will be able to continue in the future as the Project will have no effect on land tenure or usage beyond the WL site boundaries. Overall, with mitigation and engagement in place, Project effects on other land and resource use are expected to be negligible.

CNL will implement an Environmental Assessment Follow-up Program for the Project to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. In addition, to mitigate perceptions related to the suitability for use of the WL site and the lands around it, CNL will support robust communication of environmental monitoring results to confirm the safety of the WL site and help address concerns about future uses.

12.15 Socio-economic Environment

Socio-economics refers to the way social and economic factors influence one another in local communities and households. The socio-economic environment assessment considers potential effects of the Project on the people and communities who are part of the existing socio-economic environment in the immediate vicinity of the Project. The socio-economic VCs chosen for the assessment are employment and income, business opportunities, government finances, community infrastructure and services, community well-being and public safety.

With in situ disposal, there will be a reduced amount of radioactive waste transported off-site, and thus a reduced amount of traffic generated. The reduction in traffic will limit the potential for transportation incidents and risks to public safety. Considering the small number of additional employees required by the Project and the reduced amount of waste transported off-site, changes traffic volumes associated with Project employment will have a negligible effect on the transportation infrastructure in the local area and reduce the probability that the public may be exposed to radioactive material.

The permanent presence of the WRDF will change the suitability of a small portion of the WL site for future uses due to the restrictive land use categories that will be applied to the Project site. Although a small proportion of the WL site will have restrictions on use because of the Project (i.e., 0.07 ha), it is still anticipated that the majority of the site will be safe and appropriate for unrestricted use, and that future designations will seek to maximize the amount of lands available for other uses.

The availability of land for future uses does not stem directly from environmental effects of the Project, but rather from the indirect effect of zoning restrictions that will be required for the Project site into the distant future. The public expressed concern with the Project because it would limit the types of businesses and industries that could use the WL site for future operations and therefore reduce the number of economic development opportunities available to them. CNL provides support for the Community Regeneration Partnership, which has been established to create a feasible socio-economic plan for the region, facilitate economic development and hopefully provide high quality employment to replace the losses associated with the overall WL site closure. Depending on the future uses and access to the WL site, the plan is expected to help focus recruitment efforts or provide another route for achieving the same economic goals without reliance on the WL site.

The implications of the change in decommissioning activities associated with WR-1 does not necessarily alter the number of new employment and/or contracting opportunities, but rather indirectly changes the nature of the employment and/or contracting opportunities available and timeframe. The proposed change will increase the requirements for engineering and construction, while decreasing the amount of transportation labour required. While the schedule for reducing employment has been accelerated, the Community Regeneration Partnership is working to enhance benefits for area communities and the Indigenous Nations in the local area to the extent possible.

Considering CNL's programming to support current employees in transitioning to new work, CNL's support of fostering economic development in the region, and the potential for siting a small modular reactor on the WL site, the Project's indirect effects on employment and income, and business opportunities are expected to be negligible relative to the overall closure of the site despite the accelerated timeline and change in land use restrictions.

While the Project does not return the WL site to an area completely available for unrestricted use, no residual adverse effects were identified between the Project and the aquatic environment or the terrestrial environment. Similarly, the ecological and human health risk assessment concluded it is unlikely that there would be significant adverse effects on either aquatic or terrestrial populations or communities as a result of maximum potential contaminant releases associated with the Project. Even under an accidents and malfunctions scenario (i.e., a WRDF Barrier Failure Disruptive Event), all predicted radiological and non-radiological doses are well below their respective protective benchmark values indicating that no adverse residual effects are expected. With negligible effects predicted to the biophysical environments, the assessment does not indicate the potential for direct or indirect effects to the well-being of communities.

Indigenous Nations have commented on the ongoing adverse effects the presence of the WL site has had on their well-being since the site's establishment in the 1960s, including ongoing fear and trauma for Sagkeeng First Nation members. The Manitoba Métis Federation, Black River First Nation, Hollow Water First Nation, and Brokenhead Ojibway Nation have also noted that WL site, along with other historical industrial development in the local area, have affected the communities' well-being by adversely affecting the environment. The change in the decommissioning strategy for WR-1 is understood from an Indigenous perspective as having the potential to result in fear, stigma and anxiety associated with the long-term presence of nuclear materials in the region. Given the importance of the topic to Indigenous Nations, CNL acknowledges that efforts to support dialogue and learning are central to the relationship going forward. CNL and Atomic Energy of Canada Limited recognize and acknowledge the cumulative impacts and trauma experienced by Sagkeeng First Nation members in relation to the initial siting of the WL site and are willing and committed to begin addressing this through community-led initiatives facilitated by the Technical Working Group. In addition, CNL, Black River First Nation, and Hollow Water First Nation signed a comprehensive relationship agreement to support greater community involvement in the Project. CNL and the Manitoba Métis Federation have also been working together to develop the draft multi-year relationship agreement that will help to mitigate the Manitoba Métis Federation's concerns on the Project.

The assessment does not indicate the potential for direct or indirect effects to the well-being of Indigenous Nations since the effects documented by local Indigenous Nations are linked to the historical presence of the WL site, there are no predicted changes to the biophysical environment, and CNL and Atomic Energy of Canada Limited are committed to working with the Manitoba Métis Federation and First Nations going forward to develop programs and initiatives that provide meaningful mitigation to Indigenous Nations to address the issues of fear and stigma identified.

12.16 Accidents and Malfunctions

This section of the Environmental Impact Statement focuses on accidents and malfunctions that could occur during the closure phase of the Project. Hazards, accidents and malfunctions that result in consequences only over long timeframes (i.e., post-closure phase) are not included in the accident and malfunction assessment, as they are assessed in the Decommissioning Safety Assessment Report and are encompassed by the bounding scenarios for the human and ecological health assessment.

To identify potential accident and malfunction events during the closure phase, as well as the potential health and environmental effects that may occur, the Project used a systematic and comprehensive approach. Credible events were identified through a review of Project activities to identify hazards, which were then assigned a likelihood and consequence severity ranking, and an overall risk priority level. The process of estimating the consequence severity index includes a consideration of existing CNL programs, procedures and policies that are in place to mitigate potential hazards.

Conventional occupational hazards are typical of a major construction project and evaluated to be controlled by human performance; thus, CNL has put in place provisions including training, procedures and oversight of contractors to achieve as-low-as-reasonably possible accident and malfunction rates. Events such as spills and leaks, off-site transportation accidents, system and equipment failure, fire and explosions are well understood and encompassed by existing and proven engineering controls, management program and standard operating procedures at the WL site. The residual risks for these accidents and malfunctions are expected to be within regulatory requirements. In addition, no off-site effects are predicted for the accident and malfunction scenarios, including those identified by the public and Indigenous Nations.

Management systems and safety culture already in effect at the WL site, where regular assessment of safety performance is conducted and lessons learned from experience are applied, will continue to be applied during the Project. Therefore, if an accident or malfunction situation occurs, CNL has procedures in place that address requirements for immediate response and post-event clean-up or remediation.

12.17 Effects of the Environment on the Project

The assessment focused on the effects of natural hazards (e.g., extreme weather events, forest fires, seismic events) and climate change on the Project. It summarized the risks associated with each kind of environmental change, along with environmental design features, management practices and other mitigation to reduce the risks.

Implementation of CNL's Emergency Preparedness Program and the Fire Protection Program will mitigate the consequences of a forest fire and other extreme events (e.g., storms, extreme rainfall, and snow) during the closure phase. During the post-closure phase, the concrete cap and engineered cover will be designed to limit water infiltration and to direct water away from the WRDF towards the Winnipeg River. The end-state plan for the WL site, which includes the WRDF, is to return lands disturbed by site activities to a condition that is physically stable, safe, and in keeping with the post-closure land use classification and release criteria. The drainage system for the reclaimed WL site will have the physical characteristics similar to natural drainage systems in the general geographic region in terms of dynamic stability, robustness, and longevity.

The Province of Manitoba is the least earthquake-prone area in Canada. Furthermore, the Canadian Nuclear Fuel Waste Management Program studied seismic stability in Northwest Ontario and Eastern Manitoba and found, based on a detection level of 2.5 on the Richter scale that the WL site and the southern two-thirds of Manitoba are aseismic. Liquefaction is not seen as an issue for the WL site due to the essentially aseismic conditions of Eastern Manitoba, and the consolidated nature of the overburden geology. The probability of earthquake damage from such low ground acceleration approaches zero in this area.

Climate change may result in shifts in the frequency and/or intensity of the extreme weather events, temperature precipitation and forest fires. When evaluating the potential effects from climate change, Project design features and mitigation as well as management and monitoring practices are also considered. The climate change resilience assessment completed for the Project indicates that the Project design is resilient to changes in climate. However, although the Project design is resilient, ongoing monitoring will be implemented as part of an adaptive management plan to monitor the performance of the infrastructure under the changing climate.

12.18 Monitoring and Follow-up Programs

Canadian Nuclear Laboratories will implement an Environmental Assessment Follow-up Program for the Project that will be integrated with the existing Environmental Assessment Follow-up Program for the WL site (being implemented under Licence No. NRTEDL-W5-8.00/2024). The purpose of the Environmental Assessment Follow-up Program for the Project is to verify the accuracy of environmental effects and determine the effectiveness of mitigation measures that have been implemented. The Environmental Assessment Follow-up Program for the Project will include sufficient information on the type, quantity and quality of information required to reliably verify effects predicted by the environmental assessment and confirm the effectiveness of mitigations. Wherever possible, existing programs (Effluent Monitoring Verification Program, the Groundwater Monitoring Program, and the Environmental Monitoring Program) will be adapted to meet the objectives of monitoring the predictions made in the environmental assessment for the Project.

The primary pathway for release of contamination from the Whiteshell Reactor Disposal Facility is by groundwater that has infiltrated into the sub-surface structure, picked up contamination and then carried it out of the sub-surface structure to the surrounding environment. As such groundwater monitoring during the post-closure phase is the main component of the Environmental Assessment Follow-up Program for the Project and adaptive management. A post-closure monitoring program will be developed as part of the Environmental Assessment Follow-up Program for the Project that will provide the sampling and analysis objectives and procedures for sampling and testing the groundwater quality in the vicinity of the Whiteshell Reactor Disposal Facility during the institutional control period. Data generated by the groundwater monitoring program will be evaluated on an ongoing basis within an adaptive management framework. If the Environmental Assessment Follow-up Program for the Project identifies that environmental effects are greater than predicted, then Canadian Nuclear Laboratories will evaluate whether they result in changes to the conclusions in this Environmental Impact Statement that describes the Project and assesses the likely effects of the Project on the environment. If changes are confirmed, then Canadian Nuclear Laboratories will evaluate the need for revised mitigation actions and management practices to manage effects. Where the need for revised mitigation is identified, it will be developed and implemented. Conversely, cessation of a monitoring activity might be appropriate once it has been shown that an effect has stabilized or has been reduced to a level where it is no longer considered significant with respect to regulatory requirements or community concerns. Any proposals on modifications to the monitoring program will be communicated to the Canadian Nuclear Safety Commission.

In addition to incorporating the monitoring actions of this Environmental Impact Statement into the Environmental Assessment Follow-up Program for the Project, Canadian Nuclear Laboratories is committed to reviewing and adapting the existing Environmental Assessment Follow-up Program for the Whiteshell Laboratories site to incorporate Traditional Knowledge that has been collected through the environmental assessment for the Project, as well as ongoing engagement and relationship building, in order to provide each community with the information that is relevant and important to them.

Canadian Nuclear Laboratories is committed to achieving continual improvement in environmental performance through its management systems. Canadian Nuclear Laboratories manages environmental-related matters through an existing Environmental Protection Program that includes compliance and improvement systems to evaluate areas for improvement or trending. The Environmental Protection Program will continue to be implemented during the Project's closure and post-closure phases, and will be updated, as needed, as part of an annual management review process.

Recognizing that the First Nations and the Red River Métis are stewards of the land who have a great interest in participating in monitoring at Whiteshell Laboratories site, Canadian Nuclear Laboratories has committed to engaging with each Nation on their specific interest and concerns regarding monitoring for the Project and the existing Whiteshell Laboratories Site Environmental Assessment Follow-up Program. Some of the key elements of the initiative may include expansion and evolution of the monitoring program at Whiteshell Laboratories, through incorporation of feedback, recommendations, Traditional knowledge, capacity development, including training in environmental monitoring, and opportunities for monitors from each First Nation and the Red River Métis to collect samples on site and in the surrounding area. The goal of the initiative is to help address concerns regarding protection of the environment, health of people, confidence in the health of country foods and to reduce stigma associated with the Project. It is also an opportunity to involve youth and Elders, collaborate on ecological restoration, and address Nation-specific interests and concerns related to monitoring at the site. Each Nation may have different preferences for how to participate in the initiative and Canadian Nuclear Laboratories commits to development of a program that is flexible to the needs of each Nation.

Canadian Nuclear Laboratories currently provides updates on environmental monitoring activities to all First Nations and the Manitoba Métis Federation and invites them to observe and participate in the monitoring activities. Further, Canadian Nuclear Laboratories shares all the results of their annual environmental monitoring reports with all the communities and is in the process of developing a user-friendly document to share with Indigenous Nations. Canadian Nuclear Laboratories will continually evaluate both the process and the outcome of the ongoing engagement and communication activities, to address and manage issues as they arise.

12.19 Conclusion

This EIS describes the Project, the existing environmental conditions on the WL site, and assesses the likely effects of the Project on the environment. The EIS includes an assessment of likely cumulative effects of the Project in combination with other past, present or reasonably foreseeable projects, as applicable. It describes the effects for normal conditions and as a result of accidents and malfunctions. The EIS also describes and assesses the likely effects of the environment on the Project.

Residual adverse effects were identified for air quality, hydrogeology, surface water quality, and human and ecological health. Mitigation and environmental design features implemented for the Project are well-understood and include existing practices at the Whiteshell Laboratories site. Canadian Nuclear Laboratories will implement an Environmental Assessment Follow-up Program for Whiteshell Reactor 1 to verify the accuracy of environmental effects and determine the effectiveness of mitigation that has or is to be implemented. Based on the evaluation, no significant adverse effects on human health or the environment were identified as a result of the Project.

Overall, the EIS confirms that the ISD approach provides a permanent, passive decommissioning end state, and incorporates proven technologies and best industry practices, including documented international experience. ISD is a safe technique, reducing the risk to workers compared to dismantling and provides long-term safety to the public and the environment. The Project design has been optimized to remain below the assessment criteria established to be protective of the environment and to demonstrate long-term safety of the workers, the public and the environment. In addition, institutional controls, including restrictions on land use and a program for monitoring will be implemented to verify and validate these conclusions.

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14.0 GLOSSARY, ABBREVIATIONS AND UNITS

14.1 Glossary

Table 14.1-1: Glossary Of Terms

Term	Definition
Acceptable Risk	A risk which is so small, whose consequences are so slight, or whose associated benefits (perceived or real) are so great, that persons or groups in society are willing to take or be subjected to that risk.
Activation Product	A radionuclide produced by activation. Often used in distinction from fission products. For example, in decommissioning waste comprising structural materials from a nuclear facility, activation products might typically be found primarily within the matrix of the material, whereas fission products are more likely to be present in the form of contamination on surfaces
Acute	With reference to toxicity, having a sudden onset, lasting a short time (usually within hours or days). With reference to a stimulus, severe enough to rapidly induce a response.
Acute Toxicity	Adverse effects occurring following oral or dermal administration of a single dose of a substance, or multiple doses given within 24 hours, or an inhalation exposure of 4 hours.
Adaptive Management	A management approach that involves the monitoring and evaluation of a reclaimed area's performance followed by any necessary actions to achieve the intended performance objectives. Adaptive management also allows information to be fed back into the planning and design process so that future reclaimed areas will meet the intended objectives.
Anthropogenic	Coming from or having been caused by man.
Anticipated Operational Occurrences	An operational process deviating from normal operation which is expected to occur at least once during the operating lifetime of a facility but which, in view of appropriate design provisions, does not cause any significant damage to items important to safety nor lead to accident conditions.
Archaeological Resources	Any material remains of past human life or activities which are of archaeological interest.
As Low As Reasonably Achievable (ALARA)	An optimization tool in radiation protection used to keep individual, workplace and public dose limits as low as reasonably achievable, social and economic factors being taken into account. ALARA is not a dose limit; it is a practice that aims to keep dose levels as far as possible below regulatory limits.
Background Radiation	The dose, dose rate or an observed measure related to the dose or dose rate, attributable to all sources other than the one(s) specified.
Batholith	A large mass of intrusive igneous rock (also called plutonic rock) formed from cooled magma deep in the Earth's crust.
Bioaccumulation Factor (BAF)	Bioaccumulation factor (BAF) is the quotient obtained by dividing the concentration of a substance in tissue by its concentration in a specified exposure medium, for example, air, food, sediment, soil, water.
Becquerels	The SI (International System) unit of radioactivity, corresponding to one disintegration per second.
Best Management Practice	Operating practice that enhances the sustainability of the resource to which the practice relates. Must be practical and economically achievable.
Beta Radiation	The emission of a beta particle from the nucleus of an atom.

Table 14.1-1: Glossary Of Terms

Term	Definition
Bioavailability	The amount of chemical which is actually available to the target tissues following exposure.
Chronic	Involving stimulus that is lingering or continues for a long time; often signifies periods from several weeks to years, depending on the reproductive life cycle of the species. Can be used to define either the exposure or the response to an exposure (effect). Chronic exposure typically induces a biological response of relatively slow progress and long continuance.
Contaminated Areas	An area where the condition or state of soil, water, or air caused by a substance release or escape results in an impairment of, or damage to, the environment, human health, safety, or property.
Contamination	(1) Radioactive substances on surfaces, or within solids, liquids or gases (including the human body), where their presence is unintended or undesirable, (2) the presence of such substances in such places or (3) the process giving rise to their presence in such places.
Cooling	A term used to describe the process of allowing radioactivity to decay and the rate of heat generation to decrease as in the case of vitrified HLW and spent fuel.
Corporate Social Responsibility	A business approach that contributes to sustainable development by delivering economic, social and environmental benefits for all stakeholders.
Crown Corporation	Any corporation that is established and regulated by a country's state or government.
Datum	A fixed starting point of a scale or operation.
Decommissioning	Administrative and technical actions taken to allow the removal of some or all of the regulatory controls from a facility. This does not apply to a repository or to certain nuclear facilities used for mining and milling of radioactive materials, for which closure is used.
Decontamination	The complete or partial removal of contamination by a deliberate physical, chemical or biological process.
Deep Geological Repository	A facility for disposal of radioactive waste located underground (usually several hundred metres or more below the surface) in a geological formation to provide long term isolation of radionuclides from the biosphere.
Diffusion	The movement of atoms or molecules from a region of higher concentration of the diffusing species to regions of lower concentration, due to a concentration gradient
Dismantling	The disassembly and removal of any structure, system or component during decommissioning. Dismantling may be performed immediately after permanent retirement of a nuclear facility or it may be deferred
Drainage Basins	Area draining to a lake, stream, reservoir or other body of water.
Duty To Consult	In Canada, the duty to consult and accommodate with Aboriginal peoples arises when the Crown contemplates actions or decisions that may affect an Aboriginal person's Aboriginal or Treaty rights.
Effluent	Liquid waste or sewage discharged into a river, lake or the sea.
Environmental Assessment	A planning tool used to identify the possible environmental effects of a proposed project and to determine if the adverse effects can be mitigated.
Environmental Impact Statement	A document that provides a detailed review of an environmental assessment and related studies.
Environmental Management System	Refers to the management of an organization's environmental programs in a comprehensive, systematic, planned and documented manner. It includes the organizational structure, planning and resources for developing, implementing and maintaining policy for environmental protection.

Table 14.1-1: Glossary Of Terms

Term	Definition
Eutrophic	A lake or other body of water that is rich in nutrients and supporting a dense plant population, the decomposition of which kills animal life by depriving it of oxygen.
Fission	The division of a heavy nucleus into two (or, rarely, more) parts with masses of equal order of magnitude; usually accompanied by the emission of neutrons and gamma radiation.
Friable	Material that can be readily reduced to dust or powder by hand or moderate pressure.
Fugitive Dust	Small airborne particulate matter which generally comes from soil. Fugitive dust is suspended in the air by wind action and human activities.
Gamma Radiation	Gamma rays are the most energetic form of electromagnetic radiation, with a very short wavelength of less than one-tenth of a nanometer. Gamma radiation is the product of radioactive atoms.
Gamma Spectroscopy	The quantitative study of the energy spectra of gamma-ray sources, in the nuclear industry, geochemical investigation, and astrophysics. Most radioactive sources produce gamma rays, which are of various energies and intensities.
Geiger Tube	It is a gaseous ionization detector and uses the Townsend avalanche phenomenon to produce an easily detectable electronic pulse from as little as a single ionising event due to a radiation particle.
Greenhouse Gases	A gas in the atmosphere that absorbs and emits radiation within the thermal infrared range. The primary greenhouse gases in the Earth's atmosphere are water vapor, carbon dioxide, methane, nitrous oxide, and ozone.
Hazardous Materials	Materials that are potentially hazardous to human health and/or the environment due to their nature and quantity and that require special handling and storage techniques.
High Level Waste	Includes used nuclear fuel and other wastes (e.g., reprocessing wastes) that have been declared as radioactive waste that generate significant heat via radioactive decay. Used nuclear fuel is associated with penetrating radiation and contains significant quantities of long-lived radionuclides.
Hydraulic Conductivity	Symbolically represented as K, is a property of vascular plants, soils and rocks that describes the ease with which a fluid (usually water) can move through pore spaces or fractures.
Hydrofluorocarbons	Organic compounds that contain fluorine and hydrogen atoms, are the most common type of organofluorine compounds. They are commonly used in air conditioning and as refrigerants.
Infrared Radiation	A type of electromagnetic radiation, as are radio waves, ultraviolet radiation, X-rays and microwaves. Infrared light is the part of the electromagnetic spectrum that people encounter most in everyday life, although much of it goes unnoticed. It is invisible to human eyes, but people can feel it as heat.
Intermediate Level Waste	Typically exhibits levels of penetrating radiation sufficient to require shielding during handling and interim storage and contains significant quantities of long lived radionuclides.
Ion Exchange	A usually reversible exchange of one ion with another, either on a solid surface, or within a lattice. A commonly used method for treatment of liquid waste.
Ionizing Radiation	A form of radiation that is capable of adding or removing electrons as it passes through matter (such as air, water, or living tissue).
Lc_{50}	LC_{50} is the lethal concentration of a toxin that is required to kill 50% of the population.
Low Level Waste	Contains material with radionuclide content above established clearance levels and exemption quantities, but generally has limited amounts of long lived activity. Low-level waste requires isolation and containment for up to a few hundred years.
Metasedimentary	Sediment or sedimentary rock that appears to have been altered by metamorphism.

Table 14.1-1: Glossary Of Terms

Term	Definition
Mixed Waste	Radioactive waste that also contains hazardous substances.
Molybdenum	The chemical element of atomic number 42, a brittle silver-gray metal of the transition series, used in some alloy steels.
Near Surface Disposal Facility	A facility for disposal of radioactive waste located at or within a few tens of metres from the earth's surface.
Nitrate	A salt or ester of nitric acid, containing the anion NO_3^- or the group —NO_3.
Nitrification/Denitrification	The biological oxidation of ammonia or ammonium to nitrite followed by the oxidation of the nitrite to nitrate. The transformation of ammonia to nitrite is usually the rate limiting step of nitrification. Nitrification is an important step in the nitrogen cycle in soil.
Nitrite	A salt or ester of nitrous acid, containing the anion NO_2^- or the group —NO_2.
Noble Gases	Any of the gaseous elements helium, neon, argon, krypton, xenon, and radon, occupying Group 0 (18) of the periodic table. They were long believed to be totally unreactive but compounds of xenon, krypton, and radon are now known.
Nuclear Facility, Sites	A facility and its associated land, buildings and equipment in which radioactive materials are produced, processed, used, handled, stored or disposed of on such a scale that consideration of safety is required.
Perfluorocarbons	Organofluorine compounds with the formula CxFy, i.e., they contain only carbon and fluorine.
Polychlorinated Biphenyls (PCBs)	Any of a class of toxic aromatic compounds, often formed as waste in industrial processes, whose molecules contain two benzene rings in which hydrogen atoms have been replaced by chlorine atoms.
Radiation Field	Represents the energy lost from the source radiator to space.
Radioactive Decay	The process by which the nucleus of an unstable atom loses energy by emitting radiation, including alpha particles, beta particles, gamma rays, and conversion electrons.
Radioactive Waste	For legal and regulatory purposes, waste that contains or is contaminated with radionuclides at concentrations or activities greater than clearance levels as established by the regulatory body. It should be recognized that this definition is purely for regulatory purposes and that material with activity concentrations equal to or less than clearance levels is radioactive from a physical viewpoint — although the associated radiological hazards are considered negligible.
Radiological	Involving radioactive materials
Radionuclide	A nucleus (of an atom) that possesses properties of spontaneous disintegration (radioactivity). Nuclei are distinguished by their mass and atomic number.
Reasonably Foreseeable Developments	Industrial or construction projects and developments that are approved or under approval, and are likely to commence in the reasonably foreseeable future.
Remediation	Any measures that may be carried out to reduce the exposure from existing contamination through actions applied to the contamination itself (the source) or to the exposure pathways to humans.
Residual Effects	Environmental effects predicted to remain after the application of mitigation outlined in an environmental assessment. The predicted residual effects are considered for each Project phase.
Shielding	A material interposed between a source of radiation and persons, or equipment or other objects, in order to absorb radiation and thereby reduce radiation exposure.

Table 14.1-1: Glossary Of Terms

Term	Definition
Sievert	The SI unit of absorbed radiation dose in living organisms modified by radiation type and tissue weighting factors. The sievert is the unit of dose measuring the “equivalent dose" and “effective dose". It replaces the classical radiation unit the rem. Multiples of sievert used in practice include millisievert (mSv) and microsievert (µSv).
Sorption	The interaction of an atom, molecule or particle with the surface of a solid. A general term including absorption (sorption taking place largely within the pores of a solid) and adsorption (surface sorption with a non-porous solid). The processes involved may also be divided into chemisorption (chemical bonding with the substrate) and physisorption (physical attraction, for example by weak electrostatic forces).
Source Term	The amount and isotopic composition of material released (or postulated to be released) from a nuclear facility.
Stochastic Effects	A term used to group radiation-induced health effects (such as cancer or inheritable diseases) which have a statistical risk. For these diseases, the probability of their occurrence increases proportionally to the radiation dose received: the higher the dose, the higher the probability of occurrence.
Subsurface Water	Water that flows or collects beneath the Earth's surface.
Sulphur Hexafluoride	Organic, colorless, odorless, non-flammable, extremely potent greenhouse gases, which are excellent electrical insulators.
Surface Water	Surface water is water collecting on the ground or in a stream, river, lake, wetland, or ocean.
Total Suspended Solids	Solids in water that can be trapped by a filter. TSS can include a wide variety of material, such as silt, decaying plant and animal matter, industrial wastes, and sewage. High concentrations of suspended solids can cause many problems for stream health and aquatic life.
Tritium	An isotope that occurs both naturally and as a by-product in nuclear reactors. Tritium is a radioactive isotope of hydrogen having two neutrons and one proton in its nucleus; hydrogen, by comparison, has only one proton. Tritium decays by emitting an electron (beta radiation) and has a half-life of 12.33 years.
Valued Component	Refers to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, government agencies, Aboriginal peoples, or the public.
Volatile Organic Compounds	Organic compounds that easily become vapors or gases.
Waste Acceptance Criteria	Quantitative or qualitative criteria specified by the regulatory body, or specified by an operator and approved by the regulatory body, for radioactive waste to be accepted by the operator of a repository for disposal, or by the operator of a storage facility for storage.
Waste Streams	The total flow of solid waste from homes, businesses, institutions, and manufacturing plants that is recycled, burned, or disposed of in landfills, or segments thereof.

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14.2 Abbreviations

Table 14.2-1: List of Abbreviations

Abbreviation	Definition
3-D	three-dimensional
AAQC	Ambient Air Quality Criteria
AC	alternating current
ACM	asbestos-containing material
AECL	Atomic Energy of Canada Limited
ALARA	As Low As Reasonably Achievable
Am-241	americium-241
Am-243	americium-243
AP	activation products
BBS	Breeding Bird Survey
C.C.S.M.	Continuing Consolidation of the Statutes of Manitoba
C-14	carbon-14
ca.	*circa*
Ca-41	calcium-41
CAAQS	Canadian Ambient Air Quality Standards
CAC	Criteria Air Contaminant
CAL3QHC	dispersion model
CANDU	Canadian Deuterium Uranium
CBC	Canadian Broadcasting Corporation
CCME	Canadian Council of Ministers of the Environment
CCS	coverage count stations
CDC	Manitoba Conservation Data Centre
CEAA 2012	*Canadian Environmental Assessment Act, 2012*
Cl-36	chlorine-36
Cm-244	curium-244
CNEA	Canadian National Energy Alliance
CNL	Canadian Nuclear Laboratories
CNSC	Canadian Nuclear Safety Commission
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
Co-60	cobalt-60
COG	Candu Owners Group
COPC	Contaminants of Potential Concern

Table 14.2-1: List of Abbreviations

Abbreviation	Definition
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CP	corrosion products
Cs-137	caesium-137
CSA	Canadian Standards Association
CSR	Comprehensive Study Report
CWB	Community Well-being Index
DC	direct current
DDP	Detailed Decommissioning Plan
DRL	Derived Release Limits
DSAR	Decommissioning Safety Assessment Report
EAFP	Environmental Assessment Follow-up Program
ECCC	Environment and Climate Change Canada
EcoRa	Ecological Risk Assessment
EIS	Environmental Impact Statement
EM	Environmental Monitoring
EOC	Emergency Operations Centre
EPA	Environmental Protection Agency
ERA	Environmental Risk Assessment
ESEA	*Endangered Species and Ecosystems Act*
Eu-152	europium-152
Eu-154	europium-154
Eu-155	europium-155
Fe-55	iron-55
FEP	Features, Events and Processes
FP	fission products
FPTCCCEA	Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment
GHA	Game Hunting Area
GHG	greenhouse gas
GHGRP	Greenhouse Gas Reporting Program
GoCo	Government-owned, Contractor-operated
GPS	Global Positioning System
H-3	tritium
HEPA	High-efficiency Particulate Air
HFC	Hydrofluorocarbon
HHRA	Human Health Risk Assessment

Table 14.2-1: List of Abbreviations

Abbreviation	Definition
HQ	Hazard Quotient
I-129	iodine-129
IAEA	International Atomic Energy Agency
ID	identification
IDF	Intensity-Duration-Frequency
INAC	Indigenous and Northern Affairs Canada
IPCC	Intergovernmental Panel on Climate Change
ISD	in situ disposal
ISO	International Organization for Standardization
KPI Program	Key Person Interview Program
LGD	Local Government District
LSA	local study area
LUOs	Land Use and Occupancy Values
MARSAME	Multi-Agency Radiation Survey and Assessment of Materials and Equipment
MBCA	*Migratory Birds Convention Act, 1994*
NAAQS	National Ambient Air Quality Objectives
NAPS	National Air Pollution Surveillance
NASA	National Aeronautics and Space Administration
Nb-94	niobium-94
NBCC	National Building Code of Canada
NHS	National Household Survey
Ni-59	nickel-59
Ni-63	nickel-63
NO	nitrogen
NO_2	nitrogen dioxide
NOC	National Occupational Classification
NO_x	nitrogen oxide
Np-237	neptunium-237
Np-239	neptunium-239
NPRI	National Pollutant Release Inventory
NSCA	*Nuclear Safety and Control Act*
NSRDR	*Nuclear Substance and Radiation Devices Regulation*
O_3	ozone
OSH	Occupational Safety and Health
Partnership	Whiteshell Laboratories Community Regeneration Partnership

Table 14.2-1: List of Abbreviations

Abbreviation	Definition
PCBs	polychlorinated biphenyls
PFC	perfluorocarbon
PGA	peak ground acceleration
PHT	primary heat transport
PLC	Public Liaison Committee
PM	particulate matter – PM_{10} is particulate matter 10 micrometres or less in diameter, $PM_{2.5}$ is particulate matter 2.5 micrometres or less in diameter.
PPE&C	Personal Protective Equipment and Clothing
Project	In Situ Decommissioning of WR-1 at the Whiteshell Laboratories Site
Pu-238	plutonium-238
Pu-239	plutonium-239
Pu-240	plutonium-240
Pu-241	plutonium-241
RCMP	Royal Canadian Mounted Police
REGDOC	Regulatory Document
RFD	Reasonably Foreseeable Development
RHA	Regional Health Authority
RM	Rural Municipality
RSA	Regional Study Area
RTAC	Roads and Transportation Association of Canada
RTL	registered trapline
SARA	*Species at Risk Act*
SCREEN3	dispersion model
SERDC	Southeast Regional Development Council
SLOWPOKE	Safe LOW-POwer Kritical Experiment
SRNL	Savannah River National Laboratory
SO_2	sulphur dioxide
SOR	Statutory Orders and Regulations
SO_x	sulphur oxide
sp.	species
SPM	suspended particulate matter
spp.	multiple species
Sr-90	strontium-90
SSA	Site Study Area
SVS	Shared Value Solutions

Table 14.2-1: List of Abbreviations

Abbreviation	Definition
Tc-99	technetium-99
The Agency	Canadian Environmental Assessment Agency
the Partnership	Whiteshell Laboratories Community Regeneration Partnership
TKLUS	Traditional Knowledge and Land Use Study
TKLUOS	Traditional Knowledge, Land Use and Occupancy Study
TLUS	Traditional Land Use Study
TRV	Toxicity Reference Value
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
URL	Underground Research Laboratory
US	United States
US DOE	United States Department of Energy
US DOE EM	United States Department of Energy Office of Environmental Management
VC	Valued Component
VOC	Volatile Organic Compound
WL	Whiteshell Laboratories
WMA	Waste Management Area
WNS	White-nose Syndrome
WQG	Water Quality Guidelines
WQSOG	Manitoba Water Quality Standards, Objectives and Guidelines
WR-1	Whiteshell Reactor 1
WRDF	Whiteshell Reactor Disposal Facility
WRTF	Winnipeg River Task Force

14.3 Units

Table 14.3-1: List of Units

Unit	Name
$	dollar
%	percent
<	less than
>	greater than
±	plus minus
°	degrees
°C	degrees Celsius
µg/L	micrograms per litre
µg/m^3	micrograms per cubic metre
µm	micrometre
µg/s	micrograms per second
µS/cm	microsiemens per centimetre
µSv	microsievert
Bq	Becquerel
Bq/kg	Becquerels per kilogram
Bq/kg fw	Becquerels per kilogram of fresh weight
Bq/L	Becquerels per litre
Bq/s	Becquerels per second
Bq/yr	Becquerels per year
cm	centimetre
cps	counts per second
dB	decibel
g	gram
g/a	grams per year
g/s	grams per second
GBq	Gigabecquerel
GL	GigaLitre
ha	hectare
hPa	hectoPascal pressure unit
hr	hour
hr/wk	hours per week
Ka	thousand years before present
kg	kilogram
kg/m^3	kilograms per cubic metre

Table 14.3-1: List of Units

Unit	Name
km	kilometre
km/hr	kilometres per hour
km^2	square kilometre
km^2/yr	square kilometres per year
kPa	kilopascal
kV	kilovolt
kWh/m^2/day	kilowatt hour per square metre per day
L	litre
L/day	litres per day
m	metre
M	Million
m/m	metres per metre
m/yr	metres per year
m^2	square metre
m^3	cubic metre
m^3/s	cubic metres per second
Ma	million years
masl	metres above sea level
Mg	megagram
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
mGy	milligray
mGy/day	milligrays per day
mGy/hr	milligrays per hour
mm	millimetre
mm[eq]	millimetres equivalent
mm/hr	millimetres per hour
Mpa	megapascal
mSv	millisievert
mSv/a	millisieverts per year
MW	megawatt
ppb	parts per billion
ppm	parts per million
t	tonne
vol.%	volume percent

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APPENDIX 1.0-1

Concordance Table with Regulatory Guidelines

- CNSC Generic EIS Guidelines
- CNSC REGDOC-2.9.1 Environmental Principles, Assessments and Protection Measures

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1.0 TABLE OF CONCORDANCE TO THE CNSC GENERIC EIS GUIDELINES

Section in Generic Guideline	Requirement	Section in the EIS
Part 1	**BACKGROUND**	
1.0	**Introduction**	
	The purpose of this document is to provide information to proponents on the requirements for the preparation of an environmental impact statement (EIS) for a designated project to be assessed pursuant to the *Canadian Environmental Assessment Act, 2012* (CEAA 2012). This document specifies the nature, scope and extent of the information required. Part 1 of this document provides guidance and general instruction on the preparation of the EIS, and part 2 outlines the information that must be included in the EIS.	■ Not Applicable
	Section 5 of the CEAA 2012 requires an assessment of the proposed project's potential environmental effects: 5. (1) For the purposes of this Act, the environmental effects that are to be taken into account in relation to an act or thing, a physical activity, a designated project or a project are: a) a change that may be caused to the following components of the environment that are within the legislative authority of Parliament: i. fish and fish habitat as defined in subsection 2(1) of the *Fisheries Act* ii. aquatic species as defined in subsection 2(1) of the *Species at Risk Act* iii. migratory birds as defined in subsection 2(1) of the *Migratory Birds Convention Act*, 1994 iv. any other component of the environment that is set out in Schedule 2 b) a change that may be caused to the environment that would occur: i. on federal lands ii. in a province other than the one in which the act or thing is done or where the physical activity, the designated project or the project is being carried out iii. outside Canada c) with respect to Aboriginal peoples, an effect occurring in Canada of any change that may be caused to the environment on: i. health and socio-economic conditions ii. physical and cultural heritage iii. the current use of lands and resources for traditional purposes iv. any structure, site or thing that is of historical, archaeological paleontological or architectural significance	■ Not Applicable

Section in Generic Guideline	Requirement	Section in the EIS
Part 1	**BACKGROUND**	
1.0	**Introduction**	
	5. (2) However, if the carrying out of the physical activity, the designated project or the project requires a federal authority to exercise a power or perform a duty or function conferred on it under any Act of Parliament other than this Act, the following environmental effects are also to be taken into account: a) a change, other than those referred to in paragraphs (1)(a) and (b), that may be caused to the environment and that is directly linked or necessarily incidental to a federal authority's exercise of a power or performance of a duty or function that would permit the carrying out, in whole or in part, of the physical activity, the designated project or the project b) an effect, other than those referred to in paragraph (1)(c), of any change referred to in paragraph (a) on: i. health and socio-economic conditions ii. physical and cultural heritage iii. any structure, site or thing that is of historical, archaeological, paleontological or architectural significance	
	The Canadian Nuclear Safety Commission (CNSC) will use the proponent's EIS and other information received during the environmental assessment (EA) process to prepare an EA report that will inform the issuance of a decision statement by the Commission. Therefore, the EIS must include a full description of the changes the project will cause to the environment that may result in potential effects on areas of federal jurisdiction (i.e., section 5 of the CEAA 2012) – including changes that are directly linked or necessarily incidental to any federal decisions that would permit the project to be carried out. The EIS should also include a list of key mitigation measures that the proponent proposes to undertake in order to avoid or minimize any adverse environmental effects of the project. It is the proponent's responsibility to provide sufficient data and analysis on potential changes to the environment.	■ Not Applicable

Section in Generic Guideline	Requirement	Section in the EIS
2.0	**GUIDING PRINCIPLES**	
2.1	**Government of Canada Interim Measures**	
	On January 27, 2016, the Minister of Environment and Climate Change Canada and the Minister of Natural Resources Canada announced an interim approach that includes principles and plans for major projects. These principles are the first part of a broader strategy to review and restore confidence in Canada's EA processes. In particular, the Government of Canada has introduced the principle that direct and upstream greenhouse gas emissions linked to the projects under review will be assessed. The proponent is expected to take the necessary steps to provide sufficient information and evidence in accordance with this principle. For more information on assessing greenhouse gas emissions, refer to Section 5.1 (part 2).	■ Section 6.2.2 Greenhouse Gases
2.2	**EA as a Planning Tool**	
	An EA is a planning tool used to ensure that projects are considered in a careful and precautionary manner in order to avoid or mitigate possible environmental effects and to encourage decision makers to take actions that promote sustainable development.	■ Not Applicable
2.3	**Public Participation**	
	One of the purposes identified in the CEAA 2012 is to ensure opportunities for meaningful public participation during an EA. The CNSC ensures that the public is provided with opportunities to participate in the EA. Meaningful public participation is best achieved when all parties have a clear understanding of the proposed project as early as possible in the review process. The proponent is required to provide current information about the project to the public and especially to the communities likely to be most affected by the project.	■ Section 5.0 Public Engagement

Section in Generic Guideline	Requirement	Section in the EIS
2.4	**Aboriginal Engagement**	
	A key objective of the CEAA 2012 is to promote communication and cooperation with Aboriginal peoples, which include First Nations, Inuit and Métis. The proponent is expected to engage with Aboriginal groups that may be affected by the project, as early as possible in the project planning process. The proponent will provide Aboriginal groups with opportunities to learn about the project and its potential effects, to communicate their concerns about the project's potential effects, and to discuss measures to mitigate those effects. The proponent is strongly encouraged to work with Aboriginal groups in establishing an engagement approach that is reasonable to both parties. The proponent will make reasonable efforts to consider traditional Aboriginal knowledge into the assessment of environmental impacts. For more information on considering Aboriginal traditional knowledge, refer to Section 3.3.2 (part 1). Information gathered through the EA process and associated engagement by the proponent with Aboriginal groups will be used to inform decisions under the CEAA 2012. In providing information to the CNSC, the proponent will ensure any confidential information shared with them by Aboriginal groups is treated in the appropriate manner. This information will also contribute to the Crown's understanding of any potential adverse impacts of the project on potential or established Aboriginal or Treaty rights and the effectiveness of measures proposed to avoid or minimize those impacts, and will assist the Crown in meeting its duty to consult obligations. The proponent is encouraged to consult the following resources: ■ REGDOC-3.2.2, Indigenous Engagement (CNSC); and ■ Aboriginal and Treaty Rights Information System (Indigenous and Northern Affairs Canada).	■ Section 4.0 Indigenous Engagement
2.5	**Application of the Precautionary Approach**	
	In documenting the analyses included in the EIS, the proponent will demonstrate that all aspects of the project have been examined and planned in a careful and precautionary manner in order to avoid significant adverse environmental effects. The Canadian Privy Council Office's *A Framework for the Application of Precaution in Science-based Decision Making About Risk* (refer to bibliography) sets out guiding principles for the application of precaution to science-based decision making.	■ Section 3.4 Project Requirements ■ Section 6.1 Environmental Assessment Approach
3.0	**Preparation and Presentation of the EIS**	
3.1	**Guidance**	
	The proponent is encouraged to consult the CNSC's draft REGDOC-2.9.1, Environmental Principles, Assessments and Protection Measures for additional guidance on the preparation of the EIS. The proponent may also consider consulting the relevant EA policy and guidance documents provided on the Canadian Environmental Assessment Agency website. The proponent is further encouraged to consult with the CNSC and, if applicable, other federal authorities, during the planning and development of the EIS and supporting documentation.	■ All EIS sections and Appendices

Section in Generic Guideline	Requirement	Section in the EIS
3.2	**Study Strategy and Methodology**	
	The proponent is expected to respect the intent of these guidelines and to consider the effects that are likely to arise from the project (including situations not explicitly identified in these guidelines), the technically and economically feasible mitigation measures that will be applied, and the significance of any residual effects. Except where specified by the CNSC, the proponent has the discretion to select the most appropriate methods to compile and present data, information and analysis in the EIS as long as the methods are transparent, justifiable and replicable. These guidelines may include matters that the proponent does not deem relevant or significant to the project. If such matters are omitted from the EIS, the proponent will clearly indicate it and provide a justification so that the CNSC, federal authorities, Aboriginal groups, the public and any other interested party will have an opportunity to comment on this decision. Where the CNSC disagrees with the proponent's decision, it will require the proponent to provide the specified information. The proponent must explain and justify methods used to predict impacts of the project on each valued component (VC) (see Section 5.2.1 in part 2 of this document for the definition of valued component). VCs include biophysical and socioeconomic components, the interactions among them, and their relationships within the environment. The information presented must be substantiated; in particular, the proponent must describe how the VCs were identified and what methods were used to predict and assess the project's potential adverse environmental effects on these components. The value of a component not only relates to its role in the ecosystem, but also to the value that humans place on it. The culture and way of life of the people using the area affected by the project may be considered VCs themselves. The EIS will also explain and justify methods used to identify mitigation measures and follow-up program elements. The EIS will document how scientific, engineering, traditional and local knowledge were used to reach conclusions. Assumptions will be clearly identified and justified. All data, models and studies will be documented such that the analyses are transparent and reproducible. All data collection methods will be specified. The uncertainty, reliability and sensitivity of models used to reach conclusions must be indicated. The sections in the EIS regarding the existing environment and the potential adverse environmental effects predictions and assessment must be prepared, using best available information and methods, to the highest standards in the relevant subject area. All conclusions must be substantiated. The EIS will identify all significant gaps in knowledge and understanding related to key conclusions, and the steps to be taken by the proponent to address these gaps. Where the conclusions drawn from scientific, engineering and technical knowledge are inconsistent with the conclusions drawn from traditional and local knowledge, the EIS will contain a balanced presentation of the issues and a statement of the proponent's conclusions.	■ Section 6.1 Environmental Assessment Approach ■ Section 6.2 Atmospheric Environment ■ Section 6.3 Geological and Hydrogeological Environment ■ Section 6.4 Surface Water Environment ■ Section 6.5 Aquatic Environment ■ Section 6.6 Terrestrial Environment ■ Section 6.7 Human and Ecological Health ■ Section 6.8 Land and Resource Use ■ Section 6.9 Socio-economic Environment

Section in Generic Guideline	Requirement	Section in the EIS
3.3	**Use of Information**	
3.3.1	**Federal Coordination of Information or Knowledge**	
	Section 20 of the CEAA 2012 requires that every federal authority with specialist or expert information, or knowledge with respect to a project subject to an EA, make that information or knowledge available to the CNSC. The CNSC will coordinate the involvement, and notify the proponent, of federal departments and other jurisdictions with expert and specialist knowledge specific to the EA.	■ Not Applicable
3.3.2	**Community Knowledge and Aboriginal Traditional Knowledge**	
	Subsection 19(3) of the CEAA 2012 states that "the environmental assessment of a designated project may take into account community knowledge and Aboriginal traditional knowledge". The proponent will consider community and Aboriginal traditional knowledge to which it has access or that is acquired through Aboriginal and public engagement activities, in keeping with appropriate ethical standards and obligations of confidentiality. Agreement should be obtained from Aboriginal groups regarding the use, management and protection of their existing traditional knowledge information during and after the EA. Where community and Aboriginal traditional knowledge has been considered by the proponent, the EIS will document the following: ■ the traditional knowledge information gathered ■ how the traditional knowledge information was gathered (e.g., interviews with key community leaders and elders, collaborative field research, Aboriginal traditional knowledge studies, etc.) ■ the source of the traditional knowledge information ■ how the traditional knowledge information gathered was taken into consideration by the proponent in the assessment, including both methodology (e.g., identifying VCs, establishing spatial and temporal boundaries, defining significance criteria) and analysis (e.g., baseline characterization, effects prediction, development of mitigation measures)	■ Section 4.3 Influence of Traditional Knowledge on the Environmental Assessment ■ Section 6.4.2 Surface Water Quality ■ Section 6.5 Aquatic Environment ■ Section 6.6 Terrestrial Environment ■ Section 6.7 Human and Ecological Health ■ Section 6.8.1 Traditional Land and Resource Use by Indigenous Peoples ■ Section 6.9 Socio-economic Environment
3.3.3	**Existing Information**	
	In preparing the EIS, the proponent is encouraged to make use of existing information relevant to the project. When relying on existing information to meet requirements of the EIS guidelines, the proponent will either include the information directly in the EIS or clearly direct the reader to where it may obtain the information (i.e., through cross-referencing). When relying on existing information, the proponent will also comment on how the data were applied to the project, separate factual lines of evidence from inference, and state any limitations on the inferences or conclusions that can be drawn from the existing information.	■ All EIS Sections and Appendices

Section in Generic Guideline	Requirement	Section in the EIS
3.3.4	**Confidential Information**	
	In implementing the CEAA 2012, the CNSC is committed to promoting public participation in the EA of projects and providing access to the information on which EAs are based. All documents prepared or submitted by the proponent or any other stakeholder in relation to the EA are posted or referenced on the Canadian Environmental Assessment Registry and/or the CNSC's website and made available to the public upon request. For this reason, the EIS should not contain information that: ■ is sensitive or confidential (i.e., financial, commercial, scientific, technical, personal, cultural or other nature) in accordance with the Privacy Act and the Access to Information Act, that is treated consistently as confidential, and the person affected has not consented to the disclosure ■ may cause harm to a person or harm to the environment through its disclosure If the EIS contains information that should be treated as "confidential" or "protected" in accordance with the Privacy Act and the Access to Information Act, the proponent should identify and request to the CNSC that such information be treated accordingly.	■ All EIS Sections and Appendices

Section in Generic Guideline	Requirement	Section in the EIS
Part 2	**EIS CONTENT AND STRUCTURE** Part 2 of this document provides specific instructions for the content of each section in the EIS. The EIS as a whole must reflect the guiding principles in part 1 of this document.	
1.0	**Presentation and Organization of the EIS**	
	To facilitate the identification of the documents submitted, the title page of the EIS and its related documents will contain the following information: ■ project name and location ■ title of the document, including the term “environmental impact statement” ■ subtitle of the document ■ proponent name and contact information ■ date	■ EIS Cover Page
	The EIS will be written in clear, precise language. A glossary of technical words, acronyms and abbreviations will be included. It will include charts, diagrams, tables, maps and photographs, where appropriate, to clarify the text. Perspective drawings that clearly convey the various components of the project will also be provided. Wherever possible, maps will be presented in common scales and datum to allow for comparison and overlay of mapped features. For purposes of brevity and to avoid repetition, cross-referencing within the EIS is preferred. The EIS may make reference to the information that has already been presented in other sections of the document, rather than repeating it. Detailed studies (including all relevant and supporting data and methodologies) will be provided in separate appendices and will be referenced by appendix, section and page in the text of the main document. The EIS will explain how information is organized in the document. This will include a list of all tables, figures, and photographs referenced in the text. A complete list of supporting literature and references will also be provided. A table of concordance, which cross references the information presented in the EIS with the information requirements identified in the EIS guidelines, will be provided. The proponent will provide copies of the EIS and its summary for distribution, as directed by the CNSC, including paper and electronic version in an unlocked, searchable PDF format.	■ All EIS Sections and Appendices

Section in Generic Guideline	Requirement	Section in the EIS
2.0	**Executive Summary**	
	For efficiency, the proponent may consider preparing a summary of the EIS in both of Canada's official languages (French and English), which is to be provided to the CNSC at the same time as the EIS. The proponent is also encouraged to consider making the executive summary available in the language(s) spoken by Aboriginal communities in close proximity to the project (e.g., Cree, Dene). The summary will include the following: ■ a concise description of all key components of the project and related activities ■ a summary of the consultation conducted with Aboriginal groups, the public, and government agencies, including a summary of the issues raised and the proponent's responses ■ an overview of the key environmental effects of the project and proposed technically and economically feasible mitigation measures ■ the proponent's conclusions on the residual environmental effects of the project after taking mitigation measures into account and the significance of those effects The summary will be provided as a separate document and will have sufficient details for the reader to learn and understand the project, potential environmental effects, mitigation measures, the significance of the residual effects and follow-up program.	■ Executive Summary
3.0	**Introduction and Overview**	
3.1	**Project Overview**	
	The EIS will describe the project, key project components and associated activities, scheduling details, the timing of each phase of the project and other key features. If the project is a part of a larger sequence of projects, the EIS will outline the larger context. The overview is to identify the project's key components, rather than providing a detailed description, which will follow in section 4 (part 2) of this document.	■ Section 1.2 Project Overview

Section in Generic Guideline	Requirement	Section in the EIS
3.2	**Project Location**	
	The EIS will contain a description of the geographical setting where the project will take place. This description should include those aspects of the project and its setting that are key to understanding the project's potential adverse environmental effects, including: ■ geographical maps of the project location (at an appropriate scale) including project components, project boundaries of the proposed site with the Universal Transverse Mercator (UTM) coordinates – the lease boundary, site study area, local study area, regional study area, the major existing infrastructure, adjacent land uses and any important environmental features ■ current land use in the area ■ distance of the project facilities and components to any federal lands ■ the environmental significance and value of the geographical setting in which the project will take place and the surrounding area ■ environmentally sensitive areas, such as national, provincial and regional parks, ecological reserves, wetlands, estuaries, and habitats of federally (Schedule 1 of Species at Risk Act) or provincially listed species at risk and other sensitive areas ■ description of local and Aboriginal communities ■ traditional Aboriginal territories, treaty lands, and Indian reserve lands and Métis harvesting regions and/or settlements	■ Section 1.3 Project Location
3.3	**Regulatory Framework and the Role of Government**	
	The EIS should identify: ■ the environmental and other regulatory approvals and legislation, including CEAA 2012, that are applicable to the project at the federal, provincial, regional and municipal levels ■ government policies, resource management plans, planning or study initiatives pertinent to the project and/or EA and their implications ■ any treaty or self-government agreements with Aboriginal groups that are pertinent to the project and/or EA ■ any relevant land use plans, land zoning, or community plans ■ regional, provincial and/or national objectives, standards or guidelines that have been used by the proponent to assist in the evaluation of any predicted environmental effects	■ Section 1.6 Regulatory Framework

Section in Generic Guideline	Requirement	Section in the EIS
4.0	**Project Description**	
4.1	**Purpose of the Project**	
	The EIS will describe the purpose of the project by providing the rationale for the project, explaining the background, the problems or opportunities that the project is intended to satisfy and the stated objectives from the perspective of the proponent. If the objectives of the project are related to broader private or public sector policies, plans or programs, this information should also be included.	■ Section 2.3 Purpose of the Project
4.2	**Alternative Means of Carrying out the Project**	
	The EIS will identify and consider the effects of alternative means of carrying out the project that are technically and economically feasible as described in appendix A, section A.3.2 Alternative means for carrying out the project, of the CNSC's draft REGDOC-2.9.1, Environmental Principles, Assessments and Protection Measures. The proponent will complete the following procedural steps for addressing alternative means: ■ Identify and describe in sufficient detail the alternative means to carry out the project: ■ develop criteria to determine the technical and economic feasibility of the alternative means ■ identify those alternative means that are technically and economically feasible ■ Identify the effects of each technically and economically feasible alternative means: ■ identify those elements of each alternative means that could produce effects in sufficient detail to allow a comparison with the effects of the project ■ the effects referred to above include both environmental effects and potential adverse impacts on potential or established Aboriginal and Treaty rights and related interests ■ Describe the methodology used for the analysis of alternative means and the conclusion reached (i.e., preferred means). For further information regarding the "purpose of" and "alternative means", please consult the Agency's operational policy statement, titled Addressing "Purpose of" and "Alternative Means" under the Canadian Environmental Assessment Act, 2012". The CNSC recognizes that projects may be in the early planning stages when the EIS is being prepared. Proponents are strongly encouraged to conduct an environmental effects analysis where they have not made final decisions about the placement of project infrastructure, the technologies to be used, or if several options exist for various project components.	■ Section 2.5 Alternative Means of Carrying Out the Project

Section in Generic Guideline	Requirement	Section in the EIS
4.3	**Scope of Project**	
	The scope of project for the purposes of the EA includes all the phases, components, activities and federal decisions proposed by the proponent as described in the project description that has been determined to meet the requirements of the Prescribed Information for the Description of a Designated Project Regulations. The CNSC's Commission may also determine that other components and/or activities in relation to the project are to be included in the project scope. The proponent will consider all phases, components, activities and federal decisions identified in the scope of project as part of the effects assessment.	■ Section 3.0 Project Description
4.3.1	**Project Components**	
	The EIS will describe the project by presenting the project components, associated and ancillary works, and other characteristics that will assist in understanding the environmental effects.	■ Section 3.1.1 Project Overview ■ Section 3.4.5 Project Components
4.3.2	**Project Activities**	
	The EIS will include descriptions of each phase associated with the proposed project. This will include descriptions of the activities to be carried out during each phase, the location of each activity, expected outputs and an indication of the activity's magnitude and scale. Although a complete list of project activities should be provided, the emphasis will be on activities with the greatest potential to have environmental effects. Sufficient information will be included to predict environmental effects and address concerns identified by the public and Aboriginal groups. Highlight activities that involve periods of increased environmental disturbance or the release of materials into the environment. The EIS will include a summary of the changes that have been made to the project since originally proposed, including the benefits of these changes to the environment, Aboriginal peoples, and the public. The EIS will include a schedule including time of year, frequency, and duration for all project activities.	■ Section 3.1.2 Project Schedule ■ Section 3.4.6 In Situ Disposal ■ Section 3.4.7 Temporary Supporting Infrastructure ■ Section 3.4.8 Waste Generation and Management ■ Section 3.4.9 End-State and Post-Closure Activities

Section in Generic Guideline	Requirement	Section in the EIS
5.0	**Scope of the Environmental Assessment**	
5.1	**Factors to be Considered**	
	Scoping establishes the EA's parameters and focuses the assessment on relevant issues and concerns. The EA of the designated project must take into account the following factors, as listed in subsection 19(1) of the CEAA 2012: a) the section 5 environmental effects of the designated project (such as changes to fish and fish habitat, aquatic species, migratory birds), including the environmental effects of malfunctions or accidents that may occur in connection with the designated project, and any cumulative environmental effects likely to result from the designated project in combination with other physical activities that have been or will be carried out b) the significance of those environmental effects c) comments from the public that are received in accordance with the CEAA 2012 d) mitigation measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the designated project e) the requirements of the follow-up program in respect of the designated project f) the purpose of the designated project g) alternative means of carrying out the designated project that are technically and economically feasible and the environmental effects of any such alternative means h) any changes to the designated project that may be caused by the environment i) the results of any relevant study conducted by a committee established under section 73 or 74 of the CEAA 2012 j) any other matter relevant to the EA that the CNSC requires to be taken into account, in accordance with the *Nuclear Safety and Control Act* Pursuant to subsection 19(2) of the CEAA 2012, the scope of the factors to be taken into account under paragraphs 19(1)(a), (b), (d), (e), (g), (h) and (j) is determined by the CNSC, as the responsible authority.	■ Section 2.0 Purpose of the Project and Alternatives to the Project ■ Section 3.0 Project Description ■ Section 4.0 Indigenous Engagement ■ Section 5.0 Public Engagement ■ Section 6.1 Environmental Assessment Approach ■ Section 6.2 Atmospheric Environment ■ Section 6.3 Geological and Hydrogeological Environment ■ Section 6.4.2 Surface Water Environment ■ Section 6.5 Aquatic Environment ■ Section 6.6 Terrestrial Environment ■ Section 6.7 Human and Ecological Health ■ Section 6.8 Land and Resource Use ■ Section 6.9 Socio-economic Environment ■ Section 7.0 Accidents and Malfunctions ■ Section 8.0 Summary of Cumulative Effects ■ Section 9.0 Summary of Significance of Residual Effects ■ Section 10.0 Assessment of Effects of the Environment on the Project ■ Section 11.0 Summary of Monitoring and Follow-up Programs

Section in Generic Guideline	Requirement	Section in the EIS
5.1	**Factors to be Considered**	
	To implement the Government of Canada interim measure with respect to upstream greenhouse gas emissions, the CNSC may require consideration of these types of emissions in the scope of the EA. On March 19, 2016, a definition of upstream GHG emissions was published by Environment Canada and Climate Change in the Canada Gazette. The proposed definition of upstream includes "*all industrial activities from the point of resource extraction to the project under review*." The processes that are to be considered as upstream activities will vary by the type of resource and the nature of the project under assessment. In general, upstream activities will include extraction, processing and handling as well as transportation. Where there is a reliable and feasible methodology for calculating upstream greenhouse gas emissions that are linked to the project, the proponent will be required to provide sufficient information to estimate these types of emissions. This information should be presented by individual pollutant and should be summarized in CO_2 equivalent units per year. If upstream greenhouse gas emissions are not considered in the assessment, the proponent will provide a rationale in the EIS.	■ Section 6.2.2 Greenhouse Gases

Section in Generic Guideline	Requirement	Section in the EIS
5.2	**Scope of Factors**	
5.2.1	**Valued Components to be Examined**	
	Valued components (VCs) refer to environmental biophysical or human features that may be impacted by a project. The value of a component not only relates to its role in the ecosystem, but also to the value people place on it. For example, it may have scientific, social, cultural, economic, historical, archaeological or aesthetic importance. The EIS will identify the VCs linked to section 5 of the CEAA 2012, including the ones identified in section 9.2 (part 2) that may be affected by changes in the environment, as well as species at risk and their critical habitat as per the requirement outlined in section 79 of the Species at Risk Act (SARA). Under section 73 of SARA, the Minister of Environment and Climate Change Canada may grant permits authorizing an activity affecting a listed wildlife species or any part of its residence or critical habitat that would otherwise be prohibited. Should the proponent identify a listed wildlife species or any part of its residence or critical habitat that would be affected by the project activities, the proponent should consult directly with the Canadian Wildlife Service as early as possible in the process. The final list of VCs to be presented in the EIS will be completed according to the evolution and design of the project and reflect the knowledge on the environment acquired through public consultation and Aboriginal engagement. The EIS will describe what methods were used to predict and assess the potential adverse environmental effects of the project on these components. The VCs will be described in sufficient detail to allow the reviewer to understand their importance and to assess the potential for environmental effects arising from the project activities. The EIS will provide a rationale for selecting specific VCs and for excluding any VCs or information specified in these guidelines. Challenges with particular exclusions may arise, so it is important to document the information and criteria used to make each determination. Examples of justification include primary data collection, computer modelling, literature references, public consultation, expert input or professional judgement. The EIS will identify those VCs, processes, and interactions that were identified to be of concern during any workshops or meetings held by the proponent, or that the proponent considers likely to be affected by the project. In doing so, the EIS will indicate to whom these concerns are important and the reasons why, including environmental, Aboriginal, social, economic, recreational, and aesthetic considerations. If comments are received on a component that has not been included as a VC, these comments will be summarised and the rationale for excluding the VC will be provided.	■ Section 6.1.3 Valued Components ■ Section 6.2.1.3 Valued Components – Air Quality ■ Section 6.2.2.3 Valued Components – Greenhouse Gases ■ Section 6.3.1.3 Valued Components – Geology ■ Section 6.3.2.3 Valued Components – Hydrogeology ■ Section 6.4.1.3 Valued Components – Hydrology ■ Section 6.4.2.3 Valued Components – Surface Water Quality ■ Section 6.5.3 Valued Components – Aquatic Environment ■ Section 6.6.3 Valued Components – Terrestrial Environment ■ Section 6.7.1.3 Valued Components – Human Health ■ Section 6.7.2.3 Valued Components – Ecological Health ■ Section 6.8.1.3 Valued Components – Traditional Land and Resource Use ■ Section 6.8.2.3 Values Components – Other Land and Resource Use ■ Section 6.9.3 Valued Components – Socio-economic Environment

Section in Generic Guideline	Requirement	Section in the EIS
5.2.2	**Spatial and Temporal Boundaries**	
	The spatial and temporal boundaries used in the EA may vary depending on the VC and will be considered separately for each VC. The proponent is encouraged to consult with the CNSC, federal and provincial government departments and agencies, local government and Aboriginal groups, and take into account public comments when defining the spatial boundaries used in the EIS. The EIS will describe the spatial boundaries, including local and regional study areas, of each VC to be used in assessing the potential adverse environmental effects of the project and provide a rationale for each boundary. Spatial boundaries will be defined by taking into account, but not limited to, the following criteria: a) the physical extent of the proposed project, including any offsite facilities or activities b) the extent of aquatic and terrestrial ecosystems potentially affected by the project c) the extent of potential effects arising from noise, light and atmospheric emissions d) the extent to which traditional land use or treaty rights could potentially be affected by the project e) current land and resource use for residential, commercial, industrial, recreational, cultural and aesthetic purposes by communities whose areas include the physical extent of the project f) the size, nature and location of past, present and reasonably foreseeable projects and activities which could interact with items (b), (c), (d) and (e) g) community and Aboriginal traditional knowledge, ecological, and technical considerations The following geographic study areas should serve as the basis for developing project specific and effect-specific study areas: ■ **Site study area:** The site study area is the project footprint (i.e., where project activities would be undertaken including the project's proposed facilities, buildings and infrastructure). ■ **Local study area:** The local study area is defined as that area existing outside the site study area boundary, where measurable changes to the environment resulting from the proposed activities from any phase of the project, either through normal activities, or from possible accidents or malfunctions, may be anticipated. The boundaries must change if appropriate following an assessment of the spatial extent of potential effects. The geographic boundary will depend on the factor being considered (e.g., a local study area defined for the aquatic environment will differ from that defined for the atmospheric environment). ■ **Regional study area:** The regional study area is defined as the area within which the potential effects of this project may interact with the effects of other projects, resulting in the potential for cumulative effects. The geographic boundary for the regional study areas are also specific to the factor being considered.	■ Section 6.1.4 Spatial Boundaries ■ Section 6.2.1.4 Assessment Boundaries – Air Quality ■ Section 6.2.2.4 Assessment Boundaries – Greenhouse Gases ■ Section 6.3.1.4 Assessment Boundaries – Geology ■ Section 6.3.2.4 Assessment Boundaries – Hydrogeology ■ Section 6.4.1.4 Assessment Boundaries – Hydrology ■ Section 6.4.2.4 Assessment Boundaries – Surface Water Quality ■ Section 6.5.4 Assessment Boundaries – Aquatic Environment ■ Section 6.6.4 Assessment Boundaries – Terrestrial Environment ■ Section 6.7.1.4 Assessment Boundaries – Human Health ■ Section 6.7.2.4 Assessment Boundaries – Ecological Health ■ Section 6.8.1.4 Assessment Boundaries – Traditional Land and Resource Use ■ Section 6.8.2.4 Assessment Boundaries – Other Land and Resource Use ■ Section 6.9.4 Assessment Boundaries – Socio-economic Environment

Section in Generic Guideline	Requirement	Section in the EIS
5.2.2	**Spatial and Temporal Boundaries (cont'd)**	
	Within the aforementioned study areas, the boundary of concern will extend to a depth that will include the full extent of the surface water and groundwater. The EA's temporal boundaries will span all phases of the project determined to be within the scope of the project as specified under section 4.3 above. If impacts are predicted after project decommissioning, this should be taken into consideration in defining boundaries. At a minimum, the assessment is expected to include the period of time during which the maximum impact is predicted to occur. Community and Aboriginal traditional knowledge should factor into decisions around temporal boundaries. If the temporal boundaries do not span all phases of the project, the EIS will identify the boundaries used and provide a rationale.	
6.0	**Public and Stakeholder Consultation**	
	In accordance with CNSC's REGDOC-99.3, Public Information and Disclosure, the EIS will describe the ongoing and proposed participation activities that the proponent will undertake or that it has already conducted on the project. It will describe efforts made to distribute project information, as well information and materials that were distributed during the public consultation process. The EIS will indicate the methods used, where the consultation was held, the persons and organizations consulted, the concerns voiced and the extent to which this information was incorporated in the design of the project as well as in the EIS. The EIS will provide a summary of key issues raised related to the Project and its potential environmental effects, as well as describe any outstanding issues and ways to address them.	■ Section 5.2 Project-specific Public Engagement Methods and Activities

Section in Generic Guideline	Requirement	Section in the EIS
7.0	**Aboriginal Engagement**	
	In accordance with the CNSC's REGDOC-3.2.2, Indigenous Engagement, the EIS will describe the proponent's engagement activities with potentially affected Aboriginal groups. The EIS will include, and the proponent should consider engaging with potentially affected Aboriginal groups to obtain their views on, the following: ■ the objectives of and the methods used for Aboriginal engagement activities ■ each Aboriginal group's potential or established rights including geographical extent, nature, frequency, timing and maps and data sets (e.g., fish catch numbers) when this information is provided by a group to the proponent or available through public records ■ comments, specific issues and concerns raised by Aboriginal groups and how the key concerns were responded to or addressed ■ the potential adverse impacts of the project on potential or established Aboriginal or treaty rights effects of changes to the environment on Aboriginal peoples (health and socioeconomic conditions; physical and cultural heritage, including any structure, site or thing that is of historical, archaeological, paleontological or architectural significance; and current use of lands and resources for traditional purposes) pursuant to paragraph 5(1)(c) of the CEAA 2012 ■ VCs suggested by Aboriginal groups for inclusion in the EIS, whether they were included, and the rationale for any exclusions ■ measures identified to mitigate or accommodate potential adverse impacts of the project on the potential or established Aboriginal or treaty rights and effects of changes to the environment on Aboriginal peoples, including suggestions raised by Aboriginal groups A suggested format for providing the information above is the creation of a tracking table of key issues raised by each Aboriginal group, including the concerns raised related to the project, proposed mitigation options, and where appropriate, a reference to the proponent's analysis in the EIS.	■ Section 4.2 Project-specific Indigenous Engagement Activities

Section in Generic Guideline	Requirement	Section in the EIS
8.0	**Description of the Environment**	
8.1	**Baseline Environment**	
	The EIS will include a description of the environment, including the components of the existing environment and environmental processes, their interrelations and interactions as well as the variability in these components, processes and interactions over time scales appropriate to the EIS. In characterizing the environmental effects of the project, the proponent will consider the current baseline environment and environmental trends within the project area. The description of the existing baseline and the environmental trends should include a consideration of past projects and activities carried out by the proponent and/or others within the project area. Based on the scope of project described in section 4.3 (part 2), the EIS will present baseline information in sufficient detail to enable the identification of how the project could affect the VCs and an analysis of those effects. Should other VCs be identified during the conduct of the EA, the baseline condition for these components will also be described in the EIS. The baseline description should include results from studies done prior to any physical disruption of the environment due to initial project activities (e.g., site preparation). The proponent will use the information in appendix B of the CNSC's draft REGDOC-2.9.1, *Environmental Principles, Assessments and Protection Measures* to develop the characterization of the baseline environment. If a federal decision (as per section 5(2) of the CEAA 2012) in relation to the project may result in environmental changes such as changes on federal lands, outside the province or Canada, the proponent will use the information in appendix A, section A.3.7, Socio-economic environment, of the CNSC's draft REGDOC-2.9.1, *Environmental Principles, Assessments and Protection Measures*, to describe the baseline conditions in relation to these potential changes.	■ Section 6.1.5 Description of the Environment ■ Section 6.2.1.5 Description of the Environment – Air Quality ■ Section 6.2.2.5 Description of the Environment – Greenhouse Gases ■ Section 6.3.1.5 Description of the Environment – Geology ■ Section 6.3.2.5 Description of the Environment – Hydrogeology ■ Section 6.4.1.5 Description of the Environment – Hydrology ■ Section 6.4.2.5 Description of the Environment – Surface Water Quality ■ Section 6.5.5 Description of the Environment – Aquatic Environment ■ Section 6.6.5 Description of the Environment – Terrestrial Environment ■ Section 6.7.1.5 Description of the Environment – Human Health ■ Section 6.7.2.5 Description of the Environment – Ecological Health ■ Section 6.8.1.5 Description of the Environment – Traditional Land and Resource Use ■ Section 6.8.2.5 Description of the Environment – Other Land and Resource Use ■ Section 6.9.5 Description of the Environment – Socio-economic Environment

Section in Generic Guideline	Requirement	Section in the EIS
9.0	**Effects Assessment**	
9.1	**Predicted Changes to the Physical Environment**	
	The assessment will include a consideration of the predicted changes to the environment as a result of the project being carried out or as a result of any powers, duties or functions that are to be exercised by the federal government in relation to the project. These predicted changes to the environment are to be considered in relation to each phase of the project (i.e., construction, operation, decommissioning) and are to be described in terms of the following: ■ magnitude ■ geographic extent ■ timing ■ frequency ■ duration, ■ reversibility As changes to various parts of the physical environment may be inter-related as part of an ecosystem, the EIS will explain and describe the connections between the changes described. The proponent will use the information in Appendix C of the CNSC's draft REGDOC-2.9.1, *Environmental Principles, Assessments and Protection Measures*, to assess the environmental effects of the project.	■ Section 6.1.9 Residual Effects Classification and Determination of Significance ■ Section 6.2.1.9 Residual Effects Classification and Determination of Significance – Air Quality ■ Section 6.3.2.7 Residual Effects Analysis – Hydrogeology ■ Section 6.4.2.7 Residual Effects Analysis – Surface Water Quality ■ Section 6.7.1.9 Residual Effects Classification and Determination of Significance - Human Health ■ Section 6.7.2.9 Residual Effects Classification and Determination of Significance - Ecological Health
9.2	**Predicted Effects on Valued Components**	
	Based on the predicted changes to the environment identified in section 9.1 (part 2) above, the proponent is to assess the environmental effects of the project on the VCs identified as per section 5.2.1 (part 2). Based on the changes to the environment that have been identified in section 9.1 (part 2), additional VCs are to be selected based on the following: ■ If there is the potential for the project to result in environmental changes on federal lands, another province, or another country, then VCs of importance not already identified above are to be listed in this section. ■ If federal decisions about the project will lead to an environmental change, then these environmental changes are to be considered stand-alone VCs. All interconnections between VCs and between changes to multiple VCs will be described.	■ Section 6.1.7 Residual Effects Analysis ■ Section 6.2.1.7 Residual Effects Analysis – Air Quality ■ Section 6.3.2.7 Residual Effects Analysis – Hydrogeology ■ Section 6.4.2.7 Residual Effects Analysis – Surface Water Quality ■ Section 6.7.1.7 Residual Effects Analysis – Human Health ■ Section 6.7.2.7 Residual Effects Analysis – Ecological Health

Section in Generic Guideline	Requirement	Section in the EIS
9.3	**Accidents and Malfunctions**	
	The proponent will use the information in appendix A, section A.3.4, Malfunctions and accidents, of the CNSC's draft REGDOC-2.9.1, *Environmental Principles, Assessments and Protection Measures*, to assess the potential health and environmental effects from postulated accident and malfunction scenarios.	■ Section 7.0 Accidents and Malfunctions
9.4	**Cumulative Effects**	
	The proponent will use the information in appendix A, section A.3, Cumulative effects, of the CNSC's draft REGDOC-2.9.1, *Environmental Principles, Assessments and Protection Measures*, to assess the project's potential cumulative effects.	■ Section 8.0 Summary of Cumulative Effects
9.5	**Socio-economic Environment**	
	The proponent will use the information in appendix A, section A.3.7, Socio-economic environment, of the CNSC's draft REGDOC-2.9.1, *Environmental Principles, Assessments and Protection Measures*, to assess the project's indirect socio-economic effects.	■ Section 6.9 Socio-economic Environment
9.6	**Effects of the Environment on the Project**	
	The proponent will use the information in appendix A, section A.3.9, Assessment of effects of the environment on the project, of the CNSC's draft REGDOC-2.9.1, *Environmental Principles, Assessments and Protection Measures*, to assess the effects of the environment on the project (i.e., severe weather events).	■ Section 10.0 Assessment of Effects of the Environment on the Project

Section in Generic Guideline	Requirement	Section in the EIS
10.0	**Mitigation Measures**	
	Every EA conducted under the CEAA 2012 will consider measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the project. Measures that are technically and economically feasible include application of best industry practices, pollution prevention principles such as best available technology and techniques economically achievable (BATEA), and radiation protection principles such as keeping radiation exposure and doses as low as reasonably achievable (ALARA). Under the CEAA 2012, mitigation includes measures to eliminate, reduce or control the adverse environmental effects of a project, as well as restitution for damages to the environment through replacement, restoration, compensation or other means. Each measure will be specific, achievable, measurable and verifiable, and described in a manner that avoids ambiguity in intent, interpretation and implementation. Mitigation measures may be considered for inclusion as conditions in the EA decision statement and/or in other compliance and enforcement mechanisms provided by other authorities' permitting or licensing processes. As a first step, the proponent is encouraged to use an approach based on the avoidance and reduction of the effect(s) at the source. Such an approach may include the modification of the design of the project or relocation of project components. The EIS will describe the standard mitigation practices, policies and commitments that constitute technically and economically feasible mitigation measures and that will be applied as part of standard practice regardless of location (including the measures directed at mitigating adverse socio-economic effects). The EIS will then describe the project's environmental protection plan and its environmental management system, through which the proponent will deliver this plan. The plan will provide an overall perspective on how potentially adverse effects would be minimized and managed over time. The EIS will further discuss the mechanisms the proponent would use to require its contractors and sub-contractors to comply with these commitments and policies and with auditing and enforcement programs. The EIS will then describe mitigation measures that are specific to each environmental effect identified. Measures will be written as specific commitments that clearly describe how the proponent intends to implement them and the environmental outcome the mitigation is designed to address. The EIS will describe mitigation measures in relation to species and/or critical habitat listed under the Species at Risk Act (SARA). These mitigation measures will be consistent with any SARA permit, applicable recovery strategy and/or action plan.	■ Section 6.1.6 Project Interactions and Mitigation ■ Section 6.2.1.6 Project Interactions and Mitigation – Air Quality ■ Section 6.2.2.6 Project Interactions and Mitigation – Greenhouse Gases ■ Section 6.3.1.6 Project Interactions and Mitigation – Geology ■ Section 6.3.2.6 Project Interactions and Mitigation – Hydrogeology ■ Section 6.4.1.6 Project Interactions and Mitigation – Hydrology ■ Section 6.4.2.6 Project Interactions and Mitigation – Surface Water Quality ■ Section 6.5.6 Project Interactions and Mitigation – Aquatic Environment ■ Section 6.6.6 Project Interactions and Mitigation – Terrestrial Environment ■ Section 6.7.1.6 Project Interactions and Mitigation – Human Health ■ Section 6.7.2.6 Project Interactions and Mitigation – Ecological Health ■ Section 6.8.1.6 Project Interactions and Mitigation – Traditional Land and Resource Use ■ Section 6.8.2.6 Project Interaction and Mitigation – Other Land and Resource Use ■ Section 6.9.6 Project Interactions and Mitigation – Socio-economic Environment

Section in Generic Guideline	Requirement	Section in the EIS
10.0	**Mitigation Measures (cont'd)**	
	The EIS will specify the actions, works, minimal disturbance footprint techniques, best available technology, corrective measures or additions planned during the project's various phases to eliminate or reduce the significance of potential adverse effects. The impact statement will also present an assessment of the effectiveness of the proposed technically and economically feasible mitigation measures. The reason(s) for determining if the mitigation measure reduces the significance of a potential adverse effect will be made explicit. The proponent is also encouraged to identify mitigation measures for effects that are adverse although not significant. The EIS will indicate what other technically and economically feasible mitigation measures were considered, and explain why they were rejected. Trade-offs between cost savings and effectiveness of the various forms of mitigation will be justified. The EIS will identify who is responsible for the implementation of these measures and the system of accountability. For proposed mitigation measures for which there is little experience or that have questionable effectiveness, the potential environmental risks and effects – should those measures not be effective –will be clearly and concisely described. In addition, the EIS will identify the extent to which technological innovations will help mitigate environmental effects. Where possible, it will provide detailed information on the nature of these measures, their implementation and management and how these are integrated in the follow-up program.	
11.0	**Conclusion on Significance**	
	The proponent will use the guidance and information in Appendix A, Section A.3.6, Significance of residual effects, of the CNSC's draft REGDOC-2.9.1, *Environmental Principles, Assessments and Protection Measures*, for the preparation of this section of the EIS.	■ Section 9.0 Summary of Significance of Residual Effects

Section in Generic Guideline	Requirement	Section in the EIS
12.0	**Follow-up Program**	
	The proponent will use the guidance and information in Appendix A, Section A.3.10 EA follow-up program, of CNSC's draft REGDOC-2.9.1, *Environmental Principles, Assessments and Protection Measures* for the preparation of this section of the EIS. Where applicable, the proponent will describe how the follow-up program relates to the project's environmental protection plan and environmental management system as mentioned in section 10 above. Environmental assessment effects predictions, assumptions and mitigation actions that are to be tested in the follow-up program must be converted into field-testable monitoring objectives. The monitoring design must include a statistical evaluation of the adequacy of existing baseline data to provide a benchmark for testing project effects, and the need for any additional pre-construction or pre-operational monitoring to establish a firmer project baseline. The proponent will propose a schedule for the follow-up program. The schedule should indicate the timing, frequency and duration of effect monitoring. This schedule would be developed after statistical evaluation of the length of time needed to detect effects given estimated baseline variability, probable environmental effect size and desired level of statistical confidence in the results (type 1 and type 2 errors). The description of the follow-up program will include any contingency procedures or plans or other adaptive management provisions as a means of addressing unforeseen effects, or for correcting exceedances, as required, so as to comply with benchmarks, regulatory standards or guidelines. The follow-up program will describe roles and responsibilities for the program and its review process, by both peers and the public. The EIS should provide discussion on the follow-up program's requirements, and include: ■ objectives and structure of the follow-up program and the VCs targeted by the program ■ tabular summary and explanatory text of the main components of the program including: ■ a description of each monitoring activity under that component ■ which of the two generic program objectives the activity is relevant to (e.g., verify EA predictions, determine effectiveness of mitigation measures) ■ the specific statement from the EA that goes along with that generic objective and will be the focus for that activity (e.g., program objective: verify predicted effects; environmental assessment effect: no potential adverse effects) ■ the specific monitoring objective for that activity ■ planned schedule	■ Section 6.1.10 Monitoring and Follow-up ■ Section 6.2.1.10 Monitoring and Follow-up – Air Quality ■ Section 6.2.2.8 Monitoring and Follow-up – Greenhouse Gases ■ Section 6.3.1.7 Monitoring and Follow-up – Geology ■ Section 6.3.2.9 Monitoring and Follow-up – Hydrogeology ■ Section 6.4.1.7 Monitoring and Follow-up – Hydrology ■ Section 6.4.2.9 Monitoring and Follow-up – Surface Water Quality ■ Section 6.5.7 Monitoring and Follow-up – Aquatic Environment ■ Section 6.6.7 Monitoring and Follow-up – Terrestrial Environment ■ Section 6.7.1.10 Monitoring and Follow-up – Human Health ■ Section 6.7.2.10 Monitoring and Follow-up – Ecological Health ■ Section 6.8.1.7 Monitoring and Follow-up – Traditional Land and Resource Use ■ Section 6.8.2.7 Monitoring and Follow-up – Other Land and Resource Use ■ Section 6.9.7 Monitoring and Follow-up – Socio-economic Environment ■ Section 11.0 Summary of Monitoring and Follow-up Programs

Section in Generic Guideline	Requirement	Section in the EIS
12.0	**Follow-up Program (cont'd)**	
	■ roles and responsibilities to be played by the proponent, regulatory agencies, Aboriginal people, local and regional organizations and others in the design, implementation and evaluation of the program results ■ possible involvement of independent researchers ■ program funding sources ■ information management and reporting (reporting frequency, methods and format) ■ possible opportunities for the proponent to include the participation of the public and Aboriginal groups, during the development and implementation of the program The follow-up program plan should be sufficiently described in the EIS to allow independent judgment as to the likelihood that it will deliver the type, quantity and quality of information required to reliably verify predicted effects (or absence of them) and confirm the effectiveness of mitigation measures.	

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2.0 TABLE OF CONCORDANCE TO THE CNSC REGDOC 2.9.1 ENVIRONMENTAL PRINCIPLES, ASSESSMENTS, AND PROTECTION MEASURES

Section in REGDOC 2.9.1	Requirement	Section in the EIS
Appendix A	**Environmental Assessments under the Canadian Environmental Assessment Act, 2012**	
A.3	**Specific CEAA 2012 Environmental Assessment Requirements**	
	Where the information is common to both the EIS and the licence application, the applicant may provide the information in either the application or the EIS, with appropriate cross-referencing between the submissions. The applicant shall clearly indicate where the requirements of both the NSCA and CEAA 2012 are addressed. The EA of a designated project shall take into account the following factors as listed in subsection 19(1) of CEAA 2012: a) the environmental effects of the designated project, including the environmental effects of malfunctions or accidents that may occur in connection with the designated project and any cumulative environmental effects that are likely to results from the designated project in combination with other physical activities that have been or will be carried out b) the significance of those environmental effects c) comments from the public that are received in accordance with CEAA 2012 d) mitigation measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the designated project e) the requirements of the follow-up program in respect of the designated project f) the purpose of the designated project g) alternative means of carrying out the designated project that are technically and economically feasible and the environmental effects of any such alternative means h) any changes to the designated project that may be caused by the environment i) the results of any relevant study conducted by a committee established under section 73 or 74 of CEAA 2012 j) any other matter relevant to the EA that the responsible authority requires to be taken into account Pursuant to subsection 19(2) of CEAA 2012, the scope of the factors to be taken into account under paragraphs 19(1)(a), (b), (d), (e), (g), (h) and (j) is determined by the Commission, as a responsible authority. The EIS and supporting technical studies are completed to meet the requirements of CEAA 2012, paragraphs 19(1)(a), (b), (d), (e), (f), (g), (h) and, if appropriate, (i) and (j) in accordance with the scope of these	■ All EIS Sections and Appendices

Section in REGDOC 2.9.1	Requirement	Section in the EIS
	factors as determined by the CNSC. The completion of the EIS and, as necessary, supporting technical studies is typically delegated to the applicant in accordance with section 23 of CEAA 2012. This regulatory document provides requirements and guidance to support project planning and early development of these documents by the applicant. These requirements and guidance do not negate the importance of pre-project engagement or the potential for project-specific EA guidelines.	
A.3.1	**Purpose of the Project**	
	Paragraph 19(1)(f) of CEAA 2012 states that the EIS shall identify the purpose of the project (defined as what is to be achieved by carrying out the project). For further guidance, consult *Addressing "Purpose of" and "Alternative Means" under the Canadian Environmental Assessment Act, 2012* [17].	■ Section 2.3 Purpose of the Project
A.3.2	**Alternative Means for Carrying out the Project**	
	Paragraph 19(1)(g) of CEAA 2012 states that the EIS shall identify and describe alternative means to carry out the project that are, from the perspective of the applicant, technically and economically feasible. As identified by the proponent, the alternative means include options for locations, development, and implementation methods, routes, designs, technologies, mitigation measures, and so on. Alternative means may also be related to the construction, operation, expansion, decommissioning and abandonment of a physical work. The approach and level of effort applied to addressing alternative means is established on a project-by-project basis taking into consideration: ■ the characteristics of the project ■ the environmental effects associated with the potential alternative means ■ the health or status of valued components (VCs) that may be impacted by the alternative means ■ the potential for mitigation and the extent to which mitigation measures may address potential environmental effects ■ the level of concern expressed by the public and Indigenous groups The EIS should also describe the environmental effects of each alternative means. The criteria used to identify alternative means as unacceptable, and how these criteria were applied, should be described, as should the criteria used to examine the environmental effects of each remaining alternative means to identify the preferred alternative. For further guidance, consult *Addressing "Purpose of" and "Alternative Means" under the Canadian Environmental Assessment Act, 2012* [17].	■ Section 2.5 Alternative Means of Carrying Out the Project

Section in REGDOC 2.9.1	Requirement	Section in the EIS
A.3.3	**Environmental Effects**	
	Paragraph 19(1)(a) of CEAA 2012 states that the EA must take into account the environmental effects of the designated project. The environmental effects that must be considered in an EA under CEAA 2012 are also requirements under the NSCA. As described in section 4, the applicant should conduct an ERA in accordance with CSA 288.6, *Environmental risk assessment at Class I nuclear facilities and uranium mines and mills* [6].	■ Section 6.1 Environmental Assessment Approach ■ Section 6.2 Atmospheric Environment ■ Section 6.3 Geological and Hydrogeological Environment ■ Section 6.4 Surface Water Environment ■ Section 6.5 Aquatic Environment ■ Section 6.6 Terrestrial Environment ■ Section 6.7 Human and Ecological Health ■ Section 6.8 Land and Resource Use ■ Section 6.9 Socio-economic Environment

Section in REGDOC 2.9.1	Requirement	Section in the EIS
A.3.4	**Malfunctions and Accidents**	
	Paragraph 19(1)(a) of CEAA 2012 states that malfunctions and accidents shall be assessed in the EA. Malfunctions and accidents should be separated into radiological and non-radiological (conventional). The applicant should provide an assessment of potential health and environmental effects resulting from postulated radiological and conventional malfunctions or accidents. The EIS should also include any mitigation measures such as monitoring, contingency, clean-up or restoration work in the surrounding environment that would be required during or immediately following the postulated malfunction and accident scenarios. The EIS should provide a description of postulated malfunction and accident sequences leading to a radiological or non-radiological release considering, as appropriate, internal events, external events and human-induced events, including their frequency and an explanation of how these events were identified, and any modeling that was performed. The applicant can use a bounding approach or use facility- or activity-specific information (for example, design, operation, projected environmental releases) in the assessment of radiological accidents and malfunctions. If a bounding approach is used, the applicant should provide a detailed rationale for the selection of each bounding scenario. The EIS should include the source, quantity, mechanism, pathway, rate, form and characteristics of contaminants and other materials (physical and chemical) likely to be released to the surrounding environment during the postulated malfunctions and accidents. **Note:** Malfunctions and accidents are reviewed in depth under the NSCA for licensing purposes (for example, under REGDOC-2.4.1, *Deterministic Safety Analysis* [18], REGDOC-2.4.2, *Probabilistic Safety Assessments for Nuclear Power Plants* [19] and RD-346, *Site Evaluation for New Nuclear Power Plants* [20]). These scenarios should be taken into consideration by the applicant when designing environmental protection measures (see section 4). If applicable, the applicant should use operating experience (OPEX) to identify any past abnormal operations, accidents and spills to the extent that they are relevant to the current assessment for the purposes of identifying malfunction and accident scenarios to be assessed.	■ Section 7.2 Methods ■ Section 7.2.1.1 Radiological Hazards ■ Section 7.2.1.2 Non-Radiological Hazards ■ Section 7.3 Accidents and Malfunctions ■ Section 7.4 Risk Evaluation of Accidents and Malfunctions

Section in REGDOC 2.9.1	Requirement	Section in the EIS
A.3.5	**Cumulative Effects**	
	Paragraph 19(1)(a) of CEAA 2012 states that the applicant shall assess any residual adverse environmental effects of the project in combination with other past, present or reasonably foreseeable projects and/or activities within the study area. The applicant should explain the approach and methods used to identify and assess cumulative effects. The approach and methods should be consistent with *Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012* [21].	■ Section 8.0 Summary of Cumulative Effects
A.3.6	**Significance of Residual Effects**	
	Paragraph 19(1)(b) of CEAA 2012 states that the applicant shall assess the significance of any residual effects that persist, taking into consideration the proposed mitigation measures. These residual effects are identified during the ERA or a characterization of the environmental effects. In the EIS, the applicant should include a detailed analysis of the significance of each residual effect. The applicant should clearly explain the method and definitions used to describe the level of the residual adverse effect (for example, low, medium, or high) for each of the issues. The applicant should also describe any cumulative environmental effects that are likely to result from the designated project in combination with other physical activities that have been or will be carried on and how these levels were combined to reach an overall conclusion on the significance of the adverse effects for each valued component (VC). **Guidance** Some specific issues to be assessed are: ■ magnitude of the effect ■ spatial extent of the effect ■ duration and frequency of the effect ■ degree to which the effect can be reversed or mitigated ■ ecological importance The method used to describe the level of the adverse effect should be transparent and reproducible. The EIS should identify additional criteria used to assign significance ratings to any predicted adverse effects. It should contain clear and sufficient information to enable the CNSC and the public to understand and review the applicant's judgement of the significance of effects. The applicant should define the terms used to describe the level of significance. In assessing significance against the criteria, the EIS should, where possible, employ relevant existing regulatory documents, environmental standards, guidelines or objectives such as prescribed maximum levels of emissions or discharges of specific hazardous substances into the environment or maximum acceptable levels of specific hazardous substances in the environment.	■ Section 9.0 Summary of Significance of Residual Effects

Section in REGDOC 2.9.1	Requirement	Section in the EIS
A.3.7	**Socio-economic Environment**	
	The applicant should characterize the socio-economic environment and identify all indirect socio-economic effects. An indirect effect is a secondary environmental effect that occurs as a result of a change that a project may cause to the environment. Paragraph 5(2)(b) of CEAA 2012 refers to any change to the environment caused by the project on health and socio-economic conditions, physical and cultural heritage, or any structure, site or thing that is of historical, archaeological, paleontological or architectural significance. For additional guidance, refer to *Technical Guidance for Assessing Physical and Cultural Heritage or any Structure, Site or Thing that is of Historical, Archeological, Paleontological or Architectural Significance under the Canadian Environment Assessment Act, 2012* [22].	■ Section 6.9 Socio-economic Environment
A.3.8	**Community and Aboriginal Traditional Knowledge**	
	Subsection 19(3) of CEAA 2012 states that community and Aboriginal traditional knowledge may be considered in the EA. CNSC staff will provide guidance to the applicant at the earliest possible stage in the EA process concerning the extent to which community and Aboriginal traditional knowledge shall be considered in the EA. For additional information, refer to: ■ *Considering Aboriginal traditional knowledge in environmental assessments conducted under the Canadian Environmental Assessment Act, 2012* [23] ■ REGDOC-3.2.2, *Indigenous Engagement* [10] (for further information on the CNSC's expectations of applicants for Indigenous engagement)	■ Section 4.3 Influence of Traditional Knowledge on the Environmental Assessment ■ Section 6.4.2 Surface Water Quality ■ Section 6.5 Aquatic Environment ■ Section 6.6 Terrestrial Environment ■ Section 6.7 Human and Ecological Health ■ Section 6.8.1 Traditional Land and Resource Use by Indigenous Peoples ■ Section 6.9 Socio-economic Environment
A.3.9	**Assessment of Effects of the Environment on the Project**	
	Paragraph 19(1)(h) of CEAA 2012 states that the EIS shall take into account how the environment could adversely affect the project. The applicant shall also take into account any potential effects of climate change on the project, including an assessment of whether the project might be sensitive to changes in climate conditions during its lifecycle. Some adverse environmental conditions are flooding, severe weather, biophysical hazards (such as algae), geotechnical hazards and seismic events.	■ Section 10.0 Assessment of Effects of the Environment on the Project

Section in REGDOC 2.9.1	Requirement	Section in the EIS
A.3.10	**EA Follow-up Program**	
	Paragraph 19(1)(e) of CEAA 2012 states that the EIS shall include a framework or preliminary program upon which EA follow-up actions will be managed throughout the life of the project. The applicant should design the follow-up program to verify the accuracy of the EA predictions and to determine the effectiveness of the measures implemented to mitigate the potential adverse environmental effects of the project. The applicant should also design the follow-up program to incorporate pre-project information that would provide the baseline data; compliance data such as established environmental quality criteria; regulatory documents, standards or guidelines; and real-time data consisting of observed data gathered in the field. As part of the follow-up program, the applicant should describe the compliance reporting methods to be used, including reporting frequency, methods and format. **Note:** The CNSC, in collaboration with other federal authorities (where applicable), verifies and monitors all EA follow-up activities through the CNSC licensing and compliance process. EA follow-up monitoring activities may be integrated within the applicant's environmental protection measures.	■ Section 6.1.10 Monitoring and Follow-up ■ Section 6.2.1.10 Monitoring and Follow-up – Air Quality ■ Section 6.2.2.8 Monitoring and Follow-up – Greenhouse Gases ■ Section 6.3.1.7 Monitoring and Follow-up – Geology ■ Section 6.3.2.9 Monitoring and Follow-up – Hydrogeology ■ Section 6.4.1.7 Monitoring and Follow-up – Hydrology ■ Section 6.4.2.9 Monitoring and Follow-up – Surface Water Quality ■ Section 6.5.7 Monitoring and Follow-up – Aquatic Environment ■ Section 6.6.7 Monitoring and Follow-up – Terrestrial Environment ■ Section 6.7.1.10 Monitoring and Follow-up – Human Health ■ Section 6.7.2.10 Monitoring and Follow-up – Ecological Health ■ Section 6.8.1.7 Monitoring and Follow-up – Traditional Land and Resource Use ■ Section 6.8.2.7 Monitoring and Follow-up – Other Land and Resource Use ■ Section 6.9.7 Monitoring and Follow-up – Socio-economic Environment ■ Section 11.0 Summary of Monitoring and Follow-up Programs

Section in REGDOC 2.9.1	Requirement	Section in the EIS
Appendix B	**Characterization of the Baseline Environment for an Environmental Assessment under CEAA 2012**	
B.1	**Atmospheric Environment**	
	The atmospheric environment includes the climate conditions at the site and in the local and regional study areas. It includes the seasonal variations in weather conditions within the study areas, to allow the assessment of effects on the facility or activity. The applicant or licensee should provide a description of the existing ambient air quality in the study areas, with emphasis on characterizing radiological and non-radiological analytes. The description should include meteorological information such as air temperature, relative humidity, precipitation, wind speed and direction, atmospheric pressure, and solar radiation. It should also include the occurrence of weather phenomena (for example, lightning, temperature inversions and fog). Special consideration should be given to the analysis of extreme and rare meteorological phenomena (for example, tornadoes).Uncertainties should be described and taken into account when discussing the reliability of the information presented. The description should also include current ambient daytime and nighttime noise levels at the site and local study areas, and include information on its source(s), geographic extent and temporal variations. The description should provide ambient noise levels for other areas that could be affected by the facility or activity. Some examples are: ■ increased traffic along transportation corridors to and from the site during construction ■ receptors at residences and sensitive sites (such as hospitals, schools, daycare facilities, seniors' residences, and places of worship) The applicant or licensee should describe the influence of regional topography or other features that could affect weather conditions in the study areas. The baseline information should be sufficient to support the use of an atmospheric dispersion model to conduct the site-specific ERA and to support an assessment of the effects of the environment on the project (for example, tornadoes).	■ Section 6.2.1.5 Description of the Environment – Air Quality ■ Section 6.2.2.5 Description of the Environment – Greenhouse Gases

Section in REGDOC 2.9.1	Requirement	Section in the EIS
B.2	**Surface Water Environment**	
	The surface water environment includes all surface water features and hydrology that affect surface water at the site or in the local and regional study areas. The applicant or licensee should include delineation of drainage basins at appropriate scales. When documenting the water quality of all surface water, the applicant or licensee should demonstrate the use of appropriate sampling and analytical protocols, for the range of analytical parameters with the potential to be influenced by the facility or activity. This information should be presented using tables, maps and figures to provide an understanding of surface water characteristics and conditions at the site and in the local and regional study areas. The applicant or licensee should describe hydrological regimes within the drainage basin, including seasonal fluctuations and year-to-year variability of all surface waters. The applicant or licensee should assess normal flow, flooding and drought properties of water bodies as well as the interactions between surface water and groundwater flow systems. The applicant or licensee should describe all water sources used for drinking water in the area, including source water intakes for drinking water treatment facilities. The baseline information should be sufficient to support the use of an aquatic dispersion model to conduct the site-specific ERA and to support an assessment of the effects of the environment on the facility or activity (for example, flooding). The applicant or licensee should document the sediment quality of all water bodies to be affected by the facility or activity, demonstrating the use of appropriate sampling and analytical protocols, for the range of analytical parameters with the potential to be influenced by the facility or activity. This information should provide an appropriate understanding of sediment characteristics and conditions on the site and in the local and regional study areas. The study design should be fully described, including the allocation of samples in space and time, measurement methods and results. The applicant or licensee should include an assessment of any limitations or gaps in the quality and extent of baseline data and methods, as well as the method(s) by which they have been addressed.	■ Section 6.4.1.5 Description of the Environment – Hydrology ■ Section 6.4.2.5 Description of the Environment – Surface Water Quality

Section in REGDOC 2.9.1	Requirement	Section in the EIS
B.3	**Aquatic Environment**	
	The aquatic environment includes the aquatic and wetland species at the site and within the local and regional study areas, including the flora, fauna and their habitats. The applicant or licensee should seek information from relevant authorities (such as Environment and Climate Change Canada (ECCC), Fisheries and Oceans Canada (DFO) and provincial or territorial authorities) on aquatic and wetland species and habitat for the local and regional study areas. The applicant or licensee should also undertake independent studies to gather the necessary information. The applicant or licensee should include a description of the food chain and food web dynamics as a habitat component as this relates to fish populations, and potential effects resulting from the facility or activity (such as impingement and entrainment). The applicant or licensee should provide detailed habitat mapping that demonstrates habitat usage by fish within the study areas. This information should include depth profiles, substrate mapping, water temperature profiles, and a description of known and potential habitat usage (such as spawning, nursery, rearing, feeding and migratory) by fish that occur in the study areas. The applicant or licensee should identify any biological species of natural conservation status (that is, rare, vulnerable, endangered, threatened or uncommon at a federal, provincial or municipal level) and their critical habitats, if identified. The applicant or licensee should provide baseline characterization of radionuclide and hazardous substance levels in aquatic biota to support human and ecological risk assessment. The applicant or licensee should fully describe the study design, including the allocation of samples in space and time, measurement methods and results. The applicant or licensee should include an assessment of any limitations or gaps in the quality and extent of baseline date and methods, as well as the method(s) by which they have been addressed.	■ Section 6.5.5 Description of the Environment – Aquatic Environment

Section in REGDOC 2.9.1	Requirement	Section in the EIS
B.4	**Geological and Hydrogeological Environment** The geological and hydrogeological environment includes the bedrock and overburden geology at both the local and regional scales.	
B.4.1	**Geology**	
	The applicant or licensee should characterize the geomorphology, topography, quaternary geology and soil characteristics, structural geology, petrology, geochemistry, economic geology and hydrogeology. The applicant or licensee should also describe the geomechanical properties that apply to the region and at the site that will be disturbed. The applicant or licensee should provide the geotechnical properties of the overburden, including shear strength and liquefaction potential, to allow for the assessment of slope stability and bearing capacity of foundations under both static and dynamic conditions. The description of the structural geology should include regional, local and site-specific documentation of fractures and faults. It should include a description of primary geological features and deformation fabrics both at the site and within the local and regional study areas. If applicable, the applicant or licensee should describe the coastal geomorphology and should include the characteristics of any lakefront or ocean bluffs, shoreline, and both near-shore zone and offshore zones. The baseline characterization should be sufficient to assess effects of the environment on the facility or activity (for example, seismic effects). The applicant or licensee should present a geological model that incorporates all overburden and bedrock information. If extrapolation is required to derive the stratigraphy, the applicant or licensee should explicitly discuss the uncertainties and the need for additional field investigations to reduce those uncertainties. The applicant or licensee should describe the geotechnical and geophysical hazards including the consideration of subsidence, uplift, seismicity (and active faulting), and consider the potential for movement at the ground surface (including co-seismic rupture) and earthquake ground motions. A seismic hazard assessment should be provided. Where appropriate, the narrative descriptions should be supplemented by geological maps, figures, cross-sections, borehole logs and photographs (with specific location information).	■ Section 6.3.1.5 Description of the Environment – Geology

Section in REGDOC 2.9.1	Requirement	Section in the EIS
B.4.2	**Hydrogeology**	
	The applicant or licensee should describe the hydrogeology at the site and in the local and regional study areas. The description should characterize the physical and geochemical properties of all overburden and bedrock hydrogeological units (from the ground surface to the uppermost basement unit, which is site dependent). Units may be characterized as aquifers or aquitards, and unit descriptions should include their geochemical characteristics, vertical and lateral permeabilities, transport mechanism (diffusion versus advection) and directions of groundwater flow. The applicant or licensee should identify the groundwater recharge and discharge areas, and describe in detail the groundwater interactions with surface waters. The applicant or licensee should present a conceptual and numerical hydrogeological model that discusses the hydrostratigraphy and groundwater flow systems. The applicant or licensee should provide a description of baseline groundwater quality at the site and in the local study area. The applicant or licensee should also describe local and regional potable groundwater supplies, including their current use and potential for future use.	■ Section 6.3.2.5 Description of the Environment – Hydrogeology

Section in REGDOC 2.9.1	Requirement	Section in the EIS
B.5	**Terrestrial Environment**	
	The terrestrial environment includes flora and fauna, their habitats, any wildlife corridors and the soil. The applicant or licensee should describe the terrestrial species at the site and within the local and regional study areas, including flora, fauna and their habitat. The applicant or licensee should identify all biological species at risk (that is, endangered, threatened, special concern, extirpated at a federal, provincial or municipal level) known to occur in the area or where the site is within the range of the species. The applicant or licensee should describe the presence and importance of wildlife habitat within the study areas, including critical habitats for listed species (if identified). The applicant or licensee should also describe any wildlife corridors and physical barriers to movement. The applicant or licensee should identify all protected and conservation areas established by federal, provincial and municipal jurisdictions (for example, wilderness areas, parks, sites of historical or ecological significance, nature reserves, federal migratory bird sanctuaries and wildlife management areas). The applicant or licensee should describe the existing soil quality (including hazardous and radiological substance concentrations) for all study areas, as well as any additional soil quality parameters potentially relevant for modelling purposes (such as transport and bioavailability of contaminants of potential concern). The applicant or licensee should provide baseline characterization of radionuclide and hazardous substance levels in vegetation and other non-human biota to support human and ecological risk assessment. The characterization should also take into consideration the baseline conditions of other applicable environmental components (such as the atmospheric environment). The applicant or licensee should undertake independent studies to gather the necessary information as appropriate. The applicant or licensee should describe field studies in terms of representativeness of the target populations where possible. The applicant or licensee should fully describe the design of the study, including the allocation of samples in space and time, measurement methods and results. The applicant or licensee should include an assessment of any limitations or gaps in the quality and extent of baseline data and methods, as well as the method(s) by which they have been addressed.	■ Section 6.6.5 Description of the Environment – Terrestrial Environment

Section in REGDOC 2.9.1	Requirement	Section in the EIS
B.6	**Ambient Radioactivity**	
	The ambient radioactivity arises from the sources, their activity levels and their origin, for all applicable environmental media (including air, soil, food, water, aquatic sediments and plant or animal tissue). The applicant or licensee should describe the ambient radiological conditions at the site and in the local and regional study areas. The applicant or licensee should include information on the existing conditions, including an inventory of sources, their activity levels and their origin (natural or anthropogenic), for all applicable environmental media. The applicant or licensee should fully describe the design of the study, including the allocation of samples in space and time, measurement methods and results. The description should include an assessment of any limitations or gaps in the quality and extent of the baseline data and methods, as well as the method(s) by which they have been addressed.	■ Section 6.7.1.5 Description of the Environment – Human Health ■ Section 6.7.2.5 Description of the Environment – Ecological Health
B.7	**Human Health**	
	The potential effects of the facility or activity on human health include both radiological sources and non-radiological contaminants. The applicant or licensee should describe the current health profiles of the communities likely to be affected by the facility or activity, including information on population health of the communities in the local and regional study areas. The applicant or licensee should provide, to the extent available, information on current consumption of locally grown harvests and country foods, and the quality by food type, amounts consumed, parts consumed (whole body or specific organs).	■ Section 6.7.1.5 Description of the Environment – Human Health

Section in REGDOC 2.9.1	Requirement	Section in the EIS
B.8	**Aboriginal Land Use**	
	Indigenous land and resource use includes lands, waters and resources of specific value; traditional activities and lifestyle; and traditional dietary habits. Traditional land use may include areas where traditional activities such as establishing seasonal camps, camping, travel on traditional routes, gathering of country foods and medicines (hunting, fishing, trapping, planting and harvesting) are being carried out. Traditional land use also includes spiritual sites of significance to Indigenous people. The applicant or licensee should identify the lands, water and resources of specific social, economic, archaeological, cultural or spiritual value to Indigenous people, including established and asserted Indigenous or treaty rights that may be affected by the facility or activity. The applicant or licensee should describe Indigenous land and resource use at the site and in the local and regional study areas. The applicant or licensee should identify traditional activities, including activities for food, social, ceremonial and other cultural purposes, in relation to such lands, waters and resources with a focus on the current use of lands, waters and resources for traditional purposes. The applicant or licensee should describe the traditional dietary habits and dependence on country foods and harvesting for other purposes, including harvesting of plants for medicinal purposes. The analysis should focus on the identification of potential adverse effects of the facility or activity on the ability of future generations of Indigenous people to pursue traditional activities or lifestyle.	■ Section 6.8.1 Traditional Land and Resource Use by Indigenous Peoples

Section in REGDOC 2.9.1	Requirement	Section in the EIS
Appendix C	**Environmental Effects for an Environmental Assessment under CEAA 2012**	
C.1	**Atmospheric Environment**	
	The licensee should characterize the effects of the facility or activity on the atmospheric environment during all phases of the lifecycle for the facility or activity, including postulated accident and malfunction scenarios. The licensee should identify and characterize all atmospheric emissions (radiological and non-radiological) expected to be generated during all phases of the lifecycle for the facility or activity, including postulated accident and malfunction scenarios. This information should include average and maximum emissions from planned discharges, point sources and fugitive (non-point source) releases (including greenhouse gases). The licensee should complete modelling that incorporates baseline (or existing ambient) air quality in combination with the predicted site-specific atmospheric characteristics (such as shoreline fumigation) to assess potential effects on air quality, the transport of atmospheric contaminants and any associated exposure to humans and non-human biota receptors. The licensee should describe predicted effects of noise on terrestrial and aquatic species as well as on nearby residents and communities. The description should include both daytime and nighttime noise levels and tonal noise. The predicted sound levels should be compared against baseline levels and any guidelines published by recognized organizations.	■ Section 6.2.1.7 Residual Effects Analysis – Air Quality ■ Section 6.2.2.6 Project Interactions and Mitigation – Greenhouse Gases
C.2	**Surface Water Environment**	
	The licensee should describe the effects of the facility or activity on the surface water environment during all phases of the lifecycle for the facility or activity, including accident and malfunction scenarios. The licensee should identify and characterize all liquid effluents that could be generated during all phases of the facility or activity. Some examples are: ■ average and maximum emissions from point sources (concentrations/activity levels and volumes) ■ planned discharges ■ fugitive releases ■ deposition from airborne particulates ■ surface runoff	■ Section 6.4.1.6 Project Interactions and Mitigation – Hydrology ■ Section 6.4.2.7 Residual Effects Analysis – Surface Water Quality

Section in REGDOC 2.9.1	Requirement	Section in the EIS
C.3	**Aquatic Environment**	
	For all phases of the lifecycle for the facility or activity, the licensee should describe the effects of the facility or activity on aquatic flora and fauna, and include a full accounting of effects on species of natural conservation status and their habitat. This evaluation should be based on results of field monitoring studies or predictions from an ecological risk assessment. The description should be clear on how predicted effects to the biota exposed to the stressor compare to the expected reference condition for unexposed biota on a biological population basis, taking natural variation into account. Predictions of effects should include sufficient detail to allow follow-up verification. Some potential effects are: ■ effects on habitat, including aquatic vegetation and sensitive areas such as spawning grounds, nursery areas, winter refuges and migration corridors ■ effects on aquatic species, including rare or sensitive species ■ effects of blasting on fish and fish habitat on local aquatic systems ■ contaminant exposures through environmental and food-chain transport ■ effects on aquatic biota due to impingement and entrainment ■ effects of infilling on loss of fish habitat and changes to productive capacity ■ effects of thermal plume(s) on fish and fish habitat ■ effects on wetlands Under the NSCA, the CNSC assesses the ongoing operation of nuclear facilities and activities to ensure protection of the environment and the health and safety of persons. Under the Memorandum of Understanding between CNSC and Fisheries and Oceans Canada (DFO), the CNSC is responsible for conducting reviews of licence applications to assess the potential effects on fish and fish habitat, and to ensure that the assessment process considers the intent and requirements of the *Fisheries Act*, the *Species at Risk Act* and their associated regulatory and policy frameworks.	■ Section 6.5.6 Project Interactions and Mitigation – Aquatic Environment

Section in REGDOC 2.9.1	Requirement	Section in the EIS
C.4	**Geological and Hydrogeological Environment** The geological and hydrogeological environment includes the bedrock and overburden geology at both the local and regional scales.	
C.4.1	**Geology**	
	The licensee should fully describe any changes to the geology and geomorphology resulting from the facility or activity, including any interrelationships with the groundwater regime. The licensee should describe any changes to the environment resulting from the removal of bedrock and/or unconsolidated deposits. The licensee should also describe the disturbance of soils or sediments that may be stockpile, used for construction purposes or otherwise perturbed. The licensee should include an assessment of changes made that would affect coastal processes and features (such as changes to the shoreline morphology due to construction, erosion or sediment transport).	■ Section 6.3.1.6 Project Interactions and Mitigation – Geology
C.4.2	**Hydrogeology**	
	The licensee should describe and assess any effects the facility or activity may have on the groundwater regime including the quantity and quality of groundwater and how these effects may influence surface waters. The licensee should carry out modelling as needed to develop and test the predicted effects.	■ Section 6.3.2.7 Residual Effects Analysis – Hydrogeology
C.5	**Terrestrial Environmental**	
	The licensee should describe the effects of the facility or activity on terrestrial fauna and flora and include a full accounting of effects on species with elevated conservation status and their habitat. This evaluation should be based on results of field monitoring studies or predictions from an ecological risk assessment. The description should be clear on how predicted effects to the biota exposed to the stressor compare to the expected “reference condition” for unexposed biota on a biological population basis taking into account natural variation. Predictions of the effects should include sufficient detail to allow follow-up verification. Some potential effects that should be considered are: ■ loss of terrestrial habitat and the quality of lost habitat for relevant species ■ disturbance of feeding, nesting or breeding habitats ■ physical barriers to wildlife ■ disruption, blockage, impediment and sensory disturbance (such as light effects, noise and vibration) of daily or seasonal wildlife movements (such as migration or home ranges) ■ direct and indirect wildlife mortality ■ reduction in wildlife productivity ■ contaminant exposures through environmental and food-chain transport ■ effects on biodiversity	■ Section 6.6.6 Project Interactions and Mitigation – Terrestrial Environment

Section in REGDOC 2.9.1	Requirement	Section in the EIS
C.6	**Ambient Radioactivity**	
	The licensee should describe the effects of the facility or activity on ambient radioactivity. Humans and non-human biota exposed to ambient radioactivity should be assessed for all relevant routes of exposure (both internal and external exposure scenarios). To support the assessment of human health (see section 3.2.7), the licensee should provide information on radiation levels to which members of the public may be exposed, including consideration of consumers of country food whose exposure pathways may differ due to cultural norms; for example, any dietary characteristics of Indigenous peoples.	■ Section 6.7.1.7 Residual Effects Analysis – Human Health ■ Section 6.7.2.7 Residual Effects Analysis – Ecological Health
C.7	**Human Health**	
	The licensee should describe the potential effects of the facility or activity on the physical well-being of Indigenous groups and other people resulting from biophysical effects, including the effects of the facility or activity on all environmental components (for example, atmospheric environment) and the resulting effects on human health. Some examples are: ■ an analysis of the effects of the facility or activity on the health and safety of the public, including the possible effects from malfunctions and accidents (radiological and conventional) ■ the predicted radiation doses to members of the public resulting from activities within the scope of the facility or activity and any resulting health effects ■ a description of quantitative risk assessment modeling conducted, where necessary, for any malfunctions and accidents ■ an assessment of the potential effects on human health from all non-radiological contaminants released from the facility or activity, through all potential exposure pathways ■ potential effects of noise generated from the facility or activity on human receptors within the study area(s)	■ Section 6.7.1.7 Residual Effects Analysis – Human Health
C.8	**Indigenous Land and Resource Use**	
	The licensee should identify any change that the facility or activity is likely to cause in the environment and any effect of any such change on the health and socio-economic conditions, physical and cultural heritage and on the current use of lands and resources for traditional purposes by any Indigenous group including effects on hunting, trapping, fishing and gathering. The licensee should identify any concerns raised by Indigenous people about the facility or activity in relation to any Indigenous or treaty rights. For further information on the CNSC's expectations of licensees for Indigenous engagement, see REGDOC-3.2.2, *Indigenous Engagement*. [10]	■ Section 6.8.1.6 Project Interactions and Mitigation – Traditional Land and Resource Use

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APPENDIX 1.0-2

Interrelation between WR-1 In situ Disposal Project Documents

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LIST OF TABLES

Table 1: Interrelation Between Whiteshell Reactor 1 (WR-1) In Situ Disposal Project Documents..... 1

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Table 1: Interrelation Between Whiteshell Reactor 1 (WR-1) In Situ Disposal Project Documents

Technical Supporting Document or Supplemental Support Document	Portion of Information or Data Applying to WR-1 In-Situ Disposal Project	How Information/Data are Applied; Outline of Assumptions, Limitations or Differences	Distinguish Factual Evidence from Inference
Stakeholder Engagement Report (WLDP-26000-REPT-010) CNL 2022c	■ Information on public engagement activities related to the Project, including timing and location of public information sessions, presentation materials, and feedback received during the sessions.	■ Information is used to demonstrate how CNL has engaged with communities that are interested in and potentially affected by the Project.	■ Factual evidence based on interactions and feedback received from stakeholders during engagement activities.
Indigenous Engagement Report (WLDP-26000-REPT-002) CNL 2022a	■ Information on Indigenous engagement activities related to the Project, including timing and location of engagement activities, presentation materials, and feedback received during the sessions.	■ Information is used to demonstrate how CNL has engaged with Indigenous peoples that are interested in and potentially affected by the Project.	■ Factual evidence based on interactions and feedback received from Indigenous peoples during engagement activities.
Decommissioning Safety Assessment Report (WLDP-26000-SAR-001) Golder 2021a	■ The DSAR provides evidence that the overall performance of the decommissioned WR-1 is safe and identifies institutional controls that will be needed in the long-term to demonstrate protection of human health and the environment. Applicable sections of the DSAR include: ▪ Site Description ▪ Project Description ▪ Safety Strategy ▪ Assessment Approach ▪ WR-1 Building Closure Safety Assessment ▪ Post Closure Safety Assessment ▪ Results Evaluation ▪ CNL WR-1 In Situ Disposal Hazards Identification and CNL WR-1 Decommissioning Activities Accidents and Malfunctions	■ Information is used to support the assessment of effects in the EIS. ■ There is uncertainty in the estimated inventory of radioactive material that could be encountered during the cutting and perforation of components, during grouting preparation activities, or dismantling of the WR-1 Building. As such, reactor characterization and radiological surveys have been completed to verify model inputs and assumptions. In addition, a building condition assessment and grout characterization and test plan work are underway, the results of which will also be used to verify model inputs and assumptions. ■ There is uncertainty in the radiological release rates to the atmosphere; however, the estimates are expected to be conservative. ■ For the ERA, both maximum and average quantities estimated for non-radionuclides were assessed. ■ For the groundwater flow and solute transport modelling, the models were configured based on measured input parameters and (in the absence of measured data) conservative assumptions. Uncertainty in model inputs was addressed through sensitivity analyses. Model components evaluated through the sensitivity analysis included geological pathways, the WR-1 concrete cap and engineered cover, foundation and grout failure modes and timeframes associated with failure, adsorption-partition coefficients, source mass inventory, corrosion of the reactor components, hydraulic conductivity of the backfill and bedrock, stage of the Winnipeg River.	■ Report is based on factual information; a summary of site characteristics, facility structures, systems, components and safety features, facility operations, and maintenance and relevant compliance programs.

Table 1: Interrelation Between Whiteshell Reactor 1 (WR-1) In Situ Disposal Project Documents

Technical Supporting Document or Supplemental Support Document	Portion of Information or Data Applying to WR-1 In-Situ Disposal Project	How Information/Data are Applied; Outline of Assumptions, Limitations or Differences	Distinguish Factual Evidence from Inference
Detailed Decommissioning Plan (WLDP-26400-DDP-001) CNL 2015, 2022b	■ The DDP describes plans for the decommissioning of the WR-1 Building. It provides a bounding scope document for the EIS that describes the work to be done, lays out the high-level work breakdown structure, and provides a high-level hazard assessment. Applicable sections of the DDP include: ▪ Description of Site and Facility ▪ Current Status ▪ Decommissioning End-State ▪ Requirements for Institutional Control ▪ Hazards Assessment ▪ Decommissioning Strategy ▪ Decommissioning Work Packages ▪ Waste Management Plan ▪ Public Consultation ▪ Radiological Status of Rooms in B100 (WR-1 Complex) ▪ Summary of Evaluation of Alternative Decommissioning Strategies	■ Information is used to support the selected approach to decommission the WR-1 Building and to determine how the equipment associated with the WR-1 Building should be managed (above-grade; below-grade; level of radioactivity). All information supports the assessment of effects in the EIS. ■ There is uncertainty in the estimated inventory of radioactive material that could be encountered during the cutting and perforation of components, during grouting preparation activities, or dismantling of the WR-1 Building. As such, reactor characterization and radiological surveys have been completed to verify model inputs and assumptions. In addition, a building condition assessment and grout characterization and test plan work are underway, the results of which will also be used to verify model inputs and assumptions. ■ There is uncertainty in the radiological release rates to the atmosphere; however, the estimates are expected to be below the release criteria. The WRDF is expected to prevent over 97% of the initial radioactivity in the WRDF from being released to the environment. ■ The worker dose estimates are based on dose rates from WR-1 radiological hazard surveys and WL Projects resource estimates. ■ While it is not possible to anticipate every potential decontamination problem during the Project planning phase, the ISD approach needs to be sufficiently flexible to accommodate the expected field conditions encountered. ■ During ISD activities, various hazards may be encountered: ▪ Radiation fields; ▪ Radioactive contamination; ▪ Environmental contamination to the geosphere and biosphere; ▪ Conventional hazards (biological, physical, chemical); ▪ Radioactive sources not included in the inventory; ▪ Leaking radioactive sources or loss of shielding; ▪ Leaks of liquids produced during decommissioning; ▪ Piping systems containing radioactive and/or chemically hazardous liquids or sediments; ▪ Buried pipes with highly contaminated liquids that might be broken; ▪ Tanks with liquids or contaminated sludge that will require draining; ▪ Accumulation of radioactive dust present in ventilation and filtration systems; ▪ Accumulation of a significant radioactive inventory typically in the form of contaminated and activated tools and materials/waste; ▪ Clean areas can be contaminated due to loss of containment; e.g., opening of closed systems, such as ventilation ducts and tanks; ▪ Decontaminated zones can be recontaminated due to personnel movement and material handling; ▪ Elevated tritium levels; ▪ Components coated with organic coolant. ■ The final end-state for the WR-1 will be a permanent, passive, multilayered disposal system that applies a Defence-in-Depth strategy. Environmental monitoring wells are expected to be installed in strategic places in the surrounding area to monitor the performance of the WRDF during the institutional control period.	■ Factual information about the facility.
Groundwater Flow and Solute Transport Modelling Report (WLDP-26000-REPT-005) Golder 2021b	■ Groundwater flow and solute transport models have been developed and used to simulate the current and future (post-closure) conditions of the WL facilities. Model calculations were completed to estimate long-term mass loadings to environmental receptors following site decommissioning. Applicable sections of the report include: ▪ Post Decommissioning Simulations ▪ Sensitivity Analysis	■ Information is used to support the EIS and the DSAR. ■ The models were configured based on measured input parameters and (in the absence of measured data) conservative assumptions. Uncertainty in model inputs was addressed through sensitivity analyses. Model components evaluated through the sensitivity analysis included geological pathways, the WR-1 concrete cap and engineered cover, foundation and grout failure modes and timeframes associated with failure, adsorption-partition coefficients, source mass inventory, corrosion of the reactor components, hydraulic conductivity of the backfill and bedrock, stage of the Winnipeg River.	■ Groundwater flow is calculated based on fact-based evidence and assumptions based on site knowledge.

Table 1: Interrelation Between Whiteshell Reactor 1 (WR-1) In Situ Disposal Project Documents

Technical Supporting Document or Supplemental Support Document	Portion of Information or Data Applying to WR-1 In-Situ Disposal Project	How Information/Data are Applied; Outline of Assumptions, Limitations or Differences	Distinguish Factual Evidence from Inference
Hydrogeological Study Report (WLDP-26000-REPT-004) Dillon 2018	■ The Hydrogeological Study Report has been developed and used to meet CNSC EIS regulatory baseline hydrogeological requirements, to identify data uncertainties and to assess their relevance/significance to the Project. Applicable sections of the report include: ▪ Geology and Hydrogeology ▪ Analytical Results ▪ Summary Tables	■ The Hydrogeological Study Report has been prepared in support of the EIS. Extensive hydrogeological studies have been performed around the WMA, the lagoons, landfill areas, and the main campus within the WL site. This report provides baseline data for refining the conceptual hydrogeological model for the site, which was used in developing and calibrating a three-dimensional (3-D) groundwater flow and transport model. ■ The results of this hydrogeological study have confirmed previous site hydrogeological observations and hypotheses: WR-1 is situated primarily within an overburden setting, draining westerly towards the Winnipeg River. Horizontal groundwater gradients observed are consistent with those observed across the WL site. Vertical hydraulic gradients were predominately downwards, and were dominant in the fine-grained soils overlying coarser grained basal sand and fractured bedrock. Groundwater flow was generally assumed to be horizontal in the basal sand and shallow bedrock and may be influenced by regional hydraulic controls (e.g., Natalie Lake hydro dam reservoir, Winnipeg River). Horizontal flow in these two units is influenced locally by the operation of the sumps at the WR-1 Building. Deeper bedrock flows (e.g., greater than 30 mbgs [metres below-ground surface]) were also expected to be under discharge conditions in the WR-1 study area, given the proximity to the Winnipeg River.	■ Values are calculated based on fact-based evidence, up-to-date available parameters (e.g., reactor characterization), sensitivity analyses, and conservative assumptions of unknown parameters.
Geosynthesis for WR-1 Environmental Impact Statement Report (WLDP-26400-041-000) CNL 2022b	■ The Geosynthesis Report has been developed and used to meet CNSC EIS regulatory baseline geological and hydrogeological requirements and to identify geoscientific data uncertainties and assess their relevance/significance to the Project. Applicable sections of the report include: ▪ Hydrogeological Summary ▪ Geomechanical Framework ▪ Future Evolution of the WL Site ▪ REGDOC-2.9.1 Requirements (CNSC 2020) ▪ Geoscience Verification Plan	■ The Geosynthesis Report has been prepared in support of the EIS. The report presents site geological, hydrogeological and geomechanical data and information. The descriptive geosphere site model of the WL site is outlined based on the descriptive geological, hydrogeological and geomechanical models provided in Sections 2.7, 3.3 and 4.8 of the report, respectively. The descriptive geosphere site model of the WL site includes geological, hydrogeological and geomechanical elements. The geosynthesis identified areas of data uncertainty, the rationale for identification of the uncertainty and recommendations to address the uncertainties, as shown in Table 6-2 of the report.	■ Values are calculated based on fact-based evidence, up-to-date available parameters (e.g., reactor characterization), sensitivity analyses, and conservative assumptions of unknown parameters.

Table 1: Interrelation Between Whiteshell Reactor 1 (WR-1) In Situ Disposal Project Documents

Technical Supporting Document or Supplemental Support Document	Portion of Information or Data Applying to WR-1 In-Situ Disposal Project	How Information/Data are Applied; Outline of Assumptions, Limitations or Differences	Distinguish Factual Evidence from Inference
WR-1 Reactor Radiological Characterization Summary and Radionuclide Inventory Estimates Report (WLDP 26100-041-000) CNL 2020a	■ The Reactor Characterization Report describes the current radiological conditions of WR-1. Applicable sections of the report include: ▪ Reactor Description ▪ Potential Contaminants of Concern ▪ Reactor Core Estimated and Characterization Inventories ▪ Reactor Biological Shield Estimated and Characterization Inventories ▪ Outside Core Reactor Systems Estimated and Characterization Inventories ▪ Non-Radiological Hazardous Materials ▪ Appendix: Radiological Characteristics of Potential Contaminants of Concern ▪ Non-Radiological Hazards in WR-1 ▪ Calculated Exposure Rates – Calandria Vessel and Fuel Channels ▪ Summary of Radiological Hazard Survey Results for WR-1 Rooms ▪ WR-1 Reference Documents	■ The Reactor Characterization Report summarizes the data collected to describe the current conditions of WR-1. This data has been used in many of the other supporting documents for the EIS, including the DDP, DSAR, ERA, the Groundwater Flow and Solute Transport Modeling Report. Results from sampling have also been compared with modelled values.	■ Factual information from sampling and testing.
Building Condition Assessment Report (WLDP-26000-REPT-011) Golder 2022b	■ The building condition assessment evaluated the integrity of the existing subsurface concrete foundation and bottom slab of WR-1. A condition assessment of the exposed and accessible concrete elements of the substructure, supplemented with laboratory testing of recovered cores was completed to establish the condition and properties of the concrete. Applicable sections of the report include: ▪ Summary of Significant Findings ▪ Need for a Repairs Work Program ▪ Laboratory Test Results	■ The building condition assessment program included the following tasks: ▪ Review of available WR-1 facility construction documentation and hydrogeological data. ▪ Visual assessment of the exposed portions of internal subsurface concrete foundation walls and the related concrete floor structure. The visual assessment included surface deterioration mapping and a delamination survey. ▪ Concrete coring investigation of the concrete foundation walls and concrete floor from the inside of the structure. ▪ Laboratory testing on the extracted concrete core samples. ▪ Preparation of a report describing the factual results of the investigation and providing recommendations for potential repairs for any condition issues which could affect the long-term integrity of the structure that were identified during the investigation. ■ Results of the assessment were used to verify the assumptions of the Groundwater Flow and Solute Transport Modelling Report.	■ This report presents a factual record of the current structure condition based on a visual inspection, core sampling and laboratory testing.

Table 1: Interrelation Between Whiteshell Reactor 1 (WR-1) In Situ Disposal Project Documents

Technical Supporting Document or Supplemental Support Document	Portion of Information or Data Applying to WR-1 In-Situ Disposal Project	How Information/Data are Applied; Outline of Assumptions, Limitations or Differences	Distinguish Factual Evidence from Inference
Environmental Risk Assessment (WLDP-26000-REPT-006) EcoMetrix 2021	■ Prediction and assessment the risk to relevant human and ecological receptors resulting from exposure to radiological and non-radiological substances expected to be released throughout the closure and post-closure periods of the Project. Applicable sections of the ERA report include: ▪ Site Description ▪ Source Term Characterization ▪ Human Health Risk Assessment - Closure ▪ Human Health Risk Assessment – Post-Closure ▪ Ecological Risk Assessment - Closure ▪ Ecological Risk Assessment – Post-Closure ▪ Ecological Receptor Profiles ▪ Evaluation of Disruptive Scenarios	■ The ERA uses the expected source terms of atmospheric and liquid releases to predict the transport of these substances through the environment, exposure and dose to the public, exposure and effects on representative ecological receptors, and changes in habitat and effects on species that rely on that habitat. ■ The IMPACT™ model was used to predict dose to identified human and ecological receptors during the closure and post-closure period. ▪ Human Health Risk Assessment: – Exposure factors were based on best-available information from literature with preference for exposure factors identified in CSA N288.1-14 (CSA Group 2014). For parameters that did not have exposure factors in CSA N288.1-14, surrogate parameters were identified. – The Harvester Model in the ERA uses the average intake rates from the 2018 Aboriginal Food Intake Survey and is considered to be a conservative reflection of potential health effects to Indigenous peoples. ▪ Ecological Health Assessment: – Uncertainties in the exposure assessment include the representativeness of the predicted concentrations used in the assessment at each location. Maximum concentrations are considered to overestimate exposure for all mobile receptors. – BAFs were used to calculate uptake into tissues. The BAFs used for the exposure assessment were taken from reputable sources (e.g., N288.1-14) and are considered to be representative of the conditions found at the site. – Reputable sources are used for wildlife exposure factors, such as intake rates and diets. They are a potential source of uncertainty, but are considered to be representative for the organisms assessed. – Dose coefficients were obtained from reputable sources for reference organisms, but have not been derived specifically for all the organisms assessed. Dose coefficients for surrogate organisms were often used.	■ Screening indices are values calculated based on fact-based evidence, up-to-date available parameters and conservative assumptions of unknown parameters.
Environmental Assessment Follow-Up Program for Whiteshell Laboratories (WL-509246-STD-001) CNL 2018a	■ The scope of the framework is described in Section 11 of the EIS. In addition, an overview of WL's Integrated Environmental Monitoring Program was included in Section 11 of the EIS. Applicable sections of the document include: ▪ Goals and Monitoring Objectives for Whiteshell Reactor Disposal Facility ▪ Whiteshell Reactor Disposal Facility Work Package Status ▪ Proposed Schedule for Decommissioning Activities	■ Information is used to provide context for and to describe purpose of the Project's EAFP. ■ The enhanced monitoring work package associated with the WRDF, as described in this report, includes: ▪ Review effluent verification monitoring for WR-1 and integrate any enhanced monitored required by the EIS for the WRDF into the WL effluent verification monitoring plan. ▪ Maintain the acquisition of pertinent meteorological data. ▪ Integrate the enhanced groundwater monitoring (including WR-1 near field wells) required by the EIS for the WRDF into the WL groundwater monitoring plan. ▪ Review environmental (e.g., surface water [Winnipeg River]) monitoring for WR-1 and integrate any enhanced monitored required by the EIS for the WRDF into the WL environmental monitoring plan. ▪ Prepare a Monitoring and Surveillance Plan for post-closure following guidance in IAEA SSG 31 (IAEA 2014) and CSA N292.6-18 (CSA Group 2018) (Annex A.13) and related CSA N288 standards. ▪ Implement, maintain, and report on the results from the monitoring and surveillance plan for post closure. ▪ Evaluate compliance, groundwater effects, and refine and enhance monitoring program. ▪ Ensure measures to prevent erosion/subsidence/deterioration at the WRDF are considered in the WL site flood/storm water management plan. This should also include an inspection and GPS measurement of the Winnipeg River bank in the vicinity of the WL site. ▪ Prepare remedial action plan for responses to unexpected results as per CNL's Environmental Incident Reporting, Investigation and Mitigation (CNL 2018b). ▪ Maintain regular reporting requirements and public information activities. ■ The follow-up monitoring plan presented in the EIS provides a preliminary description of the activities and framework for monitoring proposed for the Project. The follow-up monitoring program will be further detailed as the Project design is finalized. In addition, input from regulatory agencies, Indigenous peoples, and the public will be considered. The detailed follow-up monitoring plan will include sufficient information on the type, quantity and quality of information required to reliably verify predicted effects (or absence of them) and confirm the effectiveness of mitigation. These plans will also be prepared consistent with relevant CSA N288 standards.	■ Factual evidence based on the existing WL Integrated Environmental Monitoring Program.

Table 1: Interrelation Between Whiteshell Reactor 1 (WR-1) In Situ Disposal Project Documents

Technical Supporting Document or Supplemental Support Document	Portion of Information or Data Applying to WR-1 In-Situ Disposal Project	How Information/Data are Applied; Outline of Assumptions, Limitations or Differences	Distinguish Factual Evidence from Inference
Climate Change Assessment (WLDP-26000-REPT-007) Golder 2017	■ This document provides an assessment of changing climate considerations. The assessment follows the guidance provided by the Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment (FPTCCCEA), which has prepared a general guidance document for practitioners to use when incorporating climate change issues into environmental assessments (FPTCCCEA 2003). Applicable sections of the Climate Change Assessment Report include: ▪ Future Climate Conditions Until 2100 ▪ Future Climate Conditions Post 2100 ▪ Project Specific Climate Factors and Extreme Events	■ This document provides a quantitative assessment of the current climate analysis and future climate projections up to the year 2100. A qualitative assessment of climate change projections past 2100, through to the year 3000, is also provided. ■ Based on the historical climate parameters and climate data analyzed up to 2100, climate factors have been developed to further analyse the potential climate infrastructure interactions for the Project region. The climate factors include changes to rainfall, temperature and extreme events (e.g., storms). These factors are further subdivided into specific event type factors that describe long-term changes, such as increasing temperatures or extreme events such as increased storms with intense precipitation. Where information is available from Section 4.0 Future Climate Conditions Post 2100, the climate factor trends will be extended out to the year 3000. ■ Climate factor trends for the Project are described in Table 5.0-1 of the report. The future trends of the climate factors were analysed using the climate model projections in Section 3.0 Future Climate Conditions until 2100. If climate projections were not available from Section 3.0 Future Climate Conditions until 2100, literature values were referenced to discuss the projected change in climate.	■ Values are calculated based on fact-based evidence, up-to-date available parameters (e.g., transfer factors), and conservative assumptions of unknown parameters.
Grout Formulation Testing Report (WLDP-26000-REPT-012) Golder 2022a	■ This document provides the methodology, results, and conclusions of the testing program used to develop a grout formula for the ISD of WR-1 based on requirements developed by Savannah River National Laboratory from their experiences with ISD.	■ The key property of the grout used in the WR-1 solute transport modelling is the hydraulic conductivity. CNL has specified that the grout used in the decommissioning of WR-1 must have a hydraulic conductivity of less than 9.5×10^{-10} m/s (CNL 2017). To support the selection of this value, CNL provided reference materials for grout specifications that were used in the ISD of a nuclear reactor at the Savannah River National Laboratories site in the southern United States. In addition, a literature review of the hydraulic conductivity of other grout mixtures was completed (Golder 2018). ■ Recognizing that not all of the areas within the WR-1 Building will be fully penetrated by the grout, and some voids will remain after final grout placement, a higher value of 5×10^{-8} m/s was selected for the grout in the WR-1 ISD assessment (i.e., a factor of 50 times greater than the maximum value specified by CNL and 50 times greater than the maximum measured value at Savannah River). Results of testing (Golder 2022a) performed on a preferred grout formula indicated a hydraulic conductivity of 0.0004 m/yr (1.27E-11 m/s) (Golder 2022a) which is more than 50 times below the target.	■ This report presents a factual record of the grout formula testing program.
Safety Case Report (WLDP-26000-SAR-002) CNL 2020b	■ The Safety Case demonstrates that in situ disposal, post closure activities, and long-term disposal of the WR-1 Building can be safety undertaken. Applicable sections of the Safety Case include: ▪ Safety Strategy ▪ System Description ▪ Safety Assessment ▪ Iteration and Design Optimization ▪ Limits, Controls and Conditions ▪ Comparison of Safety Case Sections to REGDOC-2.11.1 (CNSC 2018) ■ The Safety Case is supported by the EIS and DSAR.	■ Information is used to support the safety case for the ISD of WR-1 and the mapping of the design and safety documents to the regulatory requirements is provided to demonstrate that all elements of the safety case are met by the suite of Project documents.	■ Report is primarily based on factual information; a summary of site characteristics, facility structures, systems, components and safety features, radiological and non-radiological inventories, natural and anthropological analogues, and maintenance and relevant compliance programs.

3-D = three-dimensional; BAF = bioaccumulation factor; CNL = Canadian Nuclear Laboratories; CNSC = Canadian Nuclear Safety Commission; CSA = Canadian Standards Association; DDP = Detailed Decommissioning Plan; DSAR = Decommissioning Safety Assessment Report; EAFP = Environmental Follow-up Program; EIS = Environmental Impact Statement; ERA = Environmental Risk Assessment; FPTCCCEA = Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment; GPS = Global Positioning System; IAEA = International Atomic Energy Agency; ISD = In Situ Disposal; REGDOC = Regulatory Document; WMA = Waste Management Area; WR-1 = Whiteshell Reactor 1; WRDF = Whiteshell Reactor Disposal Facility.

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APPENDIX 4.0-1

Summary of Engagements and Summary of Interests and Concerns Tables

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1.0 SUMMARY OF SECTION 4.0 APPENDICES

The following contain two sets of information for each Indigenous Nation on the Project. The first set of information provides a summary of engagement with each Nation which is described in detail in subsection 1.1 'Summary of Indigenous Engagement Tables.'

The second set of information outlines the summary of key interest and concerns organized by each Indigenous Nation which is described in detail in subsection 1.2 'Summary of Interests and Concerns Tables.' Both sets of tables are organized by each Indigenous Nation in subsection 1.3 'Summary of Indigenous Engagement Tables and Summary of Interests and Concerns Tables.'

1.1 Description of the Summary of Indigenous Engagement Tables

The Summary Tables of Indigenous Engagement provide a record of key engagement activities of the Project between CNL and each First Nation and the Manitoba Métis Federation from June 2016 to September 30, 2022. The record includes the date and method of the communication/ engagement, the topics discussed and the role or title of participants. The table also highlights engagements where key EA topics were discussed using a grid with checks. The Interests and Concerns Tables include both formal and informal concerns, CNLs responses, and next steps. The following is a list of key topics related to the Project that Indigenous communities were engaged on:

- **Baseline Conditions:**

  Information on the existing Whiteshell Laboratories site and study areas for the Project – site characterization, facility description, description of the existing environment.

- **Alternative Means Assessment:**

  Information on the various alternative options for disposing of the waste liabilities at the Whiteshell Laboratories site.

- **Project components and related activities:**

  Information on the purpose of the project, scope of the project, proposed project phases, how the project would be carried out (i.e., grouting), waste inventory and strategy, as well as information on the proposed schedule.

- **Effects assessment, including VC, Spatial and temporal boundaries for the assessment:**

  Information on the EA process, the EIS, valued components (VC), site location, and project timeline and effects assessment.

- **Proposed Mitigation Measures**

  Information on proposed mitigation measures, such as dust suppression during decommissioning execution.

- **Residual Effects**

  Information on the residual effects (impacts directly from the Project after mitigation measures are applied).

- **Follow-up Monitoring Program**

  Information on the proposed follow-up monitoring program for the WL Site.

- **Aboriginal and Treaty Rights / Traditional Land Use**

  Information on effects and potential impacts to Indigenous rights.

- **Specific Interests and Concerns of the Community**

  Information related to (and in response to) any or all of the particular topics or issues raised by the Indigenous community in either their comments on the Project Description or versions of the draft EIS or during engagement activities with CNL. A list of these interests for each community is found in Appendix 4.0-1 of Section 4 of the EIS.

- **Engagement Methods**

  Discussions with communities on structuring Indigenous engagement activities to ensure Indigenous engagement activities are appropriate to the community's needs. Engagement can be performed in a number of manners, including through face-to-face meetings, phone calls, video calls, sharing of documentation, and written communication. Each of these methods of engagement can be a source of Indigenous knowledge, perspectives, as well as issues and concerns expressed by Indigenous groups.

1.2 Description of the Summary of Interests and Concerns Tables

The Summary of Interests and Concerns tables summarize the key interests and concerns that each Indigenous community or organization has raised to date on the WR-1 In situ Decommissioning Project.

These summary tables represent an amalgamation of: the formally submitted comments as part of the Environmental Assessment (EA) process; formally submitted comments and questions to CNL (not submitted as part of the formal EA process); and summaries of topics that have been discussed between CNL and each Indigenous Nation or organization but were not part of a formal submission including project-specific studies; and all information shared by the Indigenous Nations to date. CNL has prepared these tables to provide a picture of the interests and concerns that have been raised by each Indigenous Nation or organization. These tables also reflect the evolving relationship between each community or organization and CNL. Narrative summaries of each table up to September 30, 2022 are included in Section 4 of the draft EIS.

CNL has worked with each Indigenous Nation to confirm that the Summary of Interests and Concerns tables accurately reflect the high-level key interests and concerns of Nations as well as the status of each interest and concern. The Summary of Interests and Concerns tables were updated and the tables re-verified by the corresponding Indigenous Nation following feedback CNL received from the CNSC on CNL's Nuclear Power Demonstration EIS Submission Package. In addition, the interactive validation process has occurred, most recently, in October of 2022.

These tables are currently as of September 30, 2022.

The Tables consist of four columns:

- Column 1 summarizes the key interests or concerns and why they are important in terms of effects under Section 5(1)(c) of the Canadian Environmental Assessment Act 2012 and/or impacts to Aboriginal and/or treaty rights, claims or interests.
- Column 2 summarizes how the interests or concerns are being addressed by CNL.
- Column 3 identifies where in the EIS the interests or concerns are addressed, changes made to the EIS as a result of the interests or concerns and any changes to the EIS outcomes (if applicable); and,
- Column 4 is the “Status”. This column describes the status of each interest or concern and whether the community has verified that CNL has addressed the interest or concern. Not all concerns can be quickly or easily resolved as some concerns go beyond the scope of the Project or there may remain a difference of opinion on certain interests or concerns. The table indicates when an interest or concern is out of the scope of the EA process.

1.3 Summary of Indigenous Engagement Tables and Summary of Interests and Concerns Tables

1.3.1 Sagkeeng First Nation Engagement

Date	Activity	Attendance	Description	Key EA Topics									
				Baseline Conditions	Alternative Means Assessment	Project Components	Effects Assessment	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Topics of Interest	Engagement Methods
April 1, 2016	Teleconference	Chief, Sagkeeng First Nation 4 representatives from CNL 5 representatives from CNSC 1 representative from AECL 1 CNL contractor	CNSC initiated teleconference and two-way dialogue with Chief Derick Henderson from Sagkeeng First Nation. Chief Henderson confirmed his preferred point of contact for the community and expressed an interest in reviewing the environmental baseline conditions, WR-1 in-situ design, environmental monitoring, and economic opportunities.	✓		✓	✓			✓			
May 18, 2016	In-person meeting	5 members of Sagkeeng First Nation 3 representatives from CNL 1 CNL contractor	Introductions of the Sagkeeng First Nations and the CNL representatives and discussion of the preliminary concerns and how Sagkeeng First Nation would like to be involved in the future.	✓		✓		✓	✓	✓		✓	✓
August 3, 2016	Email/Letter	Sagkeeng First Nation	CNL sent a Project Introductory Letter to all Indigenous communities in the area and request for community input on any potential adverse impacts from project activities. The letter requested meaningful feedback on the following: Whether the project may have environmental effect on any lands and/or resources currently used by Indigenous peoples for traditional purposes; Whether the project may have any perceived impacts on Aboriginal and Treaty Rights; Whether local and traditional knowledge can assist in describing the existing environment; and, The view of Indigenous communities on proposed valued ecosystems components (environmental attributes) that have been identified for the assessment.										✓
January 25, 2017	In-person Meeting	4 representatives from Sagkeeng First Nation (Chief and Council) 3 representatives from CNL	CNL provided an overview of the proposed Project and responded to questions directly from the community. Sagkeeng and CNL discussed how best to engage Sagkeeng on the Project.			✓			✓			✓	✓
January 25, 2017	Open House	3 First Nations members 2 members of the public	CNL presentation providing an overview of CNL and WR-1. There were discussions on the WR-1 design, clean up criteria of the site, environmental monitoring, procurement opportunities for Indigenous people, and a discussion about Aboriginal and treaty rights. The discussions were guided by the community's interest in the topics presented in a PowerPoint presentation. This was a two-way dialogue between Sagkeeng and CNL.			✓			✓	✓	✓		
May 17, 2017	In-person meeting	5 representatives from Sagkeeng First Nation 2 representatives from Wabaseemoong Independent Nations 4 representatives from CNSC 6 representatives from CNL 2 representatives from AECL 1 CNL contractor	CNSC led meeting about engagement and presented on the CNSC's role and the Project.	✓		✓			✓		✓		✓
July 4, 2017	Site Tour	7 representatives from Sagkeeng First Nation 9 Sagkeeng First Nation students 4 representatives from CNL 1 CNL contractor	CNL welcomed Sagkeeng's Chief and Council and Sagkeeng's summer students for a tour and hands on demonstration of tools followed by a period for questions and two-way discussion. Topics covered included CNL's environmental protection program, WR-1 design, and the waste management area.	✓		✓				✓			
July 6, 2017	In-person event - Industry Day	2 CNL contractors 3 representatives from CNL	CNL hosted an industry day, presentation of Whiteshell Laboratories.									✓	

Date	Activity	Attendance	Description	Key EA Topics									
				Baseline Conditions	Alternative Means Assessment	Project Components	Effects Assessment	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Topics of Interest	Engagement Methods
October 5, 2017	Email/Letter	Sagkeeng First Nation	CNL sent a mass notification of public and Indigenous comment period on the draft EIS and invitation to engage to all Indigenous communities.										✓
November 1, 2017	Email/Letter	Sagkeeng First Nation	CNL sent a mass notification Mailed hard copies of Community specific report and draft EIS executive summary.										✓
November 29, 2017	Teleconference	2 representatives from OKT Law Firm 4 representatives from CNL	Teleconference and two-way dialogue with Sagkeeng First Nation Lawyers on moving forward with the community.			✓			✓	✓	✓		✓
December 14, 2017	Teleconference	2 representatives from Sagkeeng's Legal Counsel, OKT Law Firm 5 representatives from CNL	Representatives from OKT and CNL had a teleconference to discuss future engagement processes with Sagkeeng First Nation on the Project and proposed funding to support OKT's involvement.			✓						✓	✓
February 22, 2018	Email: Contribution agreement	Sagkeeng First Nation CNL	Contribution agreement signed with Sagkeeng First Nation.										✓
April 3, 2018	Benchmarking trip	2 representatives from Black River First Nation 2 representatives from Brokenhead Ojibway Nation 1 consultant representing Sagkeeng First Nation 2 representatives from Wabaseemoong Independent Nations 2 representatives from MMF	Communities attended the In situ disposal facility in Hallam Nebraska ISD reactor to learn more about in situ design, monitoring and what the local community thinks. This was a relationship building trip and enabled Indigenous communities to be able to better inform their communities.	✓	✓		✓	✓	✓	✓	✓	✓	
August 9, 2018	In-person meeting	1 representative from OKT Law 4 representatives from CNL	Meeting to discuss funding the TK study. CNL confirmed support and provided comments/conditions.								✓		✓
September 27, 2018	In-person meeting	4 representatives from Sagkeeng First Nation 2 representatives from OKT Law 1 representative from Firelight 5 representatives from CNL 6 representatives from CNSC 3 representatives from AECL	Meeting on Sagkeeng First Nation comments on the WR-1 draft EIS.	✓	✓	✓			✓				✓
October 18, 2018	Sagkeeng First Nation / CNL / CNSC Project action follow up meeting	1 representative from OKT Law 4 representatives from CNL 4 representatives from CNSC	Whiteshell Project action follow up meeting.									✓	✓
November 1, 2018	Email: Sagkeeng First Nation food intake survey on harvested foods	Study conducted by Sagkeeng First Nation.	Sagkeeng shared a summary memo highlighting the content of the intake survey and the results	✓									
January 10 and 18, 2019	Planning meetings for Project Alternatives Analysis Workshop	1 representative from Sagkeeng First Nation 2 representatives from CNL	Preparatory meeting for Sagkeeng First Nation Alternative Means Workshop.		✓								✓

Date	Activity	Attendance	Description	Key EA Topics									
				Baseline Conditions	Alternative Means Assessment	Project Components	Effects Assessment	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Topics of Interest	Engagement Methods
February 13 – 15, 2019	Alternatives Analysis Workshop	5 representatives Sagkeeng First Nation Chief and Council 3 representatives Sagkeeng First Nation Elders 3 representatives Sagkeeng First Nation Drum Group 2 representatives from Firelight Group (1 in person, 1 by phone) 2 representatives from AECL 5 representatives from CNL 4 representatives from CNSC	Sagkeeng First Nation Alternative Means Workshop to present Sagkeeng First Nation perspectives on the WR-1 decommissioning process. The meeting was scheduled to be a 3 day meeting, but on day 2 Sagkeeng requested the meeting be put on hold until a ceremony could be performed to help them in decision making.		✓								
March 18, 2019	Ceremony	4 representatives from Sagkeeng's Chief and Council 1 Elder from Sagkeeng First Nation 1 representative from Turtle Lodge 1 representative from Firelight 1 representative from OKT 2 representatives from CNL 2 representatives from AECL 2 representatives from CNSC	Traditional ceremony and discussion on Project alternatives at the Turtle Lodge International Centre for Indigenous Education and Wellness. The Turtle Lodge Ceremony included a presentation on radioactive waste concerns.	✓	✓						✓		
July 4, 2019	Site Tour and in-person Meeting	1 Elder from Sagkeeng First Nation 2 representatives from Turtle Lodge 2 representatives from CNL 1 representative from AECL	CNL and Turtle Lodge met on site and CNL provided a project update followed by a site tour. During the meeting the parties discussed traditional Indigenous ceremony to be held on WL site.	✓		✓		✓			✓		
September 10, 2019	Check-in call re upcoming meetings and Licence hearing	1 representative from OKT 3 representatives from CNSC 1 representative from CNL	CNL project updates to Sagkeeng First Nation and CNSC.										✓
September 13, 2019	Ceremony on Site	7 representatives from Sagkeeng First Nation 10 representatives from Turtle Lodge 1 representative from a First Nation in Dakota 1 representative from Sagkeeng First Nation Technical Representative (1 from Firelight Group) 2 representatives from Hollow Water First Nation 2 representatives from CNSC 2 representatives from AECL 3 representatives from CNL plus approximately 100 staff	CNL hosted a traditional Indigenous ceremony with Sagkeeng First Nation and Turtle Lodge International Centre for Indigenous Education & Wellness. Traditional Indigenous Ceremony on WL site. Ceremony included a ceremonial fire, drum group, pipe and water ceremonies and tobacco offering.								✓		
September 18, 2019	Community Meeting	Sagkeeng First Nation CNSC CNL	Meeting with a CNSC presentation providing an overview of the CNSC, Whiteshell Laboratories site, Whiteshell Licence Renewal, WR-1 In-situ Decommissioning Project, radiation protection and health.	✓		✓			✓	✓			

Date	Activity	Attendance	Description	Key EA Topics									
				Baseline Conditions	Alternative Means Assessment	Project Components	Effects Assessment	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Topics of Interest	Engagement Methods
November 25, 2019	Monthly Catch-Up Meeting	1 representative from Sagkeeng First Nation Legal Representative (OKT) 1 representative from Sagkeeng First Nation representative (Firelight Group) 8 representatives from CNSC 2 representatives from CNL	CNL met with Sagkeeng's Legal representatives to discuss action items and provide a project update.										✓
December 5 – 6, 2019	CNL's Environmental Remediation Management Launch with Elder Dave Courchene	60 CNL employees 2 representatives from Turtle Lodge 1 representative from AECL 1 representative from CNSC	Elder Dave Courchene provided an opening prayer and a presentation at CNL's ERM launch in Ottawa, Ontario.										
December 11, 2019	In-person Meeting	Chief and 6 Councillors Sagkeeng First Nation Legal Representative (1 from OKT Law) 6 representatives from CNL	Long-term relationship workshop discussing the CNL/Sagkeeng relationship, establishment of an Indigenous Advisory Committee, review of WR-1 EIS, environmental monitoring, LLW Trench ISD, end state planning, and next steps.						✓	✓	✓		✓
January 20, 2020	Email: Memorandum of Understanding	Sagkeeng First Nation CNL	CNL and Sagkeeng First Nation signed an MOU to provide capacity support to review CNL's responses to Sagkeeng's comments on the EIS.	✓	✓	✓		✓					✓
February 18, 2020	Letter from Sagkeeng First Nation to CNL	Sagkeeng First Nation CNL	CNL received a letter from Chief Henderson regarding the Alternative Means Assessment.		✓								
March 6, 2020	In-person Meeting with CNL and Sagkeeng First Nation	Sagkeeng First Nation Chief and Council 4 representatives from CNL 1 representative from OKT Law 1 representative from The Firelight Group	Review of February 18, 2020 letter from Chief Henderson to CNL and issues noted. CNL requested to discuss a Long-Term Relationship Agreement however Sagkeeng requested the agenda be limited to the Alternatives Means Assessment.		✓							✓	✓
May 4, 2020	Letter from CNL to Sagkeeng First Nation	Sagkeeng First Nation CNL	CNL provided responses to questions raised during the March 6 meeting.	✓	✓	✓	✓					✓	
June 15, 2020	Email: Memorandum of Understanding	Sagkeeng First Nation CNL	CNL and Sagkeeng First Nation sign an MOU to fund the completion of Sagkeeng's Alternative Means Assessment.		✓								
June 30, 2020	In-person Meeting with CNL and Sagkeeng First Nation	Sagkeeng First Nation OKT Law CNL	Review of CNL's offer to fund a community liaison position and description of what that role entails.										✓
July 17, 2020	Teleconference: Meeting with CNL and Sagkeeng First Nation	OKT Law CNL	Discussed Indigenous Liaison position, potential Long Term Relationship Agreement, Environmental Monitoring, and setting up regular recurring meetings.							✓			✓
August 11, 2020	In-person Meeting with CNL and Sagkeeng First Nation Liaison Officer and Site Tour	1 representative from Sagkeeng First Nation (Sagkeeng's Liaison Officer) 3 representatives from CNL (one representative joined remotely)	CNL met with Sagkeeng's new Indigenous Liaison. Discussed overview of Whiteshell Laboratories Closure Project, WR-1 ISD project and engagement with Sagkeeng to date; and took a preliminary site tour.	✓		✓				✓			
August 12, 2020	Teleconference	2 representatives from Sagkeeng First Nation 3 representatives from CNL	Firelight, Sagkeeng's Consultant, provided an update of progress to date on Sagkeeng's Alternatives Assessment work.		✓								

Date	Activity	Attendance	Description	Key EA Topics									
				Baseline Conditions	Alternative Means Assessment	Project Components	Effects Assessment	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Topics of Interest	Engagement Methods
September 2, 2020	Site Visit: Training for Sagkeeng's Liaison	1 representative from Sagkeeng First Nation (Sagkeeng's Liaison Officer) 4 representatives from CNL	CNL provided one on one presentations to Sagkeeng's Liaison on topics including Nuclear Energy and Radiation 101; Nuclear Waste 101; WR-1 In-situ disposal.	✓	✓	✓		✓		✓		✓	
September 5, 2020	Email: Memorandum of Understanding	Sagkeeng First Nation CNL	CNL and Sagkeeng signed an MOU to provide funding for a community liaison position.									✓	✓
September 8, 2020	Site Visit	Sagkeeng's Liaison Officer 2 representatives CNL	Sagkeeng's community liaison came to site; CNL provided an overview of the history of the facility and the proposed decommissioning of the WR-1 reactor.	✓		✓				✓			
September 15, 2020	Teleconference with Sagkeeng's Lawyer	1 representative from Sagkeeng's Legal Counsel, OKT Law 3 representatives from CNL	Sagkeeng's Lawyer and CNL reviewed and discussed Action Items. Action still in-progress include setting up a land use and end state workshop and CNL to share an advanced copy of the IER.		✓	✓				✓	✓	✓	✓
September 16, 2020	Email: Invitation to project webinar	Sagkeeng First Nation	CNL sent out an invitation to community members to attend the breakfast session on development and test results of the WR-1 grout.										✓
October 19, 2020	Email: Alternative Means Assessment Report	Sagkeeng First Nation CNL	CNL received Sagkeeng's final report on their Alternative Means Assessment.		✓								
October 20, 2020	Email: Contribution Agreement	Sagkeeng First Nation CNL	CNL and Sagkeeng signed a contribution agreement to support Firelight Group's review of CNL's responses to Sagkeeng's comments on the draft EIS to assess whether CNL has proposed adequate mitigation measures and considered and included Sagkeeng's traditional knowledge and positions.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
October 20, 2020	Site Tour: Environmental Monitoring	2 representatives from Black River First Nation 1 representative from Manitoba Metis Federation 1 representative from Sagkeeng First Nation 4 representatives from CNL	Community representatives observed fish processing on site and the environmental monitoring team provided an overview presentation.							✓			
October 28, 2020	Email: Psycho-social Impact Assessment Letter	Sagkeeng First Nation CNL	CNL received Sagkeeng's completed Psycho-social Assessment Report.								✓		
November 2, 2020	Teleconference	1 representative from Sagkeeng First Nation (Sagkeeng's Liaison Officer) 1 representative from CNL	Provided an update and discussed setting up follow up workshop to develop key deliverables for engaging Sagkeeng.			✓						✓	✓
November 12, 2020	Teleconference	1 representative from Sagkeeng's Consultant, Narratives Inc. 1 representative from Sagkeeng's legal counsel, OKT Law 1 representative from Sagkeeng's Technical Consultants, Firelight Group 6 representatives from CNSC 3 representatives from CNL	Sagkeeng representatives presented an overview of the psycho-social report and CNL and CNSC asked questions.	✓	✓			✓			✓	✓	✓
November 16, 2020	E-mail: Letter from Sagkeeng on Sagkeeng's EIS Comments	Sagkeeng First Nation CNL	CNL received Sagkeeng's feedback on CNL's responses to Sagkeeng's comments on the draft EIS.										✓

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				Baseline Conditions	Alternative Means Assessment	Project Components	Effects Assessment	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Topics of Interest	Engagement Methods
November 19, 2020	Teleconference – Alternative Means Assessment Overview	1 representative from Sagkeeng First Nation 1 representative from Sagkeeng's Technical Consultant, Firelight Group 1 representative from Sagkeeng's Legal Counsel, OKT Law 6 representatives from CNSC 4 representatives from CNL 1 representative from AECL	Sagkeeng presented an overview of the alternative means assessment report and CNL and CNSC asked questions.		✓								
November 25, 2020	Teleconference	Sagkeeng Liaison Officer 1 representative from CNL	Sagkeeng's liaison and CNL met to discuss strategies for engaging Sagkeeng's membership during the pandemic.										✓
November 26, 2020	Teleconference	1 representative from OKT Law 1 representative from Firelight Group 1 Sagkeeng independent consultant 5 representatives from CNSC 3 representatives from AECL 5 representatives from CNL 2 CNL consultants	CNL hosted a meeting (Part I) with Sagkeeng to discuss Sagkeeng's comments and CNL's proposed responses. The feedback received during these meetings helped inform CNL's responses to address Sagkeeng's concerns.	✓	✓	✓	✓	✓	✓	✓	✓		
December 1, 2020	Teleconference	1 representative from OKT Law 1 representative from Firelight Group 1 representative from Sagkeeng First Nation 1 Sagkeeng independent consultant 5 representatives from CNSC 3 representatives from AECL 5 representatives from CNL 2 CNL consultants	CNL hosted a meeting (Part II) with Sagkeeng to discuss Sagkeeng's comments and CNL's proposed responses. This meeting took place prior to CNL drafting their responses to test their proposed next steps to address Sagkeeng's concerns.	✓	✓	✓	✓	✓	✓	✓	✓		✓
December 22, 2020	E-mail: Letters	Sagkeeng First Nation CNL	CNL provided Sagkeeng with a formal letter of response to Sagkeeng's Alternative Means Assessment Report and a formal letter of response to Sagkeeng's Psycho-social Impact Assessment Report.		✓						✓		
January 11, 2021	Invitation	Sagkeeng First Nation CNL	CNL sent Sagkeeng an invitation to participate in CNL's Virtual Career Fair.									✓	
January 13, 2021	E-mail/ Letter	Sagkeeng First Nation CNL	CNL sent Sagkeeng a final round of responses to Sagkeeng's comments on the draft Environmental Impact Statement.	✓	✓	✓	✓	✓	✓	✓	✓		✓
January 15, 2021	E-mail	Sagkeeng First Nation CNL	CNL sent Sagkeeng an advanced copy of the draft Indigenous Engagement Report and a new section of the EIS that explains the considerations given to Sagkeeng's Alternative Mean Assessment Report for validation.		✓								
January 18, 2021	E-mail	Sagkeeng First Nation CNL	CNL sent a copy of a new subsection of the EIS that explains the considerations given to Sagkeeng's psychosocial impact assessment report for validation.								✓	✓	
February 2, 2021	E-mail	Sagkeeng First Nation CNL	CNL followed up from the letters of response on the alternative means and psychosocial impact assessment that requested meeting with Chief and Council to verify CNL's proposed mitigation measures.								✓	✓	

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				Baseline Conditions	Alternative Means Assessment	Project Components	Effects Assessment	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Topics of Interest	Engagement Methods
February 13, 2021	E-mail	Sagkeeng First Nation CNL	Sagkeeng provided CNL with a copy of the reviewed Alternative Means Assessment for their review for consideration.		✓								
February 18, 2021	Teleconference	1 Representative from Sagkeeng First Nation 2 Representatives from OKT Law 5 Representatives from CNSC 7 Representatives from AECL 4 Representatives from CNL 1 CNL Consultant	CNL participated in a meeting with Sagkeeng, the CNSC, and AECL to discuss the applications of FPIC on the Project. Parties agreed to following the principle of FPIC is important, however the ultimate decision of the project will still be determined through the environmental assessment process.								✓	✓	✓
February 26, 2021	E-mail	2 representatives from Sagkeeng 2 representatives from CNL	CNL provided Sagkeeng with a copy of the updated copy of the Alternative Means Assessment Write-Up for verification. The copy was provided to demonstrate how CNL incorporated their feedback.		✓								
February 26, 2021	E-mail	2 representatives from Sagkeeng 2 representatives from CNL	CNL received the first round of feedback from Sagkeeng on the updated copy of the Alternative Means Assessment, stating they had three outstanding concerns. CNL incorporated Sagkeeng's feedback and sent Sagkeeng a revised copy to confirm CNL had adequately incorporated their feedback.		✓								
February 26, 2021	E-mail	1 representative from Sagkeeng 2 representatives from CNL	Sagkeeng provided a second round of comments on CNL's revised alternative means assessment write up and CNL updated the write up based on Sagkeeng's second round of feedback.		✓								
February 26, 2021	E-mail	1 representative from Sagkeeng 2 representatives from CNL	CNL received Sagkeeng's review of the IER and revised the IER based on Sagkeeng's feedback. CNL also transferred Sagkeeng's requested edits into Section 4.0 of the EIS as well.								✓		✓
February 26, 2021	E-mail	1 representative from Sagkeeng 2 representatives from CNL	Sagkeeng provided feedback on CNL's write-up of Psychosocial Impact Assessment write-up.										✓
March 1, 2021	E-mail	1 representative from Sagkeeng 1 representative from CNL	CNL followed up with Sagkeeng via e-mail requesting a meeting to discuss how CNL can engage more closely with Sagkeeng's community.										✓
March 10, 2021	E-mail	1 representative from Sagkeeng 1 representative from CNL	CNL received an e-mail from Sagkeeng's lawyer with Narratives/Sagkeeng's responses for CNSC's questions on Sagkeeng's Psychosocial Impact Assessment Report. Sagkeeng's lawyer also requested a meeting between leadership. CNL provided dates and times for the proposed meeting.								✓		
March 25, 2021	Phone Call	1 representative from Sagkeeng 1 representative from CNL	CNL reached out to Sagkeeng's Liaison Officer to discuss the development of communication materials specific to Sagkeeng's needs and discussing and revising the main focus of the upcoming meeting at the time.									✓	✓
April 6, 2021	Teleconference	8 Representatives from Sagkeeng, 5 Representatives from CNL, 5 Representative from AECL, 4 Representatives from CNSC	CNL, AECL, CNSC and Sagkeeng leadership met to discuss Sagkeeng's Psychosocial Impact Assessment Report and discuss next steps that will help address Sagkeeng's concerns.				✓		✓		✓	✓	✓
April 12, 2021	Site Visit	1 representative from Sagkeeng 3 representatives from CNL	Sagkeeng's liaison officer came on site to tour the WR-1 reactor and participate in a Nuclear 101 presentation, as a part of his on boarding process.										✓
April 23, 2021	Letter	2 representatives from Sagkeeng 2 representatives from CNL	Chief Henderson sent CNL a letter as a follow-up correspondence from the April 6th Leadership Meeting stating it was a position meeting and outlined key initiatives that would help address Sagkeeng's interests and concerns on the Project.					✓				✓	✓

Date	Activity	Attendance	Description	Key EA Topics									
				Baseline Conditions	Alternative Means Assessment	Project Components	Effects Assessment	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Topics of Interest	Engagement Methods
May 11, 2021	E-mail/Letter	1 representative from Sagkeeng 1 representative from CNL	CNL sent a letter to Chief Henderson, as a response to his letter sent on April 23rd, 2021. In the letter, CNL agreed with Chief Henderson's recommended initiatives and agreed to help form a technical working group to support the development and implementation of these initiatives.					✓				✓	✓
May 18, 2021	Phone Call	1 representative from Sagkeeng 1 representative from CNL	Sagkeeng's liaison officer called CNL to touch base and provided an update on the community engagement.										✓
June 16, 2021	Teleconference: Technical Working Group Meeting #1	3 representatives from Sagkeeng 3 representatives from AECL 4 representatives from CNL	CNL, Sagkeeng, and AECL representatives met to discuss Technical Working Group objectives, initiatives, outstanding concerns, and action items.					✓				✓	✓
June 17, 2021	On Site Visit	1 representative from Sagkeeng 4 representatives from CNL	Sagkeeng's liaison officer came on site to film Mother Earth Teachings for National Indigenous Peoples' Day by the Winnipeg River. The film was provided to CNL Staff on Indigenous People's Day.									✓	✓
June 24, 2021	E-mail	3 representatives from Sagkeeng, 3 representatives from CNL	CNL provided Sagkeeng with a copy of Sagkeeng's tables of interests and concerns and requested Sagkeeng verify CNL had adequately characterized Sagkeeng's position, interests, and concerns.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
July 5, 2021	Phone Call	1 representative from Sagkeeng Sagkeeng's Liaison Officer 1 representative from CNL	Sagkeeng's Liaison Officer and CNL's Indigenous Engagement Officer discussed Sagkeeng's edits to the Liaison Committee proposal as well as Sagkeeng's participation in the upcoming exit bat survey.									✓	✓
July 7, 2021	E-mail	Sagkeeng First Nation, CNL	CNL provided Sagkeeng with a copy of the contribution agreement for their review and feedback									✓	✓
July 14, 2021	Site Environmental Monitoring	1 representative from Sagkeeng 2 representatives from MMF 1 representative from Black River and Hollow Water 6 representatives from CNL	Sagkeeng's Liaison Officer visited site to participate in the exit bat survey to determine whether bats are burrowing in building 100.									✓	
July 21, 2021	E-mail	3 representatives from Sagkeeng 3 representatives from CNL	CNL provided Sagkeeng with the revised summary of interests and concerns table to demonstrate how Sagkeeng's edits have been incorporated in the document.										✓
August 11, 2021	Site Visit	1 representative from Sagkeeng 3 representatives from CNL	Sagkeeng's Liaison Officer came on site to participate in the optional Waste Management Area and WR-1 tour as a site refresher prior to the Indigenous Advisory Committee meeting.			✓							
August 17, 2021	Teleconference: Technical Working Group #3	3 representatives from Sagkeeng 3 representatives from AECL 4 representatives from CNL	CNL, AECL and Sagkeeng met via teleconference to continue moving forward on key objectives and initiatives, primarily focusing on the Contribution Agreement budget, the review of Sagkeeng's Summary of Interests and Concerns Table and Sagkeeng's Three Column Table.					✓				✓	✓
August 24, 2021	Teleconference: EIS Technical Working Group Subcommittee Meeting	3 representatives from Sagkeeng 4 representatives from CNL	CNL and Sagkeeng met to discuss the Sagkeeng's comments on their summary of interest and concerns table, Sagkeeng's list of valued components, the Psychosocial Impact Assessment write up	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
August 31, 2021	E-mail	3 representatives from Sagkeeng 4 representatives from CNL	CNL provided Sagkeeng consultation with a copy of the EIS Section 2.0 for their revision.		✓								✓
September 7, 2021	Teleconference: EIS Technical Working Group Subcommittee Meeting	3 representatives from Sagkeeng 4 representatives from CNL	CNL and Sagkeeng met via teleconference to discuss Sagkeeng's feedback and general comments on EIS Section 2.		✓							✓	✓

Date	Activity	Attendance	Description	Key EA Topics									
				Baseline Conditions	Alternative Means Assessment	Project Components	Effects Assessment	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Topics of Interest	Engagement Methods
September 14, 2021	Teleconference: Technical Working Group #4	3 representatives from Sagkeeng 3 representatives from AECL 5 representatives from CNL	CNL, AECL and Sagkeeng met via teleconference to discuss the development of next priority initiatives including trauma informed action plan, environmental monitoring, and setting up a leadership meeting. All parties agreed the top priority was to sign the contribution agreement to support these initiatives.					✓				✓	✓
September 16, 2021	E-mail	3 representatives from Sagkeeng 4 representatives from CNL	Sagkeeng provided feedback and edits to their summary of interests and concerns table.								✓	✓	✓
September 20, 2021	E-mail	3 representatives from Sagkeeng 4 representatives from CNL	CNL provided Sagkeeng with an updated copy of the revised Psychosocial Assessment write-up and a revised copy of Sagkeeng's Summary of Interests and Concerns to verify CNL had adequately captured Sagkeeng's position, interests, and concerns.								✓	✓	✓
September 22, 2021	In-person Training: Trauma Informed Engagement Training	1 representative from Sagkeeng, 10 representatives from CNL, 4 representatives from AECL, 1 representative from CNSC	As a key initiative identified in the Technical Working Group Meetings, AECL, CNL and Sagkeeng met to receive training in trauma-informed principles and methods of engagement.									✓	
October 6, 2021	E-mail	4 representatives from Sagkeeng 3 representatives from CNSC 2 representatives from CNL	CNL sent Chief Henderson a thank you letter, thanking Sagkeeng for their participation and review of the summary of interests and concerns table and valued components for Sagkeeng.										✓
October 13, 2021	E-mail	3 representatives from Sagkeeng 3 representatives from CNL	Sagkeeng consultation team confirmed that the latest version of CNL's write-up of Sagkeeng's Psychosocial Impact Assessment adequately captured Sagkeeng's position to the extent possible at this time. Sagkeeng had with the drafting and confirmed that findings and suggestions were incorporated.										✓
October 13, 2021	E-mail	3 representatives from Sagkeeng 2 representatives from CNL	CNL provided Sagkeeng and consultation with a final version of EIS section 11.0 for their review.							✓	✓		✓
October 14 , 2021	E-mail	1 representative from Sagkeeng 1 representative from CNL	CNL provided Sagkeeng's Liaison Officer with a copy of a Sagkeeng's fall engagement newsletter for his revision prior to sending it to Sagkeeng leadership.										✓
October 14, 2021	E-mail	3 representatives from Sagkeeng 3 representatives from CNL	CNL provided Sagkeeng with a revised version of EIS Section 6.7 for their review for verification that CNL had adequately incorporated Sagkeeng's interests and concerns related to environmental and human health into this subsection.				✓				✓		✓
October 20, 2021	E-mail	1 representative from Sagkeeng 3 representative from CNL	CNL provided Sagkeeng with a copy of the contribution agreement that was developed to support the Technical Working Group meetings for their review and feedback.										
October 20, 2021	E-mail	1 representative from Sagkeeng 5 representatives from CNL	CNL provided Sagkeeng's leadership with a Fall engagement update newsletter.									✓	✓
November 1, 2021	Teleconference	3 representatives from Sagkeeng 4 representatives from CNL 3 representatives from AECL 2 representatives from Narratives Inc.	CNL hosted a debrief on the trauma-informed engagement training with Sagkeeng, and the trainer and principle from Narratives Inc. After Narratives Inc. provided an overview of the training, CNL and Sagkeeng discuss how to use these teaching to develop a Healing and Resiliency Action Plan.						✓			✓	✓
November 1, 2021	E-mail	3 representatives from Sagkeeng 1 representative from CNL	Sagkeeng provided feedback on Section 6.7 and Section 11.0				✓			✓	✓		
November 3, 2021	E-mail	3 representatives from Sagkeeng 1 representative from CNL	CNL provided Sagkeeng with a copy of the revised Section 2.0 to show how CNL had incorporated Sagkeeng's feedback. Where integration was not possible, CNL provided a detailed explanation for why CNL was not able to incorporate Sagkeeng's comment.		✓						✓		

Date	Activity	Attendance	Description	Key EA Topics									
				Baseline Conditions	Alternative Means Assessment	Project Components	Effects Assessment	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Topics of Interest	Engagement Methods
November 4, 2021	E-mail	3 representatives from Sagkeeng 1 representative from CNL	CNL received confirmation from Sagkeeng that issues remaining with Section 2.0 would not be resolved through further consultation, and that any further disagreement Sagkeeng had with the draft would be dealt with in Sagkeeng's intervention with CNSC.		✓						✓		
November 10, 2021	Teleconference	3 representatives from Sagkeeng 8 representatives from CNL 3 representatives from AECL	The focus of this technical working group meeting was on environmental monitoring. CNL delivered a presentation on the site's environmental protection program and Sagkeeng delivered a presentation on the proposed Community Environmental Monitoring program.							✓	✓		✓
November 15, 2021	Teleconference	3 representatives from Sagkeeng 4 representatives from CNL	Sagkeeng and CNL convened the EIS subcommittee Meeting to discuss Sagkeeng's comments on Section 6.7 (Human and Ecological Health) and Section 11.0 (Summary of Monitoring and Follow-up Programs).				✓		✓	✓			
November 18, 2021	E-mail	3 representatives from Sagkeeng 4 representatives from CNL	CNL asked Sagkeeng to review Section 6.8 (Land and Resource Use) to make sure that CNL had documented Sagkeeng's information correctly.	✓		✓					✓		
November 26, 2021	E-mail	3 representatives from Sagkeeng 4 representatives from CNL	CNL sent Section 4.0 (Indigenous Engagement) and requested that Sagkeeng review to confirm CNL had documented Sagkeeng's information and concerns correctly.								✓		✓
November 30, 2021	E-mail	3 representatives from Sagkeeng 3 representatives from CNL 1 representative from AECL	CNL, AECL, and Sagkeeng signed an MOU. MOU supported the development of a liaison committee, liaison officer, the development of scopes of work for a Community Environmental Monitoring Program Program, Healing and Resiliency Action Plan, and leadership table.					✓	✓	✓	✓	✓	✓
November 30, 2021	E-mail	3 representatives from Sagkeeng 1 representative from CNL	CNL provided Sagkeeng with Section 6.9 and requested Sagkeeng review to confirm CNL had documented Sagkeeng's information correctly.						✓				
December 8, 2021	E-mail	2 representatives from Sagkeeng 1 representative from CNL	Sagkeeng provided feedback on Section 6.8 (Land and Resource Use).	✓							✓		
December 13, 2021	Phone Call	1 representative from Sagkeeng 1 representative from CNL	Sagkeeng's Liaison Officer provided an update on the development of Sagkeeng Liaison Committee.										✓
December 14, 2021	E-mail	2 representatives from Sagkeeng 2 representatives from CNL	CNL received feedback from Sagkeeng on Section 6.9 (Socio-economic Environment).						✓		✓		
December 15, 2021	Teleconference	3 representatives from Sagkeeng 9 representatives from CNL 3 representatives from AECL	Sagkeeng presented on Community Environmental Monitoring Programs and how CNL and Sagkeeng could incorporate similar elements into monitoring at Whiteshell Laboratories.							✓	✓		
January 5, 2022	Teleconference	1 representative from Sagkeeng 4 representatives from CNL	CNL held a teleconference to go over Sagkeeng's comments on Section 4.0 (Indigenous Engagement) and to confirm once again at the list of interests and concerns was complete.								✓		✓
January 31, 2022	E-mail	2 representatives from Sagkeeng 4 representatives from CNL	CNL sent Sagkeeng a revised copy of Section 4.0 (Indigenous Engagement) and Section 6.7 (Human Ecological Health). Both copies were provided in track changes with detailed responses to each of Sagkeeng's comments.				✓		✓		✓		✓
February 2, 2022	E-mail	3 representatives from Sagkeeng 1 representative from CNL	CNL sent the IAC terms of reference to Sagkeeng's consultation team or their review and input.							✓			
February 3, 2022	E-mail	5 representatives from Sagkeeng 5 representatives from CNL 3 representatives from AECL	Sagkeeng provided CNL with drafts of Sagkeeng's Community Environmental Monitoring Program and Healing and Resiliency Action Plan.										✓

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				Baseline Conditions	Alternative Means Assessment	Project Components	Effects Assessment	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Topics of Interest	Engagement Methods
February 22, 2022	Teleconference	4 representatives from Sagkeeng 9 representatives from CNL 3 representatives from AECL	The Technical Working Group discussed Sagkeeng's scope of work for Sagkeeng's Community Environmental Monitoring Program.								✓		
March 2, 2022	Teleconference	4 representatives from Sagkeeng 4 representatives from CNL 3 representatives from AECL	Sagkeeng provided an overview of the Healing and Resiliency Action Plan.								✓		✓
March 3, 2022	E-mail	4 representatives from Sagkeeng 1 representatives from CNL	CNL and AECL provided Sagkeeng with written feedback on the Community Environmental Monitoring Program scope of work.					✓		✓	✓		✓
March 9, 2022	Teleconference	4 representatives from Sagkeeng 4 representatives from CNL 3 representatives from AECL	CNL, AECL, and Sagkeeng held further discussions on Sagkeeng's scope of work for the Community Environmental Monitoring Program.							✓	✓		✓
March 15, 2022	E-mail		CNL and AECL provided Sagkeeng with written feedback on the Community Environmental Monitoring Program scope of work.							✓	✓		✓
March 22, 2022	Teleconference	2 representatives from Sagkeeng 3 representatives from CNL	Two CNL representatives met with Sagkeeng's community liaison committee to get to know each other and learn more about the Project.										
April 6, 2022	Teleconference	4 representatives from Sagkeeng 6 representatives from CNL 2 representatives from AECL	CNL and Sagkeeng discussed Sagkeeng's scope of work for the Community Environmental Monitoring Program and repackaging of Sagkeeng's interest and concerns table.			✓						✓	✓
April 11, 2022	E-mail	4 representatives from Sagkeeng 4 representatives from CNL	CNL sent Sagkeeng their repackaged interest and concerns table for their review.									✓	✓
May 10, 2022	Teleconference	4 representatives from Sagkeeng 4 representatives from CNL 3 representatives from AECL	CNL walked through Sagkeeng's revised interest and concerns table and discussed the upcoming in-person workshop (Community Environmental Monitoring Program).							✓		✓	✓
May 20, 2022	Teleconference	2 representatives from Sagkeeng 3 representatives from CNL 1 representatives from AECL	CNL and Sagkeeng discussed the logistics of the Community Environmental Monitoring Program workshop.										✓
June 9, 2022	Teleconference	3 representatives from Sagkeeng 4 representatives from CNL 3 representatives from AECL	CNL and Sagkeeng discussed the interest and concerns table as well as the agenda for the Community Environmental Monitoring Program workshop.			✓						✓	✓
June 13, 2022	E-mail	3 representatives from Sagkeeng 2 representatives from CNL	CNL asked Sagkeeng to confirm that they have reviewed and verified their interest and concerns table.										✓
June 15-16, 2022	In-person	5 representatives from Sagkeeng 3 representatives from CNL 3 representatives from AECL	CNL and Sagkeeng representatives met in-person in Winnipeg to negotiate a Community Environmental Monitoring Program that would help to reduce fear and stigma associated with the WL site and its surroundings.					✓		✓	✓	✓	✓
June 16, 2022	In-person	5 representatives from Sagkeeng 3 representatives from CNL 3 representatives from AECL	Sagkeeng confirmed during the workshop that the interests and concerns table accurately reflects what Sagkeeng stated to be its interests and concerns about the Project. While Sagkeeng doesn't agree with the proposed method of decommissioning the WR-1 Reactor, it gives credit that CNL and AECL have created that table and that table accurately reflects the interests and concerns as expressed by the community and Sagkeeng acknowledges that disagreements have been respectfully documented.			✓							✓

Date	Activity	Attendance	Description	Key EA Topics									
				Baseline Conditions	Alternative Means Assessment	Project Components	Effects Assessment	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Topics of Interest	Engagement Methods
July 11, 2022	E-mail	1 representative from Sagkeeng 5 representatives from CNL 4 representatives from AECL	CNL provided a draft copy of the trilateral agreement for the Sagkeeng Community Environmental Monitoring Program and OKT provided a revised copy for CNL and AECL's review.										✓
July 19, 2022	In-person	9 representatives from Sagkeeng 3 representatives from CNL	CNL hosted Sagkeeng's community liaison committee on site for a tour of WR-1.	✓		✓	✓	✓	✓	✓			✓
August 25, 2022	Teleconference	2 representatives from Sagkeeng 2 representatives from CNL 1 representative from AECL	Coordinated discussion on the Technical Working Group budget and specifically Line item 9, Trauma Informed Action Plan negotiations costs. CNL indicated that they were not prepared to fund the development of the plan this year as they did not understand it fully, and as much of the plan seems out of scope of the Project. Sagkeeng recommended CNL and AECL send correspondence to Sagkeeng clarifying this position. The leadership expected full commitment on the Healing and Resiliency Action Plan, based on work done on the psychosocial assessment. The parties agreed to put this matter on a subsequent TWG agenda and have a closer examination of the Healing and Resiliency Action Plan proposal.						✓			✓	✓
August 30, 2022	E-mail		CNL sent a copy of CNL's environmental monitoring program schedule and requested Sagkeeng to identify any potential activities they want to participate in.							✓		✓	✓
September 6, 2022	E-mail		CNL sent Sagkeeng the revised contribution agreement to support Sagkeeng's Community Environmental Monitoring Program for their review and feedback.									✓	✓
September 7, 2022	E-mail		CNL and Sagkeeng discussed the Technical Working Group and the Community Environmental Monitoring Program budget and scope of work.							✓		✓	✓
September 13, 2022	E-mail		CNL provided final edits to the contribution agreement to support Sagkeeng's Community Environmental Monitoring Program .							✓		✓	✓
September 20, 2022	E-mail		Sagkeeng confirmed they accepted CNL's final edits to the contribution agreement to support Sagkeeng's Community Environmental Monitoring Program .							✓		✓	✓

1.3.2 Sagkeeng First Nation (Sagkeeng) – Key Interests and Concerns

For more information on specific interests and concerns expressed by Sagkeeng First Nation, refer to their Traditional Knowledge and Land Use and Occupancy Study report, Alternative Means Assessment report, Psychosocial Impact Assessment Report and Appendix B of the Indigenous Engagement Report.

Table Verification

On June 24, 2021, CNL provided Sagkeeng with the summary table of Sagkeeng's interests and concerns and a list of the community's VC on the Project. At the same time, CNL also sent Sagkeeng a letter outlining CNL's request for Sagkeeng to verify that the table correctly captured Sagkeeng's interest and concern and status of those concerns.

Sagkeeng provided feedback on the list of VCs on July 14, 2021 and the summary of interests and concerns table July 16, 2021. CNL met with Sagkeeng to discuss their feedback on July 28, 2021. After sending Sagkeeng a revised table on August 28, 2021, Sagkeeng provided a second round of feedback August 23, 2021. CNL met with Sagkeeng on August 24, 2021 to review their summary of interests and concerns table and list of VC. After the meeting, Sagkeeng provided additional feedback on Sept 16, 2021. CNL incorporated Sagkeeng's feedback and sent the updated summary of interests and concerns table on September 20, 2021.

Sagkeeng recommended proceeding with submission of the revised draft EIS on Sept 29, 2021. CNL sent the final letter, thanking Sagkeeng for the participation in verifying the summary of interests and concerns table was complete on October 6, 2021.

On March 7, 2022, CNL informed Sagkeeng that CNL would be repackaging the interest and concerns table to better meet the needs of the CNSC, and requested a meeting to walk through the changes of the table. CNL sent the repackaged table on April 11, 2022 and received feedback from Sagkeeng on April 25, 2022. CNL incorporated Sagkeeng's feedback into the table and sent the revised table to Sagkeeng on May 4, 2022. CNL and Sagkeeng met via teleconference during their monthly Technical Working Group meeting on May 10, 2022. During the meeting, CNL walked through the table to show how CNL had incorporated Sagkeeng's revisions into the table. After the meeting, CNL sent a final copy of the table to Sagkeeng on May 12, 2022. Additional updates were made to the status column only of the interests and concerns table and these adjustments were forwarded to Sagkeeng on October 20, 2022. Sagkeeng provided their feedback on November 11, 2022 indicating that the table reflects the current status of the issues.

Key Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
Relationship-Building			
At the start of the Whiteshell Reactor 1 (WR-1) Project, the relationship between Sagkeeng and Canadian Nuclear Laboratories (CNL) was limited in scope. Although Sagkeeng was concerned about the limited opportunities for their involvement in the Environmental Assessment (EA) process, they were also interested in a positive respectful relationship with CNL to help Sagkeeng and CNL work together on topics such as the Project and to ensure that Sagkeeng's interests, concerns, and Aboriginal and treaty rights are considered by CNL in its activities. This is both a project-specific and site-wide interest.	Sagkeeng and CNL have both indicated an interest in working together to build and sustain a positive respectful relationship and are working towards the development of a long-term agreement. To support this relationship, CNL has provided capacity funding for a Sagkeeng Liaison Officer position. The Liaison Officer has distributed Project information in Sagkeeng and has supported Sagkeeng's participation in CNL's on-site monitoring program. Sagkeeng, CNL, and Atomic Energy of Canada Limited (AECL) also signed a Contribution Agreement in November 2021 that supports Sagkeeng's participation in the existing regulatory review process, the development of a long-term relationship agreement, and the establishment of a Community Liaison Committee to engage directly with Sagkeeng members to build their awareness and knowledge of the Project. CNL, AECL, and Sagkeeng established a technical working group in June 2021, to develop a contribution agreement that provides capacity supports for the following initiatives: ▪ Development of a Community Liaison Committee. ▪ Development of a Healing and Resiliency Action Plan. ▪ Development of a leadership table among Sagkeeng, AECL, and CNL. ▪ Development of a meaningful Sagkeeng Community Environmental Monitoring Program at and around the Whiteshell Laboratories (WL) site. ▪ Negotiation of a Long-term Relationship Agreement.	Section 4.2.4.1: Sagkeeng First Nation was updated to include CNL's commitment to working with Sagkeeng through the Technical Working Group to develop and implement initiatives that would help address Sagkeeng's concerns on the Project.	CNL's relationship with Sagkeeng has improved since a CNL, AECL, and Sagkeeng leadership meeting on April 6, 2021. The relationship is growing positively and is currently being managed through tripartite discussions at the Technical Working Group. CNL is committed to engagement throughout the lifecycle of the Project and the WL site. Sagkeeng has expressed that the relationship needs to be ratified through meaningful long-term commitments to Sagkeeng monitoring and management roles in relation to the WR-1 and the WL, and to support for healing and resiliency improvements and evidence of benefit to offset long-term and likely future impacts at and around the WR-1 facility.
Site Management Structure/Roles and Responsibilities			
Sagkeeng expressed an interest in reviewing the nature of the contractual relationship and financial terms between Canada and the Canadian National Energy Alliance (CNEA), with emphasis on any incentives or penalties related to the schedule and budget of the proposed undertaking. Sagkeeng wants to understand how incentives or penalties may impact site decisions and, in turn, may impact their Aboriginal and treaty rights to use lands and resources near the WL site. This is both a project-specific and site-wide concern.	CNL provided formal responses and had direct engagement with Sagkeeng to explain and discuss the contractual relationship between AECL and CNEA. CNL indicated that it could not disclose the financial terms between Canada and CNEA as that information is confidential and commercially sensitive. CNL reiterated that regardless of the contractual and financial terms, CNL will remain responsible for carrying out the Project and the overall WL site closure in accordance with all federal regulations, international best practices, and with public safety as a primary concern.	Sections 1.0: Introduction and 1.4: Proponent were revised to clarify the relationships and history between CNL, AECL, and CNEA.	Sagkeeng and CNL have differing perspectives on this matter. At this time Sagkeeng does not accept CNL's position that the financial terms of the CNEA contract cannot be disclosed. Sagkeeng has proposed entering into confidentiality agreements and other possible arrangements to allow for the confidential and "for-purpose" disclosure of the requested information.

Key Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
Sagkeeng was interested in the history of, relationship between, and responsibilities of CNL, AECL, the WL site, Canada, CNEA, and other parties responsible for the environmental liabilities at the WL site now and in the future. Specifically, they want to know who will be accountable for any impacts to their Aboriginal and treaty rights to use lands and resources near the WL site. This is both a project-specific and site-wide interest.	CNL provided formal responses and had direct engagement with Sagkeeng to explain the roles, relationships, and responsibilities of CNL, AECL, and CNEA. CNL explained that CNL and AECL operate under a Government-owned, Contractor-operated (GoCo) model, whereby the site, facilities, and assets remain the property of AECL, but are operated by CNL. Management of CNL was awarded to CNEA, a private sector consortium that represents some of the world's most experienced nuclear engineering and management firms. The GoCo model is set up so that CNL remains the operator and licensee of all AECL sites regardless of whether a new contractor is selected. AECL could award a new contract for the management and operation of CNL to a different consortium after 2025 and CNL would remain responsible for the management and operation of all AECL sites. CNL reiterated that it will remain responsible for the Project, the WL site closure, the ongoing monitoring activities, and for any remedial actions should they be required. The federal government, through AECL, will remain responsible for funding CNL throughout the closure work and ongoing post-closure monitoring.	Sections 1.0: Introduction and 1.4: Proponent were revised to clarify the relationships and history between CNL, AECL, and CNEA. CNL documented its commitment to and responsibility for the future monitoring of the WL site and the WR-1 facility, and AECL commitment to funding the monitoring program in Section 11.1: Adaptive Management. CNL's responsibility for remedial actions is documented in Section 11.2: Data Management.	Sagkeeng has expressed appreciation for the information provided about present and future nuclear liability responsibility, and has noted that the question of what degree of harm to Sagkeeng rights and interests has already occurred prior to the Project, and how much harm will occur in a future with and without the Project, remains an open issue.
Engagement			
In January 2018, Sagkeeng expressed concern with the lack of meaningful and responsive engagement by CNL. Sagkeeng has also indicated that technical results are difficult to understand and that CNL should work with Chief and Council to promote future engagement activities and go door to door to invite on-reserve members. Sagkeeng is interested in improving its community members' understanding of the Project so community members can come to their own conclusions about impacts to the environment and fully exercise their right to be consulted on projects that might adversely impact their Aboriginal and treaty rights. This is a project-specific concern.	CNL has increased the level of engagement with Sagkeeng in response to this concern to promote meaningful and timely mutual learning and understanding. CNL and Sagkeeng now have, at minimum, a monthly meeting to discuss the Project and topics of interest to Sagkeeng. CNL developed a plain language summary of its annual compliance monitoring report and updated a number of infographics on the Project and engagement with Sagkeeng. Following a CNL, AECL, and Sagkeeng leadership meeting on April 6, 2021, CNL and Sagkeeng agreed upon a path forward for working together. This included establishing a Technical Working Group and reoccurring leadership meeting between Sagkeeng, AECL, and CNL to move forward key initiatives to help address Sagkeeng's concerns and collaborate on areas of interest including the establishment of a Community Liaison Committee to help increase engagement with Sagkeeng's membership.	Section 4.2.4.1: Sagkeeng was updated to provide information on all engagement activities with Sagkeeng since 2016 and to include key next steps to help address Sagkeeng's concerns with the Project.	Sagkeeng acknowledges that CNL has meaningfully engaged with it on the Project, enabling Sagkeeng's participation in the environmental assessment and licensing process and expects that engagement to continue. Sagkeeng has expressed that for engagement to be meaningful, it must be ongoing. CNL, Sagkeeng, and AECL have established a Technical Working Group to resolve outstanding concerns and work collaboratively on areas of interest. CNL will continue to engage meaningfully with Sagkeeng Chief and Council, community members, their engagement team, and their Liaison through the lifecycle of this Project. CNL's view is that the steps CNL is taking will adequately addresses this area of interest to the extent possible.
Sagkeeng expressed interest in a greater role in reviewing draft documentation related to the WR-1 Environmental Impact Statement (EIS) as they want to ensure their Aboriginal and treaty rights, their interests, and their concerns are properly reflected and assessed. This is a project-specific interest.	CNL provided Sagkeeng with various sections of the WR-1 EIS submission for their review and feedback. CNL and Sagkeeng created a technical sub-committee to discuss Sagkeeng's feedback. CNL provided detailed responses to all of Sagkeeng's comments, particularly when CNL could not incorporate Sagkeeng's feedback. CNL did incorporated Sagkeeng's feedback where appropriate. CNL sent revised copies back to Sagkeeng to verify CNL had adequately incorporated their feedback prior to submission of the revised draft EIS.	The following sections of the draft EIS were influenced and modified based on feedback from Sagkeeng: Section 2.8: Sagkeeng's Alternative Means Assessment – Approach and Findings. CNL created Section 2.8: Sagkeeng's Alternative Means Assessment – Approach and Findings to capture Sagkeeng's alternative means study and CNL analysis of Sagkeeng's findings. Section 4.0: Indigenous Engagement, particularly 4.2.4.1: Sagkeeng First Nation, which details Sagkeeng engagement and interests and 4.2.4.1.4: Sagkeeng First Nation's Psychosocial Impact Assessment. Table 4.4-1: Summary of Issues Raised During Engagement Activities that Influenced the Scope of the Environmental Assessment (EA) provides other impacts on the EIS from engagement activities. Section 6.7: Human and Ecological Health. CNL added moose as a Valued Component (VC) for the post-closure phase and assessed the effects of the Project on moose, and Indigenous peoples harvesting moose. Section 6.8: Land and Resource Use. CNL revised the assessment boundaries in Section 6.8: Land and Resource Use based on Sagkeeng's feedback to expand the Regional Study Area (RSA) to extend downstream of the Winnipeg River and beyond the outlet into Lake Winnipeg. CNL confirmed that the land use RSA encompasses the EA areas from Sections 6.2: Atmospheric Environment through 6.7: Human and Ecological Health. Section 6.9: Socio-economic Environment. CNL elevated psychosocial aspects of the Project from a no linkage pathway to a secondary pathway in Section 6.9: Socio-economic Environment to include this concern in the assessment due to its importance to Indigenous Nations. Section 11.0: Summary of Monitoring and Follow-up Programs. Section 11.4: Indigenous Engagement and Participation in Environmental Monitoring was added to outline ongoing engagements and commitments to support meaningful discussion on the monitoring and follow-up programs, and includes	This interest was addressed in the current version of the EIS. CNL recognizes that this interest will likely apply to future versions as well and is committed to ongoing engagement and provision of capacity to support Sagkeeng in future review. Sagkeeng notes that CNL made some revisions to the EIS based on Sagkeeng comments and chose not to make revisions based on Sagkeeng comments in some instances. Sagkeeng has informed CNL that it will provide further comments on the EIS upon its acceptance by the CNSC.

Key Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
		CNL's commitment to an independent Sagkeeng Community Environmental Monitoring Program.	
Sagkeeng is concerned that the site may impact the environment in the future. Sagkeeng wants to be involved in the planning, assessment, remediation, and monitoring of WR-1 and the Waste Management Area trenches to ensure their Aboriginal and treaty rights to use lands and resources near the WL site is not impacted in the future. This is both a project-specific and site-wide concern.	CNL agreed to engage Sagkeeng on how they would like to participate in the In Situ Disposal (ISD) of WR-1 if approved. CNL also agreed to provide the Environmental Risk Assessment, Detailed Decommissioning Plans and final safety assessment for the remediation of trenches at the WL site, and other relevant documents, once drafted and to engage Sagkeeng on the institutional control framework for the Waste Management Area trenches.	Section 11.4: Indigenous Engagement and Participation in Environmental Monitoring was added to outline ongoing engagements and commitments to support meaningful discussion on the monitoring and follow-up programs, and includes CNL's commitment to an independent Sagkeeng Community Environmental Monitoring Program.	CNL's perspective is that this concern cannot be fully addressed until a licensing decision is made on the WR-1 ISD Project as WR-1 decommissioning cannot occur before that time. Sagkeeng recognizes that CNL has entered into a formal, funded agreement to support a Community Environmental Monitoring Program with Sagkeeng. Sagkeeng views this as a positive development. In addition, Sagkeeng notes that questions of Sagkeeng's role in planning and assessment of WR-1 and the WL site have yet to be addressed through concrete commitments by CNL or AECL.
Sagkeeng expressed concern that consultation with the Crown will still need to occur to discuss and determine any potential impacts on Aboriginal and Treaty rights and, where appropriate, accommodation in addition to the engagement CNL and Sagkeeng are undertaking. This is a project-specific concern.	For questions related to consultation and the Nation-to-Nation relationship, CNL responded providing its understanding of the roles of the Canadian Nuclear Safety Commission (CNSC) and AECL, and also referred Sagkeeng to the CNSC and Crown. CNL has offered to have the regulator and AECL join meetings to help address this concern. CNL has and will consider how traditional land and resource uses (such as trapping, hunting, fishing, gathering, and culture) might be different among the various Indigenous Nations. Certainly, each Indigenous Nation will describe how it undertakes traditional land and resource use in a somewhat different way and CNL has to the best of its ability described that.	Section 6.8: Land and Resource Use was revised based on feedback from Sagkeeng to improve the description of Sagkeeng's traditional land and resource use.	CNL has addressed this concern to the extent possible and acknowledges that consultation will continue on a Nation-to-Nation basis. Sagkeeng has expressed its expectation that AECL, as an agent of the Crown, the owner of the WL site, and entity primarily responsible for the nuclear liabilities, will play a role in facilitating consultation and ensuring accommodation. Sagkeeng notes that a rights impact assessment for the WR-1 decommissioning process has yet to be completed; this is a joint responsibility of CNSC and Sagkeeng.
Sagkeeng is interested in improving its community members' understanding of the WL site, through an Indigenous-led risk communication program and sharing CNL's annual reports, to improve understanding of the site and vicinity risk to the health and edibility of country food and water sources (including radiation, impact pathway identification, monitoring results and plain language reporting about the safety of country food and water sources). This would support community members to develop their own conclusions about impacts to the environment and fully exercise their right to be consulted on projects that might adversely impact their Aboriginal and treaty rights. This is both a project-specific and site-wide interest.	CNL agreed to support the development of a risk communication program to support understanding of the site and increase confidence in the health and edibility of country food and water sources. CNL, AECL, and Sagkeeng have agreed to discuss the development of this program, in addition to a Community Environmental Monitoring Program , through the Technical Working Group. CNL also revised Section 4.0 (Indigenous Engagement) of the draft EIS to reflect this commitment.	Section 4.2.4.1: Sagkeeng was revised to include CNL's commitment to support a risk communication program.	A commitment was made to support a risk communication program with Sagkeeng and the parties are currently working to determine how to best achieve that outcome. Sagkeeng views this as a positive development. Sagkeeng notes that while CNL has made a nominal commitment to support an Indigenous-led risk communication program with Sagkeeng, the scope and duration of that program that CNL and AECL are willing to support has yet to be defined. This information is material to the likelihood of success of any such initiative.
Sagkeeng expressed concern that CNL had not engaged in a meaningful way to establish a baseline, conduct an effects assessment, or consider Sagkeeng VCs. Sagkeeng expressed the position that the spatial boundaries of the assessment are inappropriate for assessing potential impacts to the Current Use of Lands and Resources for Traditional Purposes (CULRTP). Sagkeeng wants to ensure their Aboriginal and treaty rights, their interests, and their concerns are properly reflected and assessed. Sagkeeng believes the traditional land and resource use impacts of the Project should be compared to conditions prior to the establishment of the WL site rather than to current conditions. The siting and operations of the WL site had the potential to adversely impact Sagkeeng's Aboriginal and treaty rights and Sagkeeng believes this needs to be factored in to the remediation of WR-1. This is a project-specific concern.	CNL engaged with Sagkeeng on how the baseline was established and on revisions CNL made based on Sagkeeng input through engagements and incorporating Sagkeeng's Traditional Knowledge Land Use and Occupancy Study into the draft EIS. For example, CNL revised the Land and Resource Use assessment spatial boundaries based on Sagkeeng's feedback to expand the RSA to extend downstream of the Winnipeg River and beyond the outlet into Lake Winnipeg. CNL clarified that the Project is being assessed under the framework of the Canadian Environmental Assessment Act (CEAA) 2012 and Section 5 (1) (c) of the CEAA 2012 states that the assessment of effects is limited to *"the current use of lands and resources for traditional purposes"*. CNL explained that while ISD does not undo the historic developments in the area, it is an appropriate approach because it reduces the nuclear liabilities at the WL site by disposing of WR-1 in a design-reviewed, safety assessed facility without the need for major demolition and nuclear waste extraction and transportation work. This minimizes the impact to the surrounding environment and in turn builds confidence that the rights, cultural practices, and traditional land and resource use by Sagkeeng and other Indigenous Nations will not be impacted at the present or the future time. CNL provided Sagkeeng with the effects assessments sections of the draft EIS for their review and feedback. CNL reviewed Sagkeeng's studies and feedback on the draft EIS and incorporated Sagkeeng's feedback where appropriate. This helped ensure the assessment reflects the results of the engagement and covers the elements of the environment relevant to Sagkeeng.	CNL revised the assessment sections (Sections 6.2: Atmospheric Environment through 6.9: Socio-economic Environment) to include a summary describing how Indigenous VCs, interests, and land use practices, including those provided by Sagkeeng, were considered in that specific assessment. CNL revised the assessment boundaries in Section 6.8: Land and Resource Use based on Sagkeeng's feedback to expand the RSA to extend downstream of the Winnipeg River and beyond the outlet into Lake Winnipeg. CNL confirmed that the Land and Resource Use RSA encompasses the EA areas from Sections 6.2: Atmospheric Environment through 6.7: Human and Ecological Health. CNL revised Section 6.8.1.5.2.2.1: Historical and Present Day Traditional Land Use to provide additional information on traditional land use by Sagkeeng and include discussion of impacts on communities as a result of establishment of the WL site, among other developments in the area.	CNL and Sagkeeng continue to disagree on the approach taken to develop the baseline and no resolution is imminent.

Key Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
	Based on the feedback received during engagement activities and Sagkeeng studies, CNL also prepared a list of VCs for Sagkeeng in a format that compared the Sagkeeng VCs to the Project VCs. CNL requested a review and comment by Sagkeeng on this table. For each Sagkeeng VC, CNL either: • Confirmed it was encompassed by the assessment. • Added it to the assessment. • Added it to the model to be assessed. • Did not add it to the assessment, with rationale provided.		
Historical Siting and Operations of the WL Site			
Sagkeeng expressed concern over the lack of engagement during the siting and operations of the WL site as this adversely impacted their Aboriginal and treaty rights. This is a site-wide concern.	CNL acknowledged that engagement practices in the past were below today's engagement standards. CNL is committed to incorporating feedback from Sagkeeng regarding historical siting issues and agreed that this topic will be discussed at the Technical Working Group.	Section 4.2.4.1: Sagkeeng First Nation was revised to include CNL's commitment to working with Sagkeeng through the Technical Working Group to develop and implement initiatives that will help address Sagkeeng's interests and concerns related to the WL site. Section 6.8.1.5.2.2.1: Historical and Present Day Traditional Land Use was revised to provide additional information on traditional land use by Sagkeeng and include discussion of impacts on communities as a result of establishment of the WL site, among other developments in the area.	CNL has taken steps to address this concern by incorporating feedback from Sagkeeng on historical siting issues and committing to discussions between AECL, Sagkeeng, and CNL on the historic siting of the WL site and will continue to engage Sagkeeng on the Project and closure of the WL site. Sagkeeng disagrees that adequate steps have been taken on this issue, as no facilitated discussions between AECL and Sagkeeng on historic effects or past practices have occurred, or discussions on accommodations and reconciliation have occurred to date.
Sagkeeng believes the traditional land and resource use impacts of the Project should be compared to conditions prior to the establishment of the WL site rather than current conditions. The siting and operations of WL adversely impacts Sagkeeng's Aboriginal and treaty rights and Sagkeeng believes this needs to be factored in to the remediation of WR-1. This is a project-specific concern.	CNL believes that, while ISD does not undo the historic developments in the area, it is an appropriate approach because it reduces the nuclear liabilities at the WL site by disposing of WR-1 in a design-reviewed, safety assessed facility without the need for major demolition and nuclear waste extraction and transportation work. This minimizes the impact to the surrounding environment and in turn builds confidence that the rights, cultural practices, and traditional land and resource use by Sagkeeng and other Indigenous Nations will not be impacted at the present or the future time. The Project is being assessed under the framework of the CEAA 2012 and Section 5 (1) (c) of the CEAA 2012 states that the assessment of effects is limited to *"the current use of lands and resources for traditional purposes*." To confirm that there would be no effects in the future, CNL is committed to a minimum of 100 years of institutional control and environmental monitoring. CNL is also committed to working in collaboration with Indigenous Nations, including Sagkeeng, on developing a post-closure monitoring program that ensures that environmental aspects important to Indigenous Nations are monitored and timely results provided.	Section 6.8.1.5.2.2.1: Historical and Present Day Traditional Land Use was revised to provide additional information on traditional land use by Sagkeeng and include discussion of impacts on communities as a result of establishment of the WL site, among other developments in the area. Section 6.9.6.2.2: Socio-economic Environment has been revised to make the effects of WR-1 on Indigenous well-being a secondary pathway, acknowledging that the long-term presence of nuclear materials in the region, along with other historical industrial developments in the local study area, had the potential to result in fear, stigma, and anxiety, and that psychosocial effects are legitimate impact pathways affecting the Indigenous community well-being. CNL created Section 2.8: Sagkeeng's Alternative Means Assessment – Approach and Findings to capture Sagkeeng's alternative means study and CNL analysis of Sagkeeng's findings. CNL confirmed in Section 2.8.5.4: Conclusion of CNL's Consideration of Sagkeeng's Assessment that it would not consider any alternative it believed was not safe for the public, the environment, or its workers.	CNL's perspective is that this concern is out of scope of the WR-1 EA; Sagkeeng disagrees. CNL and Sagkeeng continue to disagree on the approach taken to assess cumulative effects for the project and no resolution is imminent.
Free, Prior, and Informed Consent (FPIC)			
Sagkeeng holds the perspective that Article 29(2) of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) and customary international law creates a legally binding requirement to secure Sagkeeng's FPIC prior to proceeding with the proposed ISD Project. This is a project-specific concern.	In February 2021, Sagkeeng, AECL, and the CNSC held a teleconference that included a discussion about the application of FPIC on the Project; CNL participated as an observer. During the meeting, all three parties shared the same view that it is important to engage and seek consensus and consent; ensure a genuine intention to address concerns; and ensure the government makes a responsible decision. There were differing views on the idea that CNL and AECL require Sagkeeng's consent. Reaching consent is a goal of any collaboration, engagement or consultation process, along with identifying mutually acceptable benefits and opportunities, even where consent is not achieved. AECL and CNL are committed to work towards consensus and consent, but in the event that the consent is not achieved, the regulatory decision-making process takes precedent. We recognize that we must learn from each other and work together to strengthen meaningful and effective Indigenous participation in AECL/CNL activities. CNL shared with Sagkeeng that CNL is working towards achievement of the FPIC principle with a goal to achieving consent by Sagkeeng, and that CNL is following the EA process for a final decision on the Project. CNL and Sagkeeng have signed a number of Contribution Agreements to support Sagkeeng's engagement in the EA process. CNL continues to seek direction from the community, and work closely with the Liaison Officer, to strengthen engagement with Sagkeeng community members.	Section 4.2.4.1: Sagkeeng First Nation was updated to state Sagkeeng's position regarding FPIC and the WR-1 EA process.	CNL continues to seek common ground with Sagkeeng in the interest of moving closer towards consent. Sagkeeng continues to hold that the development of a permanent hazardous waste disposal facility is a special, heightened factor re: the importance of FPIC.

Key Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
Rights Impact Assessment			
Sagkeeng expressed concern that potential impacts to their Aboriginal and treaty rights were not being adequately assessed by the Project. This is a project-specific concern.	CNL has incorporated three Sagkeeng-led studies into the EIS. These studies include Sagkeeng's Traditional Knowledge, Land Use and Occupancy Study, Alternative Means Assessment Report, and Psychosocial Impact Assessment Report. These reports include information on Sagkeeng's rights and key points on their ability to practice their rights in the future. Key findings of these documents and CNL's considerations of them are included in the revised draft EIS. CNL has also included a summary table of Sagkeeng's VCs and how they were considered in each assessment section (i.e., 6.X) in the revised EIS. CNSC REGDOC 3.2.2 provides guidance on Indigenous engagement for proposed projects that may raise the Crown's duty to consult. The regulatory document also encourages the building of long-term relationships and provides guidance on how proponents can address concerns and mitigate potential impacts to Aboriginal and treaty rights. CNL has made significant efforts, through support and review of traditional use studies and overall engagement, to be respectful of Aboriginal and treaty rights, to gain a better understanding of Aboriginal and treaty rights, and to seek understanding of any potential infringement to those rights. CNL has indicated that the CNSC is responsible for making determinations on any impacts to Aboriginal and treaty rights. As the CNSC develops the rights impact assessment for the Project, there is an opportunity for Sagkeeng to work with the CNSC on that assessment of rights. CNL is committed to engaging with Sagkeeng to gain a better understanding of Sagkeeng's concerns related to their Aboriginal and treaty rights. CNL and Sagkeeng have established a Technical Working Group to move forward on key initiatives to help address outstanding concerns Sagkeeng has with the Project and collaborate on areas of interest. This is intended to help mitigate Sagkeeng's concern about their ability to practice their rights and traditional land and resource use in the future that stem from fear of the site.	CNL added Section 4.2.4.1.4: Sagkeeng First Nation's Psychosocial Impact Assessment, including the following: *"CNL defers to the results of the rights impact assessment process for a conclusion on whether Aboriginal and treaty rights are impacted by this Project"*. CNL has documented various aspects of Traditional Land and Resource Use by Indigenous Peoples and Archaeological and Cultural Sites in Section 6.8.1.5.2: Results and assessed the impact of the Project on those aspects in Section 6.8.1.6.2: Results. The assessment determined that there would be negligible effect on Traditional Land and Resource Use or Archaeological and Cultural Sites. CNL also reflected the differing opinions of the Indigenous communities in its consideration of residual effects and accuracy of scientific predictions in Section 6.8.1.6.2.2: Secondary Pathways.	CNL has responded to this concern and endeavoured to carry out the Project with careful consideration of Indigenous interests and Aboriginal and treaty rights. CNL awaits the outcome of the CNSC's rights impact assessment to determine whether further action is required. Sagkeeng notes that what it considers to be inaccurate findings re: impacts from the Project on traditional land and resource use is an outstanding issue that is pertinent to the rights impact assessment.
Psychosocial Impact Assessment			
Sagkeeng has expressed concern that, as described in Sagkeeng's Psychosocial Impact Assessment Report, fear and stigma associated with ISD will prevent or limit future exercising of Aboriginal and treaty rights by Sagkeeng members and will cause an impact to the well-being of the Sagkeeng Nation. The Sagkeeng Assessment further states that CNL must address impacts resulting from past trauma, including the 1960s construction of the WL, the perception of environmental effects, and the perception that illnesses may be connected with environmental effects. This is a project-specific concern.	CNL worked with Sagkeeng to understand the findings and recommendations of Sagkeeng's Psychosocial Impact Assessment Report and to adequately incorporate the information provided in the EIS. Sagkeeng reviewed the Psychosocial Impact Assessment subsection that was added to the draft EIS and provided an overview of the report and also reviewed CNL's considerations of the report in the effects assessment. CNL incorporated Sagkeeng's feedback into the draft EIS. CNL staff have also taken trauma-informed engagement training with the authors of Sagkeeng's Psychosocial Impact Assessment Report to help gain further perspective on this important matter. During meetings with Sagkeeng, CNL shared that assessment of psychosocial impacts could not be considered a primary pathway under the CEAA 2012 because it was not tied to an environmental effect and expressed an interest in finding alternative ways to address Sagkeeng's concern. CNL and Sagkeeng discussed proposed next steps. CNL and AECL's leadership met with Sagkeeng's Chief to discuss the findings of the Psychosocial Impact Assessment Report and as a result established a Technical Working Group to develop and implement initiatives that would help to address Sagkeeng's concern about the Project and recommendations in the Report. At the leadership meeting, CNL, AECL, and Sagkeeng agreed to work collaboratively on developing key initiatives that would help to reduce fear and avoidance and increase confidence in country foods, build community capacity, improve the relationship and build trust between Sagkeeng, CNL, and AECL. CNL, AECL, and Sagkeeng agreed to establish a Technical Working Group to develop and implement these initiatives: ▪ Community Liaison Committee. ▪ Healing and Resiliency Action Plan in relation to WR-1 and the WL site. ▪ Leadership table between AECL, CNL, and Sagkeeng First Nation. ▪ Community Environmental Monitoring Program at the WL site. The Technical Working Group is expected to be in place for as long as necessary to put processes in place to address ongoing operational issues. CNL provided drafts of the Psychosocial section of the EIS to Sagkeeng for their review and incorporated Sagkeeng's feedback into the final version of the write-up prior to including it in the revised draft EIS.	CNL added a new subsection 4.2.4.1.4: Sagkeeng First Nation's Psychosocial Impact Assessment to describe the findings of Sagkeeng's Psychosocial Impact Assessment Report and CNL's considerations of the report. Sagkeeng reviewed the subsection and CNL incorporated Sagkeeng's revisions into the draft EIS. CNL also improved Section 6.9.6.2.2: Secondary Pathways, acknowledging that the long-term presence of nuclear materials in the region has the potential to result in fear, stigma, and anxiety, and that psychosocial effects are legitimate impact pathways. CNL is working with Sagkeeng to minimize any potential or lasting effects.	The next step is to engage with Sagkeeng through the Technical Working Group to discuss the Healing and Resiliency Action Plan. Sagkeeng's notes that CNL has made a nominal commitment to support a Sagkeeng Healing and Resiliency Action Plan. However, the scope and duration of that plan that CNL and AECL are willing to support has yet to be defined. This information is material to the likelihood of success of any such initiative.

Key Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
Valued Components			
Sagkeeng expressed concern that the draft EIS does not fully consider all of Sagkeeng's VCs identified within the Sagkeeng Traditional Knowledge and Land Use Study (TKLUS): water; medicine, berries and other food plants; hunting and trapping; and Anicinabe Pimatiziwin, ranging from the direct presence of traditionally hunted animals and gathered plants, to continued habitation, travel, and cultural activities on the land. This is a project-specific concern. Sagkeeng chose these VCs to represent the critical conditions or elements for the continued practice of Sagkeeng culture and livelihoods, which may be impacted by the Project.	CNL drafted a list of Sagkeeng specific VCs based on information from Sagkeeng-led studies and engagement activities. CNL verified this list of VCs with Sagkeeng and for each VC, CNL either: ▪ Confirmed it was encompassed by the assessment. ▪ Added it to the assessment. ▪ Added it to the model to be assessed. ▪ Did not add it to the assessment, with rationale provided. VCs selected for terrestrial and aquatic assessments were confirmed to be representative of many other species, including all species identified by Sagkeeng. VCs chosen for the land and resource use assessment were confirmed to capture archaeological and cultural sites and traditional land use as important VCs identified by all of the Indigenous Nations engaged on the Project. CNL assessed community well-being by adding "the continued use of the area by Indigenous community members for traditional land and resource use" as an assessment endpoint for the Community Well-Being VC, and assessing the potential impact to community well-being resulting from fear, stigma and anxiety associated with the long-term presence of nuclear materials in the region. With negligible effects predicted to the biophysical environments, the assessment does not indicate potential for direct or indirect effects to the well-being of Indigenous communities because of the Project-related changes to the environment; however, CNL made the Community Well-Being VC a secondary pathway in the community socio-economic well-being assessment due to its importance to Indigenous communities. Secondary pathways require mitigation measures to be in place to address potential measurable changes. The mitigation measure in this case is CNL and AECL recognizing and acknowledging the cumulative impacts and trauma experienced by Sagkeeng members in relation to the initial siting of WL and committing to begin addressing this through community-led initiatives facilitated by the Technical Working Group. In respect to the Sagkeeng Value of Anicinabe Pimatiziwin, CNL has captured it as one of the Sagkeeng Site-Specific Values in Section 6.8.1.5.2.2.1 and continues to work with Sagkeeng through the Technical Working Group table to address Sagkeeng's outstanding concerns related to the Project and Whiteshell Laboratories Closure Project (WLCP).	Section 4.2.4.1.2: Interests and Concerns was revised to include a verified list of Sagkeeng's VCs. Sections 6.5.3: Aquatic Environment VCs, 6.6.3: Terrestrial Environment VCs, 6.7.2.3: Ecological Health VCs, and 6.8.1.3: Indigenous Land and Resource Use VCs were updated to reflect the input into VC selection resulting from Indigenous Traditional Knowledge and Land Use Studies, including the study submitted by Sagkeeng. Sections 6.6.3: Valued Components and 6.7.2.3: Valued Components were specifically revised to discuss how the assessment encompasses the Indigenous VCs, how the assessment was expanded to include the Indigenous VCs (for example: moose), or the rationale for not including the Indigenous VCs (for example: wild rice). Section 6.8.1.5.2.2.1: Historical and Present Day Traditional Land Use was updated to include the Site-Specific Values identified by Sagkeeng to ensure that the assessment reflects these values. Section 6.9.6.2.2: Socio-economic Environment has been revised to make the effects of WR-1 on Indigenous well-being a secondary pathway, acknowledging that the long-term presence of nuclear materials in the region, along with other historical industrial developments in the local study area, had the potential to result in fear, stigma, and anxiety, and that psychosocial effects are legitimate impact pathways affecting the Indigenous community well-being.	CNL is currently working with Sagkeeng through the Technical Working Group to ensure Sagkeeng VCs are appropriately represented going forward. Future engagement on this topic is not anticipated to change the outcome of the assessment; however, it may result in additional commitments to Sagkeeng.
Business and Employment Opportunities			
Sagkeeng expressed interest in knowing more about CNL's procurement and employment policies, potential economic participation opportunities, potential priority contracts and employment, and qualification requirements for work associated with the WLCP. This is a site-wide interest in enabling Sagkeeng's community members to participate in the socio-economic benefits resulting from the WL site.	CNL organized a three-day business conference to help Sagkeeng and other First Nations learn more about CNL's procurement policies as well as employment and contracting opportunities for the WLCP. CNL asked for specific capabilities Sagkeeng has related to the WLCP and indicated their interest in examining Sagkeeng recommended contractors. CNL sent a listing of current and potential future external vacancies as well as criteria for security clearances to Sagkeeng. CNL adjusted the evaluation criteria for competitive bids to encourage greater economic participation by contractors that are Indigenous owned or have Indigenous employees or subcontractors. Sagkeeng forwarded a procurement strategy discussion paper in 2021 for consideration. Since that time, CNL is considering this paper in the context of developing an Indigenous procurement strategy to support greater participation of Indigenous owned business and support more Indigenous people in CNL's workforce. CNL has been sending job postings to Sagkeeng since the mid-1990s. CNL would welcome applicants from Sagkeeng and will continue to work with Sagkeeng to see how CNL can improve interest and success in recruiting, and in creating further economic benefit to Sagkeeng from the WLCP.	CNL acknowledges contracting and employment as a priority area of interest for Sagkeeng and has revised Section 4.2.4.1.2: Interests and Concerns to reflect this. Employment and business opportunities for Indigenous Nations and the Red River Métis (RRM) have been added to the project VCs in Section 6.9.3: Valued Components. CNL updated Section 6.9.6.2.2: Secondary Pathways and added a discussion of Project impacts on the employment and contract opportunities for Indigenous communities and the RRM as well as mitigations that were put in place by CNL.	Future engagements on this topic are not anticipated to change the assessment outcomes but may result in additional commitments to Sagkeeng. CNL is developing an Indigenous Procurement Strategy to support and enable Indigenous owned business to economically participate in the Whiteshell Laboratores Closure Project. Sagkeeng has raised concerns that no further commitments of substance related to employment and business benefits likely to be accessible by Sagkeeng businesses and members have been made by CNL or AECL since this issue was first raised. CNL and Sagkeeng continue to discuss the matter of contracting and employment through the Technical Working Group.

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Future Land Use and Tenure (End-State Planning for the WL Site)			
Sagkeeng is interested in future compensation for the Local Government District (LGD) of Pinawa and the First Nation since portions of the WL site is located in Treaty 1 territory. This is a site-wide interest in the socio-economic impacts of the WLCP.	CNL explained that AECL pays a grant in lieu of taxes to the LGD of Pinawa as the site falls within the municipal boundary of the LGD. The payment supports the municipal services of the community and is not compensatory for past siting. There is no compensation paid to any community for the siting of the WL site. AECL, in the past, and CNL, currently, have been a positive socio-economic development for the area, providing employment and contracts for the local supply chain. With the closure of the WL site, there are mitigations in place to enhance benefits for area communities and the Indigenous Nations in the Local Study Area to the extent possible. Mitigations focus on supporting current employees in transitioning to new work and helping foster business opportunities in the area to replace lost employment. CNL has worked to enhance options to better match Indigenous capabilities with their contracting needs, added provisions to its procurement process to encourage the use of Indigenous and local businesses, and considers single source contracting opportunities with Indigenous companies where well suited to the work. CNL has also adjusted the evaluation criteria for competitive bids to favour contracts that are Indigenous owned or have Indigenous employees. CNL also explained that a community regeneration partnership was formed to develop both nuclear and non-nuclear opportunities for the WL site after the site is decommissioned to help support the socio-economic development of the region. CNL participates in and supports the partnership. CNL invited Indigenous Nations to join.	Section 4.2.4.1.6: Next Steps was revised to include a commitment that CNL will engage Sagkeeng on the land use and end-state of the site. Section 6.9.6.2.2: Secondary Pathways was revised to add various measures that CNL, in collaboration with Indigenous Nations and local municipalities, took to mitigate socio-economic impacts resulting from the accelerated decommissioning schedule.	Sagkeeng notes that this concern is outstanding given that there is no evidence of benefit to the First Nation from employment and business opportunities, or evidence that there are “mitigations in place to enhance benefits for Indigenous Nations” with the closure of the WL site. CNL acknowledges that this concern requires more attention and will continue to engage with Sagkeeng and other Indigenous Nations on end-state planning and future land use for the WL site.
Sagkeeng is concerned that the WL site may impact the environment in the future. Sagkeeng wants to be involved in: the development of site clean-up and release criteria, the planning, assessment, and remediation of the trenches, and any end-state deviations to ensure their Aboriginal and treaty rights to use lands and resources near the WL site is not impacted in the future. This is both a project-specific and site-wide concern.	The Project incorporates multiple barriers to ensure the environment remains safe in the future and the EIS assesses the Project’s long-term impact on the environment and determined the environment will remain safe. Likewise, the trenches will undergo a rigorous safety assessment to ensure the long-term safety of the environment. CNL committed to setting up a workshop to discuss the end-state of the site including clean-up and release criteria, remediation of the waste management areas including the trenches, and future land use.	No changes were made to the EIS; however, CNL verified that there will be no impact on the environment through the assessment and documented the results of the assessment in Section 9.3: Summary. Section 4.2.4.1.6: Next Steps was revised to include a commitment that CNL will engage Sagkeeng on the land use and end-state of the site.	CNL acknowledges Sagkeeng’s interest in being involved in the future land use and end-state discussions. CNL will be engaging with Sagkeeng and other Indigenous Nations on end-state planning and future land use for the WL site. Sagkeeng has indicated that engaging in a workshop and “discussions” re: land use and the end-state of the site, is not a commitment to collaborative development of end land use criteria, thresholds or participation in remediation and rehabilitation of the site.
Sagkeeng expressed interest in the potential for siting of a small modular reactor on the WL site as this has the potential to impact their Aboriginal and treaty rights. This is a site-wide interest.	CNL had a dialogue with the community regeneration partnership, which includes Sagkeeng, on a vision for the WL site that includes the potential for on-going industrial use in some areas of the site, with other areas available for agriculture or recreation. A small modular reactor could potentially fit in the proposed end-state in the area identified as “industrial use.” CNL explained that any new nuclear project on the WL site, such as a small modular reactor, would need to go through a rigorous licensing process that would include Indigenous engagement.	Section 4.2.4.1.6: Next Steps was revised to include a commitment that CNL will engage Sagkeeng on the land use and end-state of the site.	CNL’s perspective is that this interest has been addressed. CNL will engage Sagkeeng on the future land use and end state of the WL site..
Waste Management			
Sagkeeng is concerned that the radioactive waste remaining on the WL site and the radioactive waste being transported off-site will contaminate the environment. Sagkeeng was interested in more detailed information about how much radioactive waste would remain on the WL site and where the radioactive waste being transported off-site will be stored as they want to ensure their Aboriginal and treaty rights to use land and resources near the WL site are not impacted. This is both a project-specific and site-wide concern.	CNL explained that all waste materials produced at the WL site are sorted, characterized, verified, and packaged into licensed containers for transport. Sagkeeng was informed that the vast majority of radioactive materials from the WL site will be transported to the Chalk River Laboratories (CRL) site in Ontario for interim storage or disposal in the proposed Near Surface Disposal Facility. This disposition pathway remains contingent upon the EA for the Near Surface Disposal Facility Project, which is currently underway. Approximately 2,800 m^3 (4,000 Mg) of radioactive waste will remain in the WR-1 disposal facility and approximately 3,000 m^3 (5,400 Mg) of radioactive waste from the WR-1 building will be transported to the CRL site. For waste remaining in the WR-1 disposal facility, the Project incorporated multiple engineered barriers into the ISD design to ensure the radioactive waste does not contaminate the environment and the EIS assessed the Project’s impact on the environment and determined the environment will remain safe. Likewise, the Waste Management Area trenches will undergo a rigorous safety assessment to ensure the safety of the environment. Depending on the type waste may be transported to a licensed hazardous waste management facility. Shipping of used fuel and waste from projects outside of WR-1 have been assessed in the Comprehensive Study Report and are out of the scope of this Project’s assessment. New facilities have recently been built at the WL site to temporarily store radioactive waste generated from decommissioning activities until they can be shipped to the CRL site. CNL explained that any shipment of nuclear materials is a highly regulated process. CNL has procedures in place to ship the waste in accordance with the federal Packaging and Transport of Nuclear Substances Regulations. CNL maintains a response plan and team that works together with the Transport Canada emergency services to respond to any road accident involving nuclear materials.	EIS assessments concluded there would be no impact on the environment through the EIS assessment as documented in Section 9.3: Summary. CNL confirmed that the risks resulting from transportation of Project radiological waste off-site are already captured and assessed in Section 7.3.4: Off-site Transportation Accidents. The assessment indicates that the risk and consequence severity of transportation accidents involving nuclear materials is low due to existing controls on transport of nuclear materials and the requirements for waste packaging. No changes to the assessment were required. CNL updated Section 3.4.8: Waste Generation and Management with a reference to the Detailed Decommissioning Plan as this is where the waste volume estimates are documented.	CNL has answered this question in detail. CNL acknowledges that waste management is an ongoing area of concern, will continue to respond to questions as they may arise, and will be working to resolve them with Sagkeeng and AECL through the Technical Working Group.

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	CNL explained that the WL site possesses over 50 years of experience in shipping and receiving radioactive material and have never experienced an incident that compromised the safety of workers, the public, or the environment.		
Sagkeeng expressed interest in CNL's waste transportation methods and how information about waste transportation is communicated to potentially affected communities. Sagkeeng is concerned about a potential waste transportation accident impacting human health and the environment. This is a project-specific and site-wide concern.	CNL explained that waste is transported in packages that are selected based on the nature, form, and quantity or radioactivity of the waste. There are design requirements that apply to all package types to ensure that they can be handled safely and easily, secured properly, and are able to withstand routine transport conditions. There are also federal regulations for how nuclear materials can be shipped and CNL maintains a set of procedures for packaging and transporting nuclear materials. CNL explained that it maintains a response plan and team that works together with the Transport Canada emergency services to respond to any road accident involving nuclear materials. CNL explained that the WL site possesses over 50 years of experience in shipping and receiving radioactive material and have never experienced an incident that compromised the safety of workers, the public, or the environment. The EIS assessed the risks resulting from transportation of Project waste off-site and determined that the risk and consequence severity of transportation accidents involving nuclear materials is low due to existing controls on transport of nuclear materials and the requirements for waste packaging. For security reasons, information about individual shipments of nuclear materials is kept confidential. CNL explained that the proposed ISD of the Project requires far less shipping of nuclear materials to interim storage, as it provides a securely designed disposal facility for the most radioactive parts of the WR-1, thus helping to ensure public safety.	CNL confirmed that the risk and consequence severity of transportation accidents involving nuclear materials was assessed to be low in Section 7.3.4: Off-site Transportation Accidents. CNL confirmed in Section 2.5.4: Assessment of Alternatives that the proposed ISD alternative reduces the overall amount of radioactive waste shipment compared to the original full dismantling proposal.	CNL has responded to this concern in detail. CNL acknowledges that waste transportation is an ongoing area of concern and will continue to respond to ongoing questions as they may arise and will be working with Sagkeeng and AECL through the Technical Working Group to resolve them.
Sagkeeng was interested in how water treatment on the WL site worked as they want to ensure the Winnipeg River is safe downstream of the site and protect their Aboriginal and treaty rights to use the river. This is a site-wide interest.	CNL explained how various potentially radiologically-contaminated water effluent streams on site are collected, tested, and treated before they are released back to the Winnipeg River through the outfall station, where the water is tested again. Additionally, the WL site maintains a lagoon system to treat water from domestic drains (sinks, toilets, showers, laundry). CNL documents water testing results and releases to the river from the site outfall station in an annual compliance report that is available to the public and Indigenous communities.	Section 3.2.2.4: Active Drainage System was revised to clarify the description of the waste water treatment process in the WR-1 building and the sources of potentially radioactive liquid waste.	CNL's perspective is that this interest has been addressed.
Future Monitoring			
Sagkeeng expressed a keen interest in knowing more about and participating in future site monitoring, including providing input on additional fish and water monitoring locations relevant to Sagkeeng. Sagkeeng wants to ensure the Winnipeg River and the fish are safe, and protect their Aboriginal and treaty rights to fish and use the river. This is both a project-specific and site-wide interest.	CNL explained the current WL site-wide environmental monitoring program and the proposed future monitoring program for the Project. CNL will continue operating its site-wide monitoring program that currently tests fish at one upstream and two downstream locations from the WL site. Fish monitoring carried out to date has shown that the fish have been safe to consume, with the monitoring results provided in an annual report available to the public. CNL explained that after WR-1 is decommissioned, the only way contamination could enter the environment is through releases to groundwater and groundwater movement to the Winnipeg River. CNL undertook a detailed analysis of how the WR-1 disposal facility will perform in the long-term and determined that based on the negligible amounts of radioactivity or hazardous materials released to the environment, no measurable health effects are predicted and all doses to humans and animals are orders of magnitude below federal guidelines. CNL plans to monitor the expected performance of the WR-1 disposal facility using groundwater monitoring wells for at least 100 years, at which point the performance of the facility is expected to be confirmed. CNL will stop monitoring only when the CNSC finds it acceptable. To enable this monitoring, CNL has created a monitoring well network, which will be used to detect any movement of radioactive or hazardous materials from the WR-1 disposal facility towards the river. CNL has already committed to additional groundwater monitoring well(s) as recommended during Indigenous engagements. Because the earliest way to detect emissions from the facility is through groundwater monitoring, CNL does not intend to test the river water specifically for the WR-1 facility. However, river water monitoring as part of the overall WL site monitoring will continue as part of the overall site closure monitoring to confirm that there are no residual effects on the environment from historic operation of the WL site. Additionally, CNL has committed to an independent Sagkeeng Community Environmental Monitoring Program through the Technical Working Group that will incorporate country food monitoring and risk communication.	Sections 6.7.1.7: Residual Effects Analysis and 6.7.2.7: Residual Effects Analysis describe the pathways by which releases can get into the environment. Section 11.0: Summary of Monitoring and Follow-up Programs was updated to better describe the current proposal for the closure and post-closure monitoring activities, integration of the Project monitoring into the existing site-wide program, and commitments to include Indigenous Nations in ongoing environmental monitoring. CNL has specifically revised Section 11.4: Indigenous Engagement and Participation in Environmental Monitoring to include its commitment to an independent Sagkeeng Community Environmental Monitoring Program.	CNL's perspective is that this concern will be addressed through development and implementation of Sagkeeng's independent Community Environmental Monitoring Program.

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Sagkeeng expressed concern with CNL's environmental monitoring due to a lack of Indigenous knowledge, explaining that Indigenous environmental monitoring is a critical element of Sagkeeng's stewardship and Indigenous-led risk communication with members. Sagkeeng requested a commitment from CNL for an independent, long-term future monitoring program to be designed and led by Indigenous peoples, including Sagkeeng. Sagkeeng wants to ensure the environment is safe and protect their Aboriginal and treaty rights to use lands and resources near the WL site. This is both a project-specific and site-wide concern.	CNL and Sagkeeng have agreed that incorporation of Indigenous knowledge and Sagkeeng's participation in the monitoring program could help address concerns and reduce the fear and stigma associated with the proposed ISD of WR-1. CNL has committed to reviewing and adapting the existing EA Follow-up Program for the WL site to incorporate Indigenous traditional knowledge that has been collected through the EA for the Project. Based on Indigenous feedback, CNL has adjusted its environmental monitoring to include collecting and analyzing mushrooms. CNL continues to look for additional ways to improve their environmental monitoring, including participation in monitoring by Sagkeeng. CNL has committed to an independent Sagkeeng Community Environmental Monitoring Program through the Technical Working Group that will incorporate country food monitoring and risk communication.	Section 11.2: Adaptive Management was revised with the commitment to review and adapt the existing EA Follow-up Program to incorporate Indigenous traditional knowledge and expand the program to include monitoring of traditional foods as identified by Indigenous peoples. Section 11.4: Indigenous Engagement and Participation in Environmental Monitoring was added to outline ongoing engagements and commitments to support meaningful discussion on the monitoring and follow-up programs, and includes CNL's commitment to an independent Sagkeeng Community Environmental Monitoring Program .	CNL's perspective is that this concern will be addressed more fully through development and implementation of Sagkeeng's Community Environmental Monitoring Program.
Sagkeeng is concerned that WR-1's close proximity to the river will contaminate the river and the fish in the long-term. Sagkeeng wants to ensure their Aboriginal and treaty rights to fish and use the river are not impacted by the Project. This is a project-specific concern.	CNL acknowledges the importance of fish, fish habitat and the Winnipeg River to Sagkeeng as it pertains to the exercise of Aboriginal and Treaty Rights. CNL engaged with Sagkeeng on their list of VCs and confirmed fish and fish health were included in the EIS assessment. CNL included the Winnipeg River as a VC in its assessment. CNL has modelled the long-term performance of the WR-1 disposal facility for both the expected evolution of the site and extreme events and in both cases, the assessment indicates no measurable effect on water quality or fish. CNL has committed to an independent Sagkeeng Community Environmental Monitoring Program through the Technical Working Group that will incorporate country food monitoring and risk communication.	CNL confirmed there have been no measurable effects on water quality or fish. CNL also confirmed that the assessment predicts no impact to the water quality (Section 6.4.2.7.2: Application Case Results) or fish (Section 6.7.2.7.2.2: Results) and fish habitat (Section 6.5.6.2.2: Secondary Pathways). Section 11.4: Indigenous Engagement and Participation in Environmental Monitoring was added to outline ongoing engagements and commitments to support meaningful discussion on the monitoring and follow-up programs, and includes CNL's commitment to an independent Sagkeeng Community Environmental Monitoring Program .	CNL's perspective is that this concern will be addressed through development and implementation of Sagkeeng's Community Environmental Monitoring Program . Sagkeeng notes that this issue is related not just to monitoring but also to the different approaches preferred by Sagkeeng (Full Removal) and CNL (ISD) for WR-1 decommissioning, which have differential long-term effects on real and perceived risk of contamination of fish and the Winnipeg River..
Sagkeeng expressed concern about perceived deterioration of fish quality in the Winnipeg River since establishment of the WL site, noting observation of unusual sores on some fish. Sagkeeng expressed interest in being more involved in water quality and fish monitoring on-site. Sagkeeng wants to ensure their Aboriginal and treaty rights to fish and use the river have not been impacted. This is a site-wide concern.	CNL has been testing fish upstream and downstream of the WL site for decades and testing shows that the radioactivity (< 0.001 mGy/d) is well below the benchmark recommended by the CNSC (0.6 mGy/d). CNL provided Sagkeeng with information on the Winnipeg River Task Force; the information provided included the following: • In late 1994, the Winnipeg River Task Force was created. Representatives from Indian and Northern Affairs Canada, Environment Canada, Health Canada, and Sagkeeng took part in the Task Force. • The objective of the Task Force was to look at potential sources of Winnipeg River water quality degradation near the community of Sagkeeng. • The Task Force report concluded that the drinking water quality met Canadian guidelines and that it was unlikely that the WL site had ever posed or would pose a significant threat to the health of Sagkeeng community members. The CNSC conducted an independent monitoring campaign in 2017 with assistance from Sagkeeng. This independent program included collecting and analyzing fish caught near Sagkeeng. The results of the assessment conclude that the public and the environment in the vicinity of WL are protected and there are no expected health impacts. CNL has committed to an independent Sagkeeng Community Environmental Monitoring Program through the Technical Working Group that will incorporate country food monitoring and Indigenous-led risk communication.	Section 6.5.5.2.3: Radioactivity in Fish was revised to compare fish testing results with an applicable benchmark. Section 11.4: Indigenous Engagement and Participation in Environmental Monitoring was added to outline ongoing engagements and commitments to support meaningful discussion on the monitoring and follow-up programs, and includes CNL's commitment to an independent Sagkeeng Community Environmental Monitoring Program . CNL documented the engagements with Sagkeeng on water quality and fish monitoring in Section 4.2.4.1.1: Engagement to demonstrate CNL's desire to include Sagkeeng in these programs.	CNL's perspective is that this concern will be addressed more fully through development and implementation of Sagkeeng's Community Environmental Monitoring Program and an Indigenous-led Risk Communication Program.

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Regulatory Process			
Sagkeeng expressed concern regarding limited funding provided by the CNSC for review and participation in the Project. Sagkeeng expressed interest in further opportunities for involvement in the Project. This is a project-specific concern.	In order to enable meaningful engagement on the Project, CNL provided capacity funding and support to Sagkeeng beyond the funding provided by the CNSC, and committed to providing funding to Sagkeeng as needed throughout the EIS review process. Examples include, but are not limited to the following: ▪ Access to CNL technical experts. ▪ Reimbursement of reasonable out-of-pocket expenses to participate in engagement activities such as site visits, tours, regional community open houses, and Indigenous community open houses. ▪ CNL entered into seven contribution agreements with Sagkeeng to help fund participation. To date, funds have supported legal counsel, consultants to review the EIS on Sagkeeng's behalf, support for a traditional knowledge study, other technical studies, stipends for a food intake study, benchmarking, ceremony, and other community-based events. ▪ CNL supported a three-day alternative means assessment workshop and supported a Sagkeeng-led alternative means study. ▪ CNL provided top-up funding to the CNSC-supported Psychosocial Impacts Assessment Report. Additional efforts in support of involvement can be read in the topics of Relationship Building and Engagement above in this Table.	Section 4.2.4.1.1: Engagement documents engagement activities with Sagkeeng and the funding provided for Sagkeeng's participation in the Project. Various EIS sections were sent to Sagkeeng for review and feedback; CNL worked to address or incorporate Sagkeeng's feedback where appropriate.	CNL has taken steps to address this concern and will be working with Sagkeeng and AECL through the Technical Working Group to further involve Sagkeeng in the Project.
Sagkeeng is concerned that the Project is being evaluated under CEAA 2012 and not the 2019 Impact Assessment Act (IAA). This is a project-specific concern.	Sagkeeng and CNL have discussed the matter of the regulatory review process, and the parties recognize that CNL has no authority to make any requested changes related to the regulatory process and will proceed with the environmental assessment under CEAA 2012. While the Project is being reviewed within CEAA 2012 legislation, CNL has made efforts to exceed these requirements and move towards the requirements of IAA (2019). CNL acknowledges that the long-term presence of nuclear materials in the region has the potential to result in fear, stigma, and anxiety, and has included psychosocial effects as a legitimate impact pathway to reflect Sagkeeng's concerns in the assessment.	Section 1.6.1: Federal Review Process explains why the EA for the ISD of WR-1 will continue under CEAA 2012. Section 6.9.6.2.2: Secondary Pathways was revised to acknowledge that the long-term presence of nuclear materials in the region has the potential to result in fear, stigma, and anxiety, and to include psychosocial effects as a legitimate impact pathway.	CNL and Sagkeeng continue to disagree on the approach taken on the regulatory approval process for the project and no resolution is imminent. The Project will continue under CEAA 2012 while working to exceed requirements and work collaboratively with Sagkeeng to address their concerns. Sagkeeng continues to consider this issue as outstanding because several aspects of the assessment did not meet requirements that would have been required had it been conducted using requirements of IAA 2019 (e.g., but not limited to, inclusion of impacts on Indigenous health, social and economic well-being beyond those caused by physical changes to the environment).
Sagkeeng is concerned that the Project may impact the environment in the future. Sagkeeng was interested in understanding how the WR-1 facility will be grouted, how it will maintain its long-term integrity and safety, and the potential for and impact of climate change and natural disasters as they want to ensure their Aboriginal and treaty rights to use lands and resources near the WL site are not impacted in the future. This is a project-specific concern.	CNL explained the process used to design the grout recipe, the extensive testing carried out, and the plans for how the facility will be grouted. CNL also clarified that the key to long-term safety and performance of the grouted facility is the fact that a significant portion of the contaminants are contained in the metals of the reactor, which will corrode very slowly and prevent major releases of contaminants to the environment. Barriers such as the foundation walls, grout, and the concrete cap and engineered cover provide additional protection. The specific function of grout is to resist structural subsidence of the facility and resist human intrusion into the facility. CNL explained that the normal evolution of the disposal facility over 10,000 years was assessed as well as any credible abnormal event or disaster that could affect the safety of the disposal facility and subsequent safety of the human and ecological environment around it. The assessment included climate change forecasts in the normal evolution scenario and considered the effects of an unlikely major seismic event. CNL confirmed that even if some future event, including climatic or natural disaster, causes significant damage to the disposal facility, there would be no negative effects on human and ecological health because there is no credible event that can cause faster release of contaminants from reactor metals.	CNL has been working on finalizing the grout recipe and placement designs, and carrying out additional testing. Sections 3.4.6.2: Grouting of Below-Grade Structures and Systems and 3.4.9.1.2: Grout were revised to update the description of the grout material and placement methods with the latest design and testing work. CNL confirmed the long-term safety of the WR-1 disposal facility against climate change and natural disasters in Section 10.0: Assessment of Effects of the Environment on the Project. CNL also confirmed that the assessment scenarios in Section 6.7.1.7.2.2: Results encompass the potential effects of natural disasters described in Section 10.0: Assessment of Effects of the Environment on the Project and that human and ecological health are protected even under severe adverse conditions such as glaciation, earthquakes, or rapid degradation of materials.	CNL has answered all questions related to this area of interest, but recognizes that this is an ongoing area of interest. CNL will be working with Sagkeeng and AECL through the Technical Working Group to respond to any further concerns related to the grouting.

Key Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
Sagkeeng is concerned that the Project may impact the environment. Sagkeeng members expressed interest in the existence of similar ISD projects, the cost differences between full removal and ISD, and the safety of ISD in connection with the environment as they want to ensure their Aboriginal and treaty rights to use lands and resources near the WL site are not impacted in the future. This is a project-specific concern.	CNL explained that the design and assessment of the ISD of WR-1 incorporates all applicable Canadian regulations as well as guidelines and best practices used at similar decommissioning projects internationally. CNL explained that while this type of decommissioning has not yet been undertaken for a reactor in Canada, there are reactors around the world that have been decommissioned in a similar in situ process. CNL has shared a list of these projects with Sagkeeng. Other countries, such as the United Kingdom, are assessing ISD for suitable legacy sites. CNL visited the United States Department of Energy's Savannah River site in Georgia that was decommissioned using the ISD methods. CNL looked at the lessons learned from these sites and the monitoring programs/ processes in place and incorporated a number of the lessons learned into the WR-1 ISD design, particularly on the grout development. CNL organized a site tour of an in situ disposed (entombed) reactor in Hallam, Nebraska and provided the opportunity for Sagkeeng and other Indigenous Nations to participate. CNL provided information on costs associated with ISD as well as other alternatives, including costs for ongoing and future monitoring.	CNL considered international guidelines and best practices when preparing and assessing the design of the ISD as described in Section 3.0: Project Description of the Decommissioning Safety Assessment Report. Section 2.5.4.3.1: Technical provides some information on other reactors around the world that have undergone ISD. CNL provided the cost differences between all feasible alternatives in Section 2.6.2: Economic Feasibility.	CNL has addressed this concern to the extent practical at this time. Future engagement on this topic is not anticipated to change the outcome of the assessment; however, CNL is open to further discussions with Sagkeeng.
Sagkeeng expressed concerns about incidents and accidents that affect the decommissioning of WR-1 or the safety of the WR-1 disposal facility after closure. These incidents and accidents can affect the safety of people and the environment, and could affect Sagkeeng's Aboriginal and treaty rights to use lands and resources near the WL site. This is a project-specific concern.	CNL shared with Sagkeeng that they had assessed the accidents and malfunctions that could occur during the process of decommissioning WR-1 and construction of the disposal facility. The assessment indicates that existing CNL health and safety, and work control procedures adequately address the risks and that CNL has sufficient programs in place to address any likely accident. CNL explained that the normal evolution of the disposal facility over 10,000 years was assessed as well as any credible abnormal event or disaster that could affect the safety of the disposal facility and subsequent safety of the human and ecological environment around it. The assessment included climate change in the normal evolution scenario and considered the effects of unlikely events, such as a major earthquake or glaciation.	CNL confirmed that the assessment scenarios in Section 6.7.1.7.2.2: Results encompass the potential effects of various disruptive events, human actions and natural disasters, and that human and ecological health are protected even under severe adverse conditions such as glaciation, earthquakes, or rapid degradation of materials. CNL updated Section 7.0: Accidents and Malfunctions to clarify the analysis of accidents and malfunctions during closure.	CNL has addressed this concern to the extent practical at this time. Future engagement on this topic is not anticipated to change the outcome of the assessment; however, it may result in additional commitments to Sagkeeng.
Traditional Knowledge and Land Use and Cultural Heritage			
Sagkeeng expressed interest in conducting a traditional use study as they identified traditional uses, specifically collecting wild rice and medicinal plants, in proximity to the Project study area and the larger WL site. Sagkeeng wants to ensure their interests and Aboriginal and treaty rights are well understood by CNL and adequately assessed for impacts from the Project. This is a project-specific interest.	CNL supported Sagkeeng's Traditional Knowledge Land Use and Occupancy Study and incorporated the findings into the updated draft EIS. The study helped CNL confirm that its assessment VCs, physical boundaries, pathways, and receptor models (harvester specifically) are appropriately representing the interests and practices of Indigenous peoples in the area. CNL sent draft sections of the EIS to Sagkeeng for their review and comment, and incorporated Sagkeeng's feedback into the updated draft EIS where appropriate.	CNL used Sagkeeng's TKLUS to validate the Traditional Harvester model in Sections 6.7.1.7.1: Application Case – Closure Phase and 6.7.1.7.2: Application Case – Post-closure Phase of the assessment. CNL revised the assessment boundaries for the Land and Resource Use assessments in Section 6.8: Land and Resource Use based on Sagkeeng's feedback to expand the RSA to extend downstream of the Winnipeg River and beyond the outlet into Lake Winnipeg. CNL also confirmed that this Land and Resource Use assessment boundary encompasses all of the other EA boundaries in Sections 6.2: Atmospheric Environment through 6.7: Human and Ecological Health. CNL revised Section 6.8.1.5.2.2.1: Historical and Present Day Traditional Land Use to provide additional information on traditional land use by Sagkeeng and include discussion of impacts on communities as a result of establishment of the WL site, among other developments in the area.	Sagkeeng stated this interest remains outstanding as Sagkeeng has identified that the draft EIS likely underestimates impacts on Sagkeeng traditional land and resource use and cultural heritage, and has noted that CNL has made only partial revisions to the noted sections which do not reflect the entirety of Sagkeeng's comments and proposed revisions. CNL will await the outcome of CNSC's Rights Impact Assessment for Sagkeeng and will continue working with Sagkeeng and AECL through the Technical Working Group to seek a resolution.
Sagkeeng expressed interest in conducting a traditional knowledge study, explaining that it would be a useful resource for the Species-at-Risk Field Guide used by CNL Environmental Monitoring. Sagkeeng wants to ensure that species of importance to Sagkeeng are accounted for and protected, and that their Aboriginal and treaty rights for wildlife harvesting are protected. This is both a project-specific and a site-wide interest.	CNL supported Sagkeeng's Traditional Knowledge Land Use and Occupancy Study and incorporated the findings into the updated draft EIS. CNL incorporated Sagkeeng's feedback on the revised effects assessment sections that were revised to include a summary of how Indigenous VCs were considered in the assessment. CNL shared both hard copies and a digital copy of their Species-at-Risk Field Guide with Sagkeeng for review and feedback. CNL and Sagkeeng are currently in the process of expanding Sagkeeng's participation in monitoring at the site, which will include integration of traditional knowledge into CNL's existing program. To help address Sagkeeng's broader concern on ensuring that species of importance to Sagkeeng are protected, CNL committed to collaboratively developing a Sagkeeng Community Environmental Monitoring Program that includes integrating traditional knowledge into CNL's own Environmental Protection Program as well as risk communication.	CNL revised Section 4.2.4.1.2: Interests and Concerns to include the following commitment: *"CNL committed to establishing a Community Environmental Monitoring Program with Sagkeeng. CNL has agreed to work with Sagkeeng through a Technical Working Group to establish this Community Environmental Monitoring Program that will include Indigenous risk communication and country foods monitoring with Sagkeeng members."* CNL revised Section 11.2: Adaptive Management to include a commitment to review and adapt the existing Environmental Monitoring programs to include traditional knowledge and monitoring of animals and foods significant to local Indigenous Nations.	This interest remains outstanding until the mitigations and commitments are in place. CNL has committed to support the development of Sagkeeng's Community Environmental Monitoring Program. Further engagement on this topic is not expected to have an impact on the assessment or its conclusions. .

Key Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
Alternative Means Assessment			
Sagkeeng expressed concern that CNL's alternative means assessment does not adequately consider Sagkeeng's unique values and criteria or the psychosocial impact of ISD. CNL's alternatives means study arrives at an alternative that is not acceptable to Sagkeeng and deviates from the full dismantling approach proposed in the 2001 Comprehensive Study Report. Only full and immediate dismantling is accepted by Sagkeeng. Sagkeeng is concerned that the proposed ISD of WR-1 does not fully remove the danger and liability from the WL site and does not return the land for traditional use and practice of Aboriginal and treaty rights. This is a project-specific concern.	To understand Sagkeeng's unique values and criteria regarding the WR-1 alternative means assessment, CNL held an alternative means workshop, teleconferences, and in-person meetings with Sagkeeng to discuss the alternative means assessment for WR-1. CNL explained the alternative means assessment to Sagkeeng and acknowledged Sagkeeng's concerns and strong preference for full dismantling of WR-1 instead of the proposed ISD. CNL has shared with Sagkeeng findings that point to ISD as an appropriate approach because of its effectiveness to reduce the nuclear liabilities at the WL site by disposing of the WR-1 in a design-reviewed, safety-assessed facility without the need for major demolition and nuclear waste extraction and transportation work. To better understand Sagkeeng's position and provide Sagkeeng an opportunity to meaningfully express their values and preferred alternatives, CNL supported a Sagkeeng-led Alternative Means Assessment Report. CNL also supported Sagkeeng's Traditional Knowledge Land Use and Occupancy Study and incorporated the findings into the EIS. These studies were important to CNL's assessment because they provided insight into Sagkeeng culture and values, and provided clarity on the historical and contemporary interests of Sagkeeng, including VCs. CNL reviewed and documented the findings from these studies in its assessment to demonstrate that it has considered Sagkeeng's values. CNL's used Sagkeeng's Alternative Means Assessment to conduct a critical review and reflection of CNL's own alternative means assessment and working assumptions. CNL concluded that its own alternative means assessment and findings remain valid because the proposed ISD approach fulfills the wider objectives for the project than simply removing the radioactive material from the WL site. CNL revised the draft EIS in Section 2.0: Alternative Means by including a new subsection that focuses on presenting the key finding of Sagkeeng's Alternative Means Assessment and CNL's consideration of the report. CNL also revised Section 4.0: Indigenous Engagement to clearly state Sagkeeng's preferred preference towards full dismantlement. These additions were reviewed by Sagkeeng and CNL incorporated Sagkeeng's revisions into the draft EIS. CNL has been clear that full dismantling, as described in the 2001 Comprehensive Study Report, is not a guarantee of removal of all waste from the WL site because there currently is no available storage facility at the CRL site. Dismantling will therefore not ensure immediate removal of waste from the site, full access to the lands, or necessarily a reduction in stigma. CNL also reviewed its assessment against Sagkeeng's TKLUS and updated the assessment modelling with traditional knowledge and specific Sagkeeng values from the TKLUS. The assessment confirmed that the ISD alternative is not predicted to have a measureable effect on the environment.	CNL created Section 2.8: Sagkeeng's Alternative Means Assessment – Approach and Findings that outlines Sagkeeng's Alternative Means Assessment. Section 2.8.5: CNL Consideration of Sagkeeng's Alternative Means Assessment provides a detailed description of how CNL considered Sagkeeng's Alternative Means Assessment. CNL documented Sagkeeng's preference for complete removal of WR-1 and the outcomes of the Sagkeeng-led Alternative Means Assessment in Section 2.8. CNL validated the Traditional Harvester model in the assessment using Sagkeeng's TKLUS in Sections 6.7.1.7.1: Application Case – Closure Phase and 6.7.1.7.2: Application Case – Post-closure Phase. CNL revised Section 6.8.1.5.2.2.1: Historical and Present Day Traditional Land Use to provide additional information on traditional land use by Sagkeeng and include discussion of impacts on communities as a result of establishment of the WL site, among other developments in the area. CNL confirmed through its assessment of Human and Ecological Health (Section 6.7), Land and Resource Use (Section 6.8) and Socio-economic Environment (Section 6.9) that no significant adverse effects are anticipated on Sagkeeng's interests, Aboriginal and treaty rights, or land use practices.	CNL has responded to this concern by carefully considering Sagkeeng feedback and their Alternative Means Assessment. CNL respects that Sagkeeng has an independent and different opinion on the most suitable decommissioning approach for WR-1, and that therefore this is an outstanding issue. CNL maintains that the proposed ISD alternative is its preferred option and will await the outcome of the CNSC's decision on the Project.
Sagkeeng is concerned that their interests and Aboriginal and treaty rights are not being fully considered and protected by the proposed WR-1 ISD Project. Sagkeeng wants Canada to honour its prior commitment to remove the radioactive wastes from Sagkeeng lands and expressed the position that the WR-1 ISD Project is inconsistent with the federal government's commitment to meaningful reconciliation with Indigenous peoples. This is a project-specific concern.	Through engagement with Sagkeeng, CNL provided that the current EA and licence application for the ISD of WR-1 was completed with the full intent of securing the radioactive waste and ensuring that the safety, interests, and Aboriginal and treaty rights of Indigenous Nations are fully considered and protected using a safe decommissioning approach and international best practices. CNL has considered all potential physical effects and impacts from the WR-1 disposal facility in its EA, which concluded that adverse effects on human or ecological health, or the socio-economic conditions of the surrounding communities are not likely. Therefore, CNL does not believe that Aboriginal and treaty rights will be impacted, but defers to the CNSC who will make a determination regarding impact to Aboriginal and Treaty rights. To better understand Sagkeeng's position and provide Sagkeeng an opportunity to meaningfully express their concerns and preferred alternatives, CNL supported a Sagkeeng-led Alternative Means Assessment. CNL's review of Sagkeeng's Alternative Means Assessment provided a critical review and reflection of CNL's own alternative means assessment and working assumptions. CNL concluded that its own alternative means assessment and findings remain valid because the proposed ISD approach fulfills the wider objectives for the project than simply removing the radioactive material from the WL site. CNL revised the draft EIS in Section 2.0: Alternative Means by including a new subsection that focuses on presenting the key finding of Sagkeeng's Alternative Means Assessment and CNL's consideration of the report. CNL is committed to meaningful engagement with Indigenous peoples and is committed to continuing to develop its relationship with Sagkeeng to help address Sagkeeng's concerns with the Project. To support Sagkeeng's involvement in the Project, a Technical Working Group between AECL, CNL, and Sagkeeng has been established to implement the following initiatives: ▪ Development of a Community Liaison Committee. ▪ Development of a healing and resiliency plan. ▪ Development of a leadership table among Sagkeeng, AECL, and CNL. ▪ Development of a meaningful Sagkeeng Community Environmental Monitoring Program at and around the WL site. Sagkeeng and CNL signed an agreement to support the Technical Working Group and the development of the initiatives listed above.	CNL confirmed through its assessment of Human and Ecological Health (Section 6.7), Land and Resource Use (Section 6.8) and Socio-economic Environment (Section 6.9) that no significant adverse effects are anticipated on the environment or the public. CNL also documented Sagkeeng's preference for complete removal of WR-1 and the outcomes of the Sagkeeng-led Alternative Means Assessment in Section 2.8 Sagkeeng's Alternative Means Assessment – Approach and Findings. CNL revised Section 4.2.4.1: Sagkeeng First Nation to include CNL's commitment to working with Sagkeeng through the Technical Working Group to develop and implement initiatives that would help address Sagkeeng's concerns on the Project.	CNL has responded to this concern and awaits the outcome of the CNSC's rights impact assessment to determine whether further action is required. CNL recognizes that Sagkeeng considers this issue to be outstanding, given Sagkeeng has predicted residual adverse effects on traditional land and resource use and culture in the Project case, which have not been incorporated into the EIS. In addition, Sagkeeng has noted that commitments made re: a Healing and Resiliency Action Plan require more detail before their value as mitigation for impacts on Sagkeeng values can be stated with confidence.

1.3.3 Manitoba Metis Federation (MMF) Engagement

Date	Activity	Attendance	Description	Key EA Topics1									
				Baseline Conditions	Alternative Means	Project Components	Effects Assessment2	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Interests and Concerns	Engagement Methods
August 3, 2016	Letter from CNL to multiple communities	Sagkeeng First Nation Brokenhead Ojibway Nation Black River First Nation Hollow Water First Nation Shoal Lake #40 First Nation Iskatewizaagegan #39 Independent First Nation (Shoal Lake #39 First Nation) Wabaseemoong Independent Nations Manitoba Metis Federation Grand Council of Treaty 3	Project Introductory Letter and request for community input on any potential adverse impacts from project activities.			✓							✓
November 30, 2016	Meeting	4 representatives from MMF 3 representatives from CNL 2 representatives from CNL contractor	Introductions of the MMF and the CNL representatives and discussion of the preliminary concerns and how MMF would like to be involved in the future.	✓		✓							✓
February 9, 2017	Meeting	3 representatives from MMF 4 representatives from CNL 1 representative from CNL contractor	Teleconference for Project updates. Input from Manitoba Metis Federation.			✓		✓					
July 26, 2017	Conference Call	2 representatives from MMF 2 representatives from CNSC 2 representatives from CNL 1 CNL Contractor	CNSC-led engagement. Meeting to discuss MMF Proposal for Engagement.										✓
October 5, 2017	Letter from CNL to multiple communities	Sagkeeng First Nation Brokenhead Ojibway Nation Black River First Nation Hollow Water First Nation Shoal Lake #40 First Nation Iskatewizaagegan #39 Independent First Nation (Shoal Lake #39 First Nation) Wabaseemoong Independent Nations Manitoba Metis Federation Grand Council of Treaty 3	Notification of public comment period on the draft EIS and invitation to engage.										✓
October 23, 2017	MMF-CNSC-CNL teleconference Meeting to Discuss MMF Budget for the Project	2 members from MMF 2 representatives from CNL 2 representatives from CNSC	Teleconference to discussing MMF Budget for WR-1 Decommissioning Project.										✓

1 Per CNSC guidance laid out in E-DOC # 6467843, 2021.
2 including VC, spatial and temporal boundaries for the assessment

Date	Activity	Attendance	Description	Key EA Topics1									
				Baseline Conditions	Alternative Means	Project Components	Effects Assessment2	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Interests and Concerns	Engagement Methods
November 7, 2017	Site tour and meeting with MMF	3 members from MMF 3 representatives from CNL 2 representatives from AECL 3 representatives from CNSC	Tour of WR-1 site followed by a meeting. CNL presented on the WR-1 status, decommissioning approach, EIS, public engagement and Environmental Risk Assessment. AECL presented on the history of AECL and AECL today. CNSC presented and provided update on CNSC's mandate, the licence renewal and Approach to Aboriginal Consultation. The MMF provided updates.			✓	✓	✓	✓	✓			
December 6, 2017	First recurring monthly meeting with MMF, CNL, CNSC.	3 representatives from MMF 3 representatives from CNL 3 representatives from CNSC	First recurring monthly meeting with MMF, CNL, CNSC.			✓							✓
December 14, 2017	Letter from CNL to Manitoba Metis Federation	CNL Manitoba Metis Federation	Commitment letter to MMF.										✓
February 12, 2018	MMF Community Consultation Meeting	55 MMF community members 3 representatives from CNSC 3 representatives from CNL	Introductory presentation and informal talk.	✓		✓		✓		✓			
February 27, 2018	Recurring monthly meeting	Manitoba Metis Federation CNL CNSC	Recurring monthly meeting with Manitoba Metis Federation, CNL and CNSC.								✓		
April 3, 2018	Benchmarking trip to Hallam, Nebraska ISD reactor	2 representatives from Black River First Nation 2 representatives from Brokenhead Ojibway Nation 1 representative from Sagkeeng First Nation 2 representatives from Wabaseemoong Independent Nations 2 representatives from MMF	Communities attended the In situ disposal facility in Hallam to learn more about in situ design, monitoring and what the local community thinks. This was a relationship building trip and enabled Indigenous communities to be able to better inform their communities.					✓	✓	✓			
April 24, 2018	Teleconference	3 representatives from MMF 3 representatives from CNL 3 representatives from CNSC	Recurring monthly meeting with MMF, CNL, CNSC								✓		✓
May 22, 2018	Teleconference	3 representatives from MMF 3 representatives from CNL 3 representatives from CNSC	Recurring monthly meeting with MMF, CNL, CNSC.								✓		✓
June 26, 2018	Teleconference	3 representatives from MMF 3 representatives from CNL 3 representatives from CNSC	Recurring monthly meeting with MMF, CNL, CNSC.								✓		✓
August 28, 2018	Teleconference	3 representatives from MMF 3 representatives from CNL 3 representatives from CNSC	Recurring monthly meeting with MMF, CNL, CNSC								✓		✓
October 23, 2018	Teleconference	3 representatives from MMF 3 representatives from CNL 3 representatives from CNSC	Recurring monthly meeting with MMF, CNL, CNSC								✓		✓

Date	Activity	Attendance	Description	Key EA Topics1									
				Baseline Conditions	Alternative Means	Project Components	Effects Assessment2	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Interests and Concerns	Engagement Methods
November 1, 2018	Email	MMF CNL	CNL sent the contribution agreement to support Manitoba Metis Federation's Consumption Surveys Survey Data included in MMF Traditional Knowledge and Land Use Occupancy Study.	✓							✓		✓
November 27, 2018	Teleconference	3 representatives from MMF 3 representatives from CNL 3 representatives from CNSC	Recurring monthly meeting with MMF, CNL, CNSC.								✓		✓
December 20, 2018	MMF WL site meeting	3 representatives from MMF 3 representatives from CNL 3 representatives from CNSC	Tour of WR-1.		✓	✓	✓	✓	✓	✓			
January 10, 2019	Recurring monthly meeting with MMF, CNL, CNSC	3 representatives from MMF 3 representatives from CNL 3 representatives from CNSC	Recurring monthly meeting with MMF, CNL, CNSC.								✓		✓
February 26, 2019	Recurring monthly meeting with MMF, CNL, CNSC	3 representatives from MMF 3 representatives from CNL 3 representatives from CNSC	Recurring monthly meeting with MMF, CNL, CNSC.								✓	✓	✓
March 14, 2019	MMF office meeting	4 representatives from MMF 4 representatives from CNL CNSC via telephone	Meeting in Winnipeg with MMF on TKLUS study actions.								✓		
April 26, 2019	Recurring monthly meeting with MMF, CNL, CNSC	3 representatives from MMF 3 representatives from CNL 3 representatives from CNSC	Recurring monthly meeting with MMF, CNL and CNSC.								✓		✓
May 28, 2019	Recurring monthly meeting with MMF, CNL, CNSC	3 representatives from MMF 3 representatives from CNL 3 representatives from CNSC	Recurring monthly meeting with MMF, CNL, CNSC.								✓		✓
July 22, 2019	Environmental Monitoring	1 representative from MMF 2 representatives from CNL	Safety Orientation for future Environmental Monitoring activities.	✓						✓			
August 1, 2019	MMF Observation of CNL's Environmental Monitoring Program	1 representative from MMF 3 representatives from CNL	MMF observation of CNL's Environmental Monitoring Program - river sampling.	✓						✓			
August 15, 2019	Environmental Monitoring	1 representative from MMF 3 representatives from CNL	MMF observation of CNL's Environmental Monitoring Program - sampling the Lagoon discharge pathway							✓			
September 16, 2020	Invitation	MMF CNL	CNL sent out an invitation to community members to attend the breakfast session on development and test results of the WR-1 grout.			✓		✓					
September 26, 2019	Teleconference	3 representatives from MMF 3 representatives from CNL 3 representatives from CNSC	Recurring monthly meeting with MMF, CNL, CNSC.								✓		✓
October 4, 2019	Environmental Monitoring	1 representative from MMF 3 representatives from CNL	MMF observation of CNL's Environmental Monitoring Program - harvesting mushrooms							✓			

Date	Activity	Attendance	Description	Key EA Topics1									
				Baseline Conditions	Alternative Means	Project Components	Effects Assessment2	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Interests and Concerns	Engagement Methods
October 10, 2019	Environmental Monitoring	1 representative from MMF 3 representatives from CNL	MMF observation of CNL's Environmental Monitoring Program - groundwater/well sampling							✓			
October 22, 2019	MMF Celebration of 175th anniversary of Louis Riel's birthday	3 representatives from CNL	Manitoba Metis Federation Celebration of the 175th anniversary of Louis Riel's birthday dinner in Winnipeg.										
November 1, 2019	Teleconference	3 representatives from MMF 2 representatives from CNL 2 representatives from AECL	Meeting with AECL regarding post-closure environmental monitoring.				✓			✓			
November 26, 2019	Teleconference	3 representatives from MMF 3 representatives from CNL 3 representatives from CNSC	Recurring monthly meeting with MMF, CNL, CNSC.									✓	✓
December 3, 2019	MMF Office, Winnipeg	4 representatives from MMF 4 representatives from CNL	Meeting with MMF regarding topics arising from monthly meetings and licence intervention.									✓	
January 28, 2020	Monthly update meeting	MMF CNL CNSC AECL	Monthly update meeting.										✓
March 6, 2020	Monthly update meeting	MMF CNL CNSC	Meeting with CNL, MMF and CNSC.										✓
March 24, 2020	Monthly update meeting	MMF CNL CNSC	Meeting with CNL, MMF and CNSC.										✓
April 27, 2020	Monthly update meeting	MMF CNL CNSC	Meeting with CNL, MMF and CNSC.										✓
May 25, 2020	Monthly update meeting	MMF CNL CNSC	Meeting with CNL, MMF and CNSC.										✓
June 22, 2020	Monthly update meeting	MMF CNL CNSC	Meeting with CNL, MMF and CNSC.										✓
July 6, 2020	On Site Environmental Monitoring	2 representatives from MMF 2 representatives from CNL	MMF observed Waste Shipment from Pre-Job to Loading at the Whiteshell Laboratories Site.									✓	✓
July 6, 2020	In-person Meeting	2 representatives from MMF 2 representatives from CNL	Presentation to MMF on CNL's Transportation of Waste and Emergency Response Capabilities.									✓	
August 20, 2020	E-mail/Letter	2 representatives from MMF 3 representatives from CNL	CNL provided MMF with CNL's responses to MMF comments on the draft 2017 and 2019 EIS.	✓	✓		✓	✓	✓	✓	✓		

Date	Activity	Attendance	Description	Key EA Topics1									
				Baseline Conditions	Alternative Means	Project Components	Effects Assessment2	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Interests and Concerns	Engagement Methods
August 26, 2020	Teleconference	2 representatives from MMF 2 representatives from CNL	Introduced CNL's Indigenous Engagement Officer and discussed comments on Indigenous Advisory Committee – Participation Agreement.										
September 10, 2020	E-mail	2 representatives from MMF 2 representatives from CNL	Provided a list of all fall environmental monitoring activities and invited MMF to participate.							✓			✓
September 17, 2020	On Site Environmental Monitoring	2 representatives from MMF 4 representatives from CNL	MMF participated in mushroom collection with CNL's environmental monitoring team.							✓			
October 14, 2020	Hybrid In-person/teleconference Métis Cultural Awareness Training	1 representative from Louis Riel Institute 21 representatives from CNL 5 invited from CNSC 2 invited from AECL	CNL received Métis Cultural Awareness Training provided by the Louis Riel Institute. Half the participants were in-person while the other half joined online.								✓		
October 20, 2020	On Site Environmental Monitoring	1 representative from Manitoba Metis Federation 4 representatives from CNL	An MMF representative came to site to observe fish processing on site and the environmental monitoring team provided an overview presentation.							✓		✓	
October 26, 2020	Teleconference	2 representatives from MMF 4 representatives from CNL	CNL and the MMF met to discuss MMF's feedback on CNL's comments and CNL's proposed next steps.	✓	✓	✓	✓	✓	✓	✓	✓		
November 26, 2020	Teleconference	4 representatives from MMF 4 representatives from CNL	Teleconference – Workshop #1 CNL hosted a teleconference with the MMF to discuss areas of interest and possible areas of collaboration. The communication protocol MMF recommend CNL follow, in accordance with MMF's resolution #8, was also discussed.									✓	✓
December 17, 2020	E-mail	2 representatives from MMF 1 representatives from CNL	CNL sent the MMF a final round of responses to MMF's comments on the draft EIS.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
January 11, 2021	Invitation	2 representatives from MMF 1 representative from CNL	CNL sent the MMF an invitation to participate in CNL's Virtual Career Fair.									✓	
January 13, 2021	Teleconference	1 representative from MMF 1 representative from CNL	CNL met with the MMF to book upcoming workshops. Topics for the workshops include CNL's alternative means assessment, value components, ground monitoring wells, and future environmental monitoring.										✓
January 14, 2021	Teleconference	2 representatives from MMF 2 representatives from CNL	CNL met with the MMF to confirm dates of each of the workshops.										✓
January 25, 2021	E-mail	2 representatives from MMF 2 representatives from CNL	CNL provided the MMF with an advance copy of the draft Indigenous Engagement Report and requested the MMF verify CNL had capture their position, interests, and concerns.								✓	✓	✓
January 27, 2021	Teleconference	2 representatives from MMF 1 representative from CNL	CNL met with the MMF to review the Alternative Means Assessment workshop agenda and discuss review timing of the draft IER.										✓

Date	Activity	Attendance	Description	Key EA Topics1									
				Baseline Conditions	Alternative Means	Project Components	Effects Assessment2	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Interests and Concerns	Engagement Methods
January 29, 2021	E-mail	2 representatives from MMF 2 representatives from CNL	CNL provided a job posting for a summer student at Whiteshell Laboratories.									✓	
February 2, 2021	Teleconference	2 representatives from MMF 2 representatives from CNL	CNL met with the MMF to review the groundwater monitoring well workshop agenda and to discuss existing action items from previous workshops.										✓
February 2, 2021	Email	2 representatives from MMF 1 representatives from CNL	CNL provided details on a potential detection of elevated levels of caesium on site.									✓	
February 9, 2021	Teleconference	10 representatives from MMF 4 representatives from CNL	Technical Working #3 CNL hosted a technical workshop via teleconference with the MMF and their technical staff on technical workshop #3 to discuss the next action items to address MMF's concerns in the EIS comments, specifically regarding ground water monitoring. CNL presented on the characteristics of ground water as well as current and proposed ground water monitoring. CNL included one additional ground monitoring well based on the MMF's feedback.							✓			✓
February 18, 2021	Teleconference	2 representatives from MMF 2 representatives from CNL	CNL and MMF met to discuss environmental initiatives and to discuss whether these initiatives align with CNL and MMF's goals and how best to collaborate on these initiatives moving forward.							✓		✓	✓
March 2, 2021	Teleconference	8 representatives from MMF 4 representatives CNL	Technical Workshop #2 CNL hosted a technical workshop on the Alternative Means Assessment conducted for the WR-1 EIS and CNL's methodology for selecting the Project's VCs.		✓	✓	✓						
March 17, 2021	Teleconference	5 representatives from MMF 5 representatives from CNL	Technical Working #4 CNL hosted a technical workshop to discuss the representation of Metis-specific interests in environmental monitoring.							✓		✓	✓
March 20, 2021	E-mail	2 representatives from MMF 1 representatives from CNL	CNL sent out an invitation to all communities for a WR-1 fact or fiction webinar.	✓	✓	✓	✓	✓	✓				
May 11, 2021	Teleconference	10 representatives from MMF 7 representatives from CNL	Technical Wrap Up Meeting CNL hosted a technical wrap up meeting via teleconference to review status of the action items from the past technical workshops and confirm CNL had adequately taking steps or proposed next steps to help address the MMF's concerns on the Projects	✓	✓	✓	✓	✓	✓	✓	✓		✓
May 13, 2021	Phone Call	1 representative from MMF 1 representative from CNL	CNL reached out to the MMF to schedule two meetings from last workshop's action list. An Environmental monitoring meeting and relationship agreement discussion.									✓	✓

Date	Activity	Attendance	Description	Key EA Topics1									
				Baseline Conditions	Alternative Means	Project Components	Effects Assessment2	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Interests and Concerns	Engagement Methods
May 25, 2021	Teleconference	1 representative from MMF 3 representatives from CNL	CNL and the MMF met to discuss and schedule MMF and Metis citizen scientists' participation in onsite environmental monitoring.									✓	✓
June 2, 2021	Teleconference	2 representatives from MMF 6 representatives from CNL	CNL and the MMF reached out to discuss the relationship agreement and ensure that they are aligned with each other's priorities and give them any required clarification.										✓
June 3, 2021	Teleconference	1 representative from MMF, 3 representatives CNL	CNL met with the MMF in order to provide the MMF with an update on what has been decommissioned to date, where the project is at and what is left over as well as a general refresher as an overview.									✓	✓
June 14, 2021	On Site Environmental Monitoring	2 representatives from MMF, 6 representatives from CNL	MMF environmental monitors came on site to participate in ground water monitoring, Song Bird surveying and turtle searching.									✓	✓
June 17, 2021	E-mail	2 representatives from MMF, 1 representative from CNL	CNL provided the MMF their Summary of Interests and Concerns Table and Valued Components for their verification that their concerns and interests have been captured.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
June 22, 2021	On Site Environmental Monitoring	8 representatives from MMF, 8 representatives from CNL	MMF Staff and MMF Citizen Scientists came on site to partake in the first night of the Bat Survey using acoustic monitoring equipment to determine whether bats are burrowing in the WR-1 Building.									✓	✓
July 12, 2021	E-mail	2 representatives from MMF, 3 representatives from CNL	MMF provided CNL with an updated copy of the Relationship Agreement for their review.									✓	✓
July 13, 2021	On Site Environmental Monitoring	6 representatives from MMF 8 representatives from CNL	Participants from the MMF and MMF citizen scientists came on site to participate in the exit bat survey in order to determine whether bats are burrowing in building 100.									✓	✓
July 14, 2021	On Site Environmental Monitoring	2 representatives from MMF 6 representatives from CNL	Representatives from the MMF and MMF citizen scientists came on site to participate in the exit bat survey in order to determine whether bats are burrowing in building 100.									✓	✓
July 26, 2021	E-mail	2 representatives from MMF, 3 representatives from CNL	CNL provided the MMF with a drafted MOU to support MMF's technical review of their Summary of Interests and Concerns Table										✓
August 16, 2021	On Site Environmental Monitoring	2 representatives from MMF 4 representatives from CNL	CNL welcomed participants from the MMF on site to observe River Sediment, Soil and Vegetation Sampling and Collection.									✓	✓
August 19, 2021	Teleconference	2 representatives from MMF, 4 representatives from CNSC, 3 representatives from CNL	CNSC, MMF, and CNL met via teleconference to discuss the current status of MMF's concerns and identify key next steps in addressing those concerns.					✓				✓	✓

Date	Activity	Attendance	Description	Key EA Topics1									
				Baseline Conditions	Alternative Means	Project Components	Effects Assessment2	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Interests and Concerns	Engagement Methods
August 19, 2021	Teleconference	2 representatives from MMF, 3 representatives from CNL	CNL and the MMF met to review the budget needs for each line item and determine follow up steps towards the finalization of the Relationship Agreement.					✓				✓	✓
August 19, 2021	Teleconference	2 representatives from MMF, 3 representatives from CNL	CNL and the MMF met to discuss MMF's green initiatives and explore where CNL can support these initiatives.									✓	
August 19, 2021	E-mail	2 representatives from MMF, 1 representative from CNL	CNL provided the MMF with a revised copy of MMF's Summary Table of Interests and Concerns and VCs for their verification that concerns and interests have been properly characterized and captured.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
August 24, 2021	E-mail	2 representatives from MMF, 2 representatives from CNL, 3 representatives from CNSC	CNL sent a thank you letter to the MMF, thanking them for verifying that CNL had adequately characterized their concerns on the Project. CNL also sent a final copy of the MMF's Summary Table of Interests and Concerns and VCs.										✓
August 30, 2021	E-mail	1 representative from MMF, 2 representatives from CNL	CNL provided an updated budget to support the Relationship Agreement for the MMF's review.									✓	
September 8, 2021	E-mail	2 representatives MMF, 2 representatives CNL	The MMF's Green Initiatives Coordinator provided CNL with a signed copy of the contribution agreement. CNL began on the PO process in order to release the funds in order to support the Green initiatives collaboration.									✓	
September 9, 2021	On Site Environmental Monitoring	2 representatives from MMF, 4 representatives from CNL	MMF Staff came on site to partake in the collection of mushroom samples to verify the Ambient Radiation Dose of vegetation in and around the Whiteshell Site.									✓	
September 21, 2021	Teleconference	2 representatives from MMF, 2 representatives from CNL	CNL and the MMF met to discuss the Relationship Agreement budget and allocations and key elements and initiatives that will help move the Relationship Agreement closer to finalization.									✓	
September 29, 2021	E-mail	1 representative from MMF, 2 representatives from CNL	CNL reached out to the MMF to provide and confirm the updates made to the budget of the Relationship Agreement based on the previous meeting.									✓	
November 13, 2021	E-mail	2 representatives from MMF 8 representatives from CNL	The MMF completed a technical review of CNL's annual compliance monitoring reports for the Whiteshell Laboratories site and provided CNL with a copy.									✓	
November 17, 2021	Teleconference	3 representatives from MMF 5 representatives from CNL	CNL hosted a teleconference with MMF to discuss CNL's alpha targeted therapy project which was a deliverable from the MMF, CNL, and AECL Leadership Meeting.									✓	

Date	Activity	Attendance	Description	Key EA Topics1									
				Baseline Conditions	Alternative Means	Project Components	Effects Assessment2	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Interests and Concerns	Engagement Methods
November 18, 2021	E-mail	2 representatives from MMF 3 representatives from CNL	CNL revised the relationship agreement to include both MMF's and CNL's legal review and sent the revised agreement to MMF.								✓	✓	✓
November 22, 2021	Teleconference	2 representatives from MMF 3 representatives from CNL	CNL met with MMF to review the changes recommend by both parties legal counsel. CNL and the MMF discuss additional revisions that were still required around procurement.								✓	✓	✓
November 26, 2021	E-mail	2 representatives from MMF 4 representatives from CNL	CNL sent MMF Section 4.0 (Indigenous engagement), 6.7 (Human and Ecological Health), 6.8 (Land and Resource Use), 11.0 (Summary of Follow-up Monitoring Program) and requested they review these sections and confirm CNL has adequately addressed MMF's concerns and correctly captured MMF's information	✓	✓	✓	✓	✓	✓	✓	✓		✓
November 30, 2021	E-mail	2 representatives from MMF 1 representative from CNL	CNL sent Section 6.9 (Socio-economic environment) and asked the MMF to review to make sure that CNL had documented MMF's information correctly.				✓	✓			✓		
December 7, 2021	E-mail	2 representatives from MMF 3 representatives from CNL	CNL sent a revised copy of the relationship agreement to the MMF. This included additional revisions from the teleconference and further revisions on the procurement language.									✓	✓
December 13, 2021	E-mail	2 representatives from MMF 4 representatives from CNL	CNL sent MMF a signed copy of the MOU to support MMF's technical review of the EIS sections.										✓
December 19, 2021	E-mail	2 representatives from MMF 2 representatives from CNL	The MMF sent feedback on Section 4.0 (Indigenous engagement), 6.7 (Human and Ecological Health), 6.8 (Land and Resource Use), 11.0 (Summary of Follow-up Monitoring Program).	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
December 28, 2021	E-mail	2 representatives from MMF 2 representatives from CNL	The MMF sent feedback on the draft relationship agreement.									✓	✓
January 6, 2022	Teleconference	2 representatives from MMF 4 representatives from CNL	The MMF sent feedback on the draft relationship agreement.									✓	✓
February 17, 2022	E-mail	2 representatives from MMF 1 representative from CNL	CNL sent a revised copy of the relationship agreement to MMF for their review and feedback.									✓	✓
February 17, 2022	E-mail	2 representatives from MMF 3 representatives from CNL	CNL sent the MMF revised copies of the sections of the EIS that the MMF reviewed and highlighted where any changes were made based on their feedback. CNL also provided a table to show how CNL addressed each of the MMF's concerns. Additional sections of the EIS were provided if they were referenced in CNL's responses. CNL highlighted specific passages in these sections for help MMF in their review of this information.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Date	Activity	Attendance	Description	Key EA Topics1									
				Baseline Conditions	Alternative Means	Project Components	Effects Assessment2	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Interests and Concerns	Engagement Methods
March 2, 2022	Teleconference	2 representatives from MMF 2 representatives from CNL	CNL and MMF's communication director met to discuss co-developing an infographic in preparation for MMF's Annual General Assembly.										✓
March 7, 2022	E-mail	2 representatives from MMF 2 representatives from CNL	CNL informed MMF that CNL would be repackaging their interest and concerns table.								✓	✓	✓
March 16, 2022	Phone	1 representative from MMF 1 representative from CNL	MMF confirmed they would review the interest and concerns table.										✓
March 16, 2022	E-mail	2 representatives from MMF 2 representatives from CNL	CNL resent the MMF revised copies of the EIS sections that MMF reviewed and highlighted where CNL made changes based on MMF's feedback. CNL also provided a table to show how CNL addressed each of the MMF's concerns. Additional sections of the EIS were provided if they were referenced in CNL's responses. CNL highlighted specific passages in these sections to help MMF in their review of this information.									✓	✓
March 24-27, 2022	In-person	4 representatives from CNL	CNL participated in the MMF's Annual General Assembly. CNL had a booth at the event and engaged with Red River Métis citizens on the Whiteshell Laboratories Closure Project.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
March 29, 2022	Teleconference	2 representatives from MMF 7 representatives from CNL	CNL walked MMF and their consultants through the repackaged interest and concerns table and discussed their review and timeline. CNL and the MMF also discuss Red River Métis rights, claims, and interests.									✓	✓
March 31, 2022	E-mail	2 representatives from MMF 7 representatives from CNL	CNL sent the MMF the repackaged interest and concerns table for the MMF's review and feedback.										✓
April 16, 2022	E-mail	2 representatives from MMF 2 representatives from CNL	CNL received MMF's revised relationship agreement for CNL's consideration.									✓	✓
April 25, 2022	Teleconference	5 representatives from MMF 3 representatives from CNL	CNL held a teleconference with the MMF and their technical consultants to go over the MMF's repackaged interest and concerns table before their review.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
May 18, 2022	Teleconference	5 representatives from MMF 3 representatives from CNL	CNL walked through the MMF's I&C table and the MMF's feedback on the I&C table. CNL focused on items where they would need to revise the MMF's proposed language and provided an explanation.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
May 25, 2022	Teleconference	3 representatives from MMF 5 representatives from CNL	CNL and the MMF discussed the relationship agreement and Indigenous economic participation.									✓	✓
May 27, 2022	E-mail	2 representatives from MMF 4 representatives from CNL	MMF provided an additional round of feedback on the interests and concerns table.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Date	Activity	Attendance	Description	Key EA Topics1									
				Baseline Conditions	Alternative Means	Project Components	Effects Assessment2	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Interests and Concerns	Engagement Methods
May 30, 2022	E-mail	2 representatives from MMF 4 representatives from CNL	CNL sent back a revised interests and concerns table to show that the MMF's revisions were incorporated.									✓	✓
June 7, 2022	In-person	1 representative from MMF 4 representatives from CNL	MMF's new coordinator came to site to collect mushrooms with CNL's environmental team							✓	✓		✓
June 13, 2022	E-mail	3 representatives from MMF 2 representatives from CNL	CNL asked the MMF to confirm that they have completed the verification of their interests and concerns table.										✓
June 16, 2022	E-mail	3 representatives from MMF 2 representatives from CNL	The MMF confirmed the table was reflective of their interests and concerns.										✓
July 6, 2022	Teleconference	2 representatives from MMF 2 representatives from CNL	CNL met with MMF to discuss the status of the relationship agreement, environmental monitoring activities on site, and future engagement activities.							✓		✓	✓
July 13, 2022	E-mail	2 representatives from MMF 3 representatives from CNL	CNL sent MMF the revised relationship agreement for their review and feedback.									✓	✓
July 28, 2022	In-person	1 representatives from MMF 3 representatives from CNL	CNL hosted MMF on site to participate in ground water sampling around the main campus.										
August 8, 2022	Teleconference		CNL and MMF discussed that status of the relationship agreement, environmental monitoring activities, and future engagements with the MMF.										
August 10, 2022	In-person		CNL participated a MMF Community Consult Meeting in Lac du Bonnet. CNL shared information on their environmental monitoring program.							✓		✓	✓
August 17, 2022	In-person		Metis Citizens participated in a bat survey at the Whiteshell Laboratories Site							✓			
August 30, 2022	E-mail		CNL sent a copy of CNL's environmental monitoring program schedule and requested MMF to identify any potential activities they want to participate in.							✓		✓	✓
September 7, 2022	E-mail		CNL and the MMF discussed the status of the relationship agreement, environmental monitoring and future engagement activities on WR-1.							✓		✓	✓
September 9, 2022	E-mail		CNL provided revisions to MMF on their Relationship Agreement for MMF's review and feedback.									✓	✓
September 16, 2022	E-mail		CNL provided responses to MMF's comments on CNL's 2020 Compliance Reports for the Whiteshell Laboratories Site.	✓						✓		✓	✓

1.3.4 Manitoba Metis Federation (MMF) – Key Interests and Concerns

The Manitoba Métis Federation (MMF) is the democratically elected self-government representative of the Manitoba Métis also known as the Red River Métis (RRM), an “Aboriginal peoples” under Section 35 of the Constitution Act, 1982 and currently includes the Manitoba Metis Federation Inc., a non-share corporation incorporated pursuant to the laws of Manitoba.

MMF’s concerns are multi-dimensional and cross-cutting and go beyond impacts on Indigenous rights. For more information on specific interests and concerns expressed by the MMF, refer to their Métis Traditional Knowledge and Land Use, and Occupancy Study (MTKLUOS), Harvester Consumption Survey, and Appendix B of the Indigenous Engagement Report for detailed MMF comments on the EIS.

The next steps are to work with the MMF to begin implementation of the relationship agreement, develop a list of binding commitments to address the MMF’s concerns on the Project that will be submitted to the CNSC, and finalize responses to MMF’s comments on the draft EIS. Once the commitments are implemented, CNL and the MMF will assess the success of these mitigation measures to ensure they are fully and adequately addressing MMF’s concerns.

Table Verification

On June 2, 2021, CNL sent MMF a letter requesting their review of the attached MMF summary of interests and concerns table and MMF list of VCs. CNL developed both documents based on engagements with the MMF, MMF’s MTKLUOS and MMF’s Harvester Consumption Survey. CNL asked MMF to verify whether CNL had adequately characterized MMF’s interests and concerns. In the letter, CNL offered to provide capacity funding and to meet with MMF to discuss the table and list of VCs. On July 26, 2021, MMF sent CNL feedback on the summary of interests and concerns table and list of VCs. CNL accepted all tracked changes for both documents from MMF and sent back the two revised documents on August 19, 2021 to reflect how CNL incorporated the MMF feedback. CNL sent a final thank you letter to MMF on August 24, 2021, thanking the MMF for their participation in verifying CNL had adequately captured their summary of interests and concerns table and list of VC.

On March 7, 2022, CNL sent an e-mail informing the community the CNL would be repackaging the interest and concern table based on feedback from the CNSC and requested the community to indicate whether they would like to review the table. CNL met with the MMF via teleconference to provide additional information on the CNSC’s feedback, the proposed revisions to the table and to discuss timeline for the MMF’s review. CNL sent the revise summary table of MMF’s key interests and concerns on March 31, 2022. On April 25, CNL, the MMF, and the MMF’s technical consultants held a teleconference to walkthrough the revisions to the table. CNL received feedback from the MMF on May 9, 2022 and met via teleconference on May 18, 2022 to discuss their feedback to the table. CNL sent a revised table on May 19, 2022, to the MMF following the teleconference. MMF sent CNL final revisions to the table on May 27, 2022, and CNL accepted all track changes and sent a final copy of the table to the MMF on May 30, 2022. Additional updates were made to the status column only of the interests and concerns table and these adjustments were forwarded to the Manitoba Métis Federation on October 20, 2022. The Manitoba Métis Federation provided their feedback on December 7, 2022, indicating they had no concerns.

Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
Long-Term Relationship			
The MMF is interested in a positive and collaborative relationship with Canadian Nuclear Laboratories (CNL). Strengthening the relationship will help the MMF and CNL work together on the Whiteshell Reactor 1 (WR-1) Project and will ensure that the RRM’s Section 35 and harvester rights, as well as the rights, interests, and claims more broadly are addressed by CNL and Atomic Energy of Canada Limited (AECL) in their activities, and the Canadian Nuclear Safety Commission (CNSC) in its regulatory oversight of the facility. This is both a project-specific and site-wide interest.	CNL has made efforts to improve relations with the MMF since 2017 and have been responsive in addressing immediate concerns and interests on the Project. CNL has ensured that the MMF have economic and technical capacity to support project review interests and have been negotiating the development of a long-term relationship agreement. The relationship agreement will support implementation of commitments to address the RRM interests and concerns, including providing appropriate funding capacity. At this time, the relationship agreement between the MMF and CNL is being co-developed, but is not yet signed off. For activities and responsibilities related to regulatory oversight, CNL referred MMF to the CNSC.	Engagement activities with the MMF in regards to developing a relationship agreement were included in Section 4.2.4.2.1.	This interest is being addressed through the relationship agreement.. CNL and the MMF still need to finalize the list of binding commitments and submit that list to the CNSC, and the MMF and CNL need to complete an assessment to confirm the implemented commitments adequately address MMF concerns. It is not anticipated that further engagement on this topic will influence the assessment.

Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
The Health of the Winnipeg River and Confidence in Métis Harvesting near the WL Site			
The RRM is concerned that the Project may impact the environment including plants, wildlife, and in turn impact current land uses by RRM harvesters and citizens, the health of RRM citizens, and economic systems associated with traditional land use. As the MMF's citizens use the land around the WL site for harvesting, the MMF want to ensure that the Section 35 rights, harvesting rights, and interests to use lands, resources and water near the Whiteshell Laboratories (WL) site by the RRM citizens is not impacted by the Project. This is a project-specific concern.	CNL provided information on the WR-1 In Situ Disposal (ISD) design and its uses of a multi-barrier approach to safely isolate contaminants from the environment. The environmental assessment of the normal evolution, extreme events, and accident scenarios concluded that there are no impacts on the environment, including plants and wildlife relied on by the RRM, and that the Métis citizens can safely practice traditional activities near the WL site. CNL used information from engagement activities and MTKLUOS to confirm that Project's Valued Components (VCs) and assessment adequately capture RRM interests and ensured the harvester receptor was conservative compared to the RRM harvester consumption data as part of the Project's human health risk assessment. This confirms that CNL's assessment accurately reflects RRM land and resource use practices. CNL and the MMF have co-developed a draft relationship agreement to support the MMF's long-term participation in monitoring at the WL site during decommissioning. The relationship agreement will fund a Liaison Officer position to support greater information sharing about the WL site to Métis citizen including harvesters for the purpose of increasing their confidence to practice harvesting rights in the area. CNL has committed to developing an Indigenous stewardship monitoring initiative collaboratively with the MMF.	CNL used the MTKLOUS and Métis harvester food intake study to validate and refine its Harvester receptor model in the assessment of human health in Section 6.7.1.7. Each subsection of Section 6.0 was revised to include a table of Indigenous Interests and concerns, and how they were considered under each particular assessment. CNL specifically confirmed that fish and fish habitat (the Winnipeg River) health is captured in Section 6.5 (Aquatic Environment), and that the health of fish, waterfowl, aquatic plants, and humans that consume them is captured in Section 6.7 (Human and Ecological Health). To provide additional monitoring requested by the MMF, CNL revised Section 11.4 to include a commitment to add additional groundwater well(s) in between WR-1 and the Winnipeg River, and to include additional river water and country food monitoring in its Environmental Monitoring program. In addition, Section 11.4 was updated to include CNL commitments to working with the First Nations and the MMF to involve the Nations in environmental monitoring of the site after closure.	CNL has considered these concerns and answered the question at this time. If the project is approved, the MMF will be involved in the monitoring process to ensure the disposal facility CNL has described is performing as it should. MMF's perspective is that these concerns will be considered addressed once CNL and the MMF submit the list of binding commitments and/or conditions of approval acceptable to MMF that address all MMF concerns; and the MMF and CNL assess the success of the implemented commitments to ensure they address MMF concerns.
The MMF is concerned that the site's discharge to the Winnipeg River could impact the environment and the operations of hydro-electric dams downstream. The MMF had a series of questions on the site's discharge, including the potential for CNL's discharge licence to trigger an environmental assessment. The MMF wants to be notified and involved if contaminants are discharged to the river in quantities exceeding the acceptable levels. This is a site-wide concern.	The site's discharge to the Winnipeg River is monitored for radioactivity and non-radiological contaminants and the results are shared publicly every year. The performance of the WL site environmental emission controls is very good and there is documented scientific evidence that there are no impacts to the environment or the public. If a discharge exceeds an Action Level (which are set at ≤ 15% of the regulatory limit), the exceedance must be reported to the CNSC, investigated, and mitigated to the extent practical to minimize adverse environmental impacts. CNL will commit to notifying the MMF if a discharge exceeds an Action Level and inquire whether the MMF wants to be involved in the investigation and mitigation processes. The site's discharges to the river are approximately 5000 gallons/minute; however, water intake from the Winnipeg River is of a similar volume – it operates like a loop. As such, discharges from the site have no effect on the overall volumes of water in the river and no impact on the operations of hydro-electric dams downstream. For accuracy, CNL clarified that 1.36 gigalitres (GL) of water was pumped from the river over 2015. The total discharge volume in 2015 was 1.34 GL. All discharges are monitored and the results are shared publicly every year.	The impact of the WL site on river water quality is documented in Section 6.4.2.5.2.2. CNL confirmed no impact to local hydrology as a result of the Project in Section 6.4.1.6.2.	CNL has answered the question about impacts to hydro-electric operations. Additional engagement on this topic will help address any further concerns through supporting MMF's continued participation in monitoring at the site; however, it is not anticipated to impact the assessment or its outcome. The MMF may consider this concern addressed once an answer has been provided as to the potential for CNL's discharge license to trigger an environmental assessment or compliance instruments such as other environmental permitting or approvals process are put in place. 1. CNL and the MMF finalize the Relationship Agreement and establish the communications protocol. 2. The MMF and CNL assess the success of the communications protocol to ensure it address the MMF's concerns.
The MMF is concerned that the Section 35 rights of the RRM may be impacted by construction-related disturbances on the WL site. The MMF has requested to be notified of construction activities within 21 days before the activity is due to start. This will allow the MMF to inform harvesters of potential impacts and wildlife disturbances. This is both a site-wide and project-specific concern.	CNL agreed to notify the MMF of any construction related activities on-site that would impact nearby harvesting activities.	CNL documented its commitment to establishing a communication protocol for reportable events with the MMF so that Métis harvesters are notified in the unlikely event of any off-site effects such as noise or other activities that may impact harvesting activities in Section 4.2.4.2.2.	Once the communication protocol is in place and its principles, methods, and agreements are listed in CNL's Environmental Commitments and/or as a condition of approval that CNSC attaches to the Project, this concern will be resolved.
Regulatory Process			
The MMF expressed a concern regarding participant funding from the CNSC within the Environmental Assessment process for the Project to date. The MMF wants to ensure that they have capacity, resources, and opportunity to exercise their right to be consulted on and participate in projects that might adversely impact their Section 35 rights. The MMF also wants to ensure that the rights, interests, and claims of the RRM more broadly are being upheld. This is a project-specific concern.	CNL has provided capacity funding and committed to supporting MMF participation in the environmental assessment process beyond the funding provided by the CNSC.	A description of engagement with the MMF, including participant and capacity funding commitments was documented in the revised Section 4.2.4.2.	CNL has answered and resolved this concern by providing capacity funding and supporting MMF in the environmental assessment process. As engagement in the environmental assessment process is in progress and ongoing, the MMF anticipates adequate capacity funding for participation and consultation to be provided by CNL and/ or CNSC where appropriate.

Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
The MMF expressed interest in the list of VCs for the Project and provided a list of requested additions to the VCs list as a method of ensuring the rights, interests, and claims of the RRM were appropriately considered in the assessment for the Project. These additional VCs were important for the MMF to see included in the EIS as a method for ensuring that factors that could impact the both the rights and well-being of the RRM were considered as part of the assessment. In addition the MMF also want to ensure, the exercising of rights by Métis citizens is avoided, Métis specific mitigations implemented, or Métis specific accommodation are provided. This is a project-specific concern.	CNL provided a list of VCs for the Project to the MMF. CNL then proceeded to draft a list of the MMF's VCs based on information from engagement activities with the MMF, the MMF's MTKLUOS, and the RRM's harvester consumption survey. CNL verified the VCs with the MMF and for each VC, either: ▪ Confirmed it was encompassed by the assessment. ▪ Added it to the assessment. ▪ Added it to the model to be assessed. ▪ Did not add it to the assessment, with rationale provided. • CNL confirmed that potential impacts to the environment that could impact Aboriginal rights and claims are considered under the Traditional Land and Resource Use VC in Section 6.8.1.3. • Specific to the Aboriginal Rights interests, and claims, CNL has indicated that the CNSC is responsible for making determinations on and assessing any impacts to Aboriginal and Treaty rights. As the CNSC develops the Rights Impact Assessment for the Project, there is an opportunity for the MMF to work with the CNSC on that assessment of rights.	Each subsection of Section 6.0 was revised to include a table of Indigenous Interests and concerns, and how they were considered under each particular assessment. Table 4.4-1 identifies where VC related feedback has resulted in the addition of a new VC.	CNL will await the outcome of CNSC's Rights Impact Assessment for the Red River Métis and will continue working with the MMF to seek a resolution. CNL is committed to working with the CNSC and the MMF to incorporate the results and outcomes of the Rights Impact Assessment in a manner that appropriately addresses this outstanding concern, including revising environmental commitments where necessary.
Monitoring and Control of the Proposed WR-1 Disposal Facility and the Decommissioned WL Site			
The MMF raised a concern about monitoring and control of the WL site over the long-term to ensure human and ecological health and RRM Section 35 rights to use lands and resources near the WL site are not impacted by the WL site operations or the Project. CNL has the responsibility for facility monitoring and accountability in case effects on the environment are detected.	CNL provided information on the environmental assessment and explained that the environmental assessment of normal evolution and extreme events and accident scenarios concluded there are no impacts on the environment, including plants and wildlife relied on by RRM, and that the Métis citizens can safely practice traditional activities near the WL site with no impact to traditional land use. The assessment shows that the final disposal facility is passively safe, and is not reliant on monitoring or human control to be effective in protecting people and the environment. The institutional control period for the WR-1 facility, will last for a minimum of 100 years after closure of the facility. CNL explained that they remain responsible for control and monitoring of the site until the CNSC agrees that it is no longer needed. Institutional controls will include access restrictions, ongoing observation and maintenance of the soil cover and vegetation, and ongoing environmental monitoring. The purpose of the institutional controls and the monitoring are to verify the performance of the disposal facility over time, and build confidence that the passive safety of the system will ensure the safety of people and the environment well into the future. CNL re-iterated that it will remain responsible for implementing and managing the monitoring program, including RRM environmental monitoring, as well as any remedial actions required at the WL site, and Atomic Energy of Canada Limited (AECL) is responsible for funding to CNL for the follow-up monitoring program. This funding is part of the financial guarantees submitted to CNSC as part of the WL site licence.	CNL clarified the post-closure activities and responsibilities for monitoring in Section 3.4.9.2. Section 11.0 (Summary of the Follow-up and Monitoring Programs) was updated to provide a better description of the long-term monitoring planned for the Project. CNL has clarified its commitment and responsibility for the on-going monitoring program and AECL funding in Section 11.1.	This concern has been addressed to the extent possible at this time. CNL is committed to including the MMF in current and post-closure monitoring at the site. Further engagement on the topic of future site control and monitoring is not expected to impact the assessment or its conclusions; however, it may result in additional CNL commitments to MMF related to environmental monitoring activities. Any additional commitments to the MMF on monitoring of the site will be documented by CNL in the binding commitments list and submitted to the CNSC.
The MMF expressed concerns about containment of waste in the WR-1 disposal facility and groundwater monitoring in the vicinity of the WR-1 facility, as it has a potential to release radioactive and hazardous materials into the environment, endangering human and ecological health, as well as RRM Section 35 rights to use lands and resources near the WL site, including the Winnipeg River as an ecologically and culturally significant area to the Red River Métis. This is a project-specific concern.	CNL carried out the environmental assessment and determined that the amount of radioactive and hazardous material that would be released from the WR-1 facility would be sufficiently low to not endanger human or ecological health. To confirm this modelling, CNL proposes a network of groundwater monitoring wells around the WR-1 facility, in addition to the site's existing broader environmental monitoring program. CNL held a technical workshop with the RRM to present this information and agreed to the RRM's recommendation for additional groundwater monitoring well(s) closer to the WR-1 facility and an additional surface water monitoring location.	CNL updated Section 11.4 to include CNL commitments to working with the First Nations and the MMF to involve them in environmental monitoring of the site after closure, as well as adding ground water monitoring well(s) between WR-1 and the river as requested by the MMF.	This concern has been addressed to the extent possible at this time and this concern will be fully addressed once CNL has incorporated and installed the monitoring wells at additional locations. This concern, related to monitoring wells, will be considered addressed once CNL includes the installation of groundwater monitoring wells within its list of binding commitments and submitted to the CNSC and once a follow-up assessment is completed by the MMF and CNL and it is confirmed the implemented commitment addresses MMF's concern.

Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
The MMF is concerned that the WL site activities may impact wildlife in the area. The MMF wants to work alongside CNL in the development of a wildlife mortality monitoring and adaptive management program to address impacts to wildlife important to the MMF to ensure the RRM's Section 35 rights to hunt and for trade and commerce in their harvesting territory are not impacted by WL site activities. This is both a site-wide and project-specific concern.	In March 2020, CNL hosted a workshop with the MMF on the site's Environmental Protection Program that included a dialogue on the wildlife mortality monitoring and adaptive management program. The MMF said they would consider this issue addressed by CNL, if CNL established a wildlife mortality monitoring plan that takes into consideration timing and seasonality (for example: monitoring focused on nesting snapping turtles in spring/summer, white-tailed deer more of a concern in the fall), and that specifies mortality thresholds, as well as adaptive management measures to be implemented in the event a threshold is exceeded. CNL's Environmental Protection team provided a summary of the current Wildlife Mortality Plan and clarified that the Environmental Protection Program is in the process of addressing concerns that were discussed. All wildlife mortality is monitored on the plant road and the results of this monitoring are included in the annual Environmental Monitoring report. Since the program was initiated in 2014, no mortalities of species at risk have been recorded. The current ongoing Wildlife Mortality Monitoring Plan was implemented in 2021, recording any wildlife mortalities on site. Currently wildlife awareness road signage and ditch monitoring are underway. Road inspections by the Emergency Services team and notification of any wildlife fatalities are ongoing.	CNL assessed the Project's impact on terrestrial species in Section 6.6, including mitigation measures to reduce species mortality and loss of habitat for species at risk in Section 6.6.6.2.2. CNL has documented the commitment to monitor wildlife mortality to help inform adaptive management practices as part of the Environmental Assessment Follow-up Program for the WL site in Section 11.1.	This concern has been addressed to the extent possible at this time and will be fully addressed once a MMF wildlife and environmental monitoring program is stated explicitly in the binding commitments submitted to the CNSC for the Project and/or conditions of approval, the program is implemented at the site, and the MMF has the opportunity to review and evaluate the program to confirm that it addresses this concern appropriately.
The MMF is concerned that the Project may impact the environment and the perceived safety of the site by Métis harvesters through potential psycho-social impacts of the Project. The MMF is interested in more active involvement in planning and execution of environmental monitoring activities on site as they want to ensure their Section 35 rights to use lands and resources near the WL site are not impacted by the Project. This is both a project-specific concern and a site-wide interest.	CNL presented information on the WR-1 ISD design and stated the WR-1 ISD design uses a multi-barrier approach to safely isolate contaminants from the environment. The environmental assessment of the normal evolution, extreme events, and accident scenarios concluded that there are no impacts on the environment, including plants and wildlife relied on by the RRM, and that the Métis citizens can safely practice traditional activities near the WL site. To demonstrate that the WR-1 ISD is safe, CNL proposed that monitoring for the Project will be incorporated into the overall WL site monitoring program, which already monitors a number of the terrestrial and aquatic species. CNL has also committed to develop an Indigenous stewardship monitoring initiative, which will allow the MMF to participate in environmental monitoring at the WL site. Some of the key elements of the initiative may include: ▪ Expansion and evolution of the monitoring program at WL through incorporation of feedback, recommendations, and Métis Traditional Knowledge. ▪ Capacity development including training in environmental monitoring. ▪ Opportunities for monitors from the MMF to collect samples on-site and in the surrounding area. The initiative will also have a reporting and risk communication component to increase the level of awareness and participation from the wider RRM citizens. The goal of the initiative is to help address concerns regarding protection of the environment, health of people, increase confidence in the health of country foods so to minimize any potential avoidance of RRM harvesters, and reduce stigma associated with the Project. It is also an opportunity to involve youth and Elders, collaborate on ecological restoration, and address nation specific interests and concerns related to monitoring at the site. In May of 2021, CNL committed to funding a liaison position. To provide a supplementary mechanism for communication with MMF and other First Nations, CNL supported the MMF's participation in the Indigenous Advisory Committee. These initiatives will improve communication about site activities and support alleviating concerns about the Project. CNL has also committed to establishing a communication protocol for reportable events with the MMF so that Métis Harvesters are notified in the unlikely event of any off-site effects such as noise or other activities that may impact harvesting activities. This commitment was affirmed during a workshop in November 2020. CNL provided opportunity, training, and capacity for an MMF Monitor to directly observe and participate in environmental monitoring activities on the site to build familiarity and confidence that CNL is effectively monitoring the environment to ensure protection of people and the environment. The Métis Monitor has visited site eight times and participated in river water collection, lagoon discharge monitoring, fish monitoring, collection of traditional foods/plants for monitoring, and other activities. The Métis Monitor provides activity reports directly back to Manitoba Métis Citizens, ensuring trusted sharing of information about CNL's operations and protection of the environment. CNL has adapted its environmental monitoring program based on feedback provided by the MMF. During the fall 2020 monitoring season, the Métis Monitor walked the site with CNL Environmental Monitoring Technologists to identify plants of importance to Métis Harvesters. CNL gathered mushrooms for analysis and will search for berries in season. The results will be incorporated to the Annual Safety Compliance Report.	No changes were made to the assessment; however, CNL confirmed that there will be no impact on the environment through the assessment and documented the results of the assessment in Section 9.3. Engagement activities with the MMF in regards to participation in environmental monitoring activities on site were added to the revised Section 4.2.4.2.1. Section 11.2 was updated with a CNL commitment to review and adapt the existing Environmental Assessment Follow-Up Program for the WL site to incorporate Indigenous Traditional Knowledge that has been collected through the environmental assessment for the Project. Section 11.4 was updated to include CNL commitments to working with the First Nations and the MMF to involve them in environmental monitoring of the site after closure.	CNL considers this concern to be partially addressed. This will be completely addressed when MMF participation in environmental monitoring activities is established through the relationship agreement and will continue throughout the lifecycle of the Project and the WL site. It is not anticipated that further engagement on this topic will influence the assessment or its outcomes; however, it may result in additional commitments to the MMF.

Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
Incorporation of Métis Information			
The MMF expressed interest in providing Métis input into the grass seed mix and revegetation measures including tree and bush planting for site remediation areas to ensure species of importance to the Métis are considered and to avoid species that may conflict with Métis harvest practices. This is both a site-wide and project-specific concern. The MMF wants to ensure the rights, interests, and claims of the RRM, including Section 35 rights to use lands and resources near the WL site are not impacted by site and Project activities.	CNL committed to using only native species in the grass seed mix for remediation of the WL site. CNL will provide the MMF with the detailed site revegetation plan once it has been drafted, will consider feedback from the MMF and will continue to engage with the MMF on seeds, bushes and trees for site revegetation activities as well as potential sources.	Section 3.4.6.5 was updated with a commitment to use a grass seed mixture native to the area.	CNL has responded to and addressed this area of interest. The MMF will continue to be engaged to ensure the commitment made by CNL is honoured. CNL will follow through with this commitment first by including it within the binding commitments and those commitments are submitted to the CNSC. In addition, the MMF requests a follow-up evaluation of the applied mitigations be completed to indicate their success in addressing the concern with feedback and involvement by the MMF.
Economic Opportunities (Business, Capacity Building, etc.)			
The MMF stated RRM citizens must be able to equitably participate in the economic benefits and opportunities associated with the construction, operations, and maintenance of the Project. The MMF specified CNL needs to support RRM employment to ensure MMF is able to participate in the environmental monitoring and management of the Project in all stages.	CNL has worked to enhance options to better match Indigenous capabilities with CNL contracting needs, added provisions to CNL procurement process to encourage the use of Indigenous and local businesses, and considers single source contracting opportunities with Indigenous companies where well suited to the work. CNL has also adjusted the evaluation criteria for competitive bids to favour contracts that are Indigenous owned or have Indigenous employees. A relationship agreement between the MMF and CNL has been drafted, but not yet signed off. It will include provisions for economic participation in the Whiteshell Laboratories Closure Project, continued participation in site monitoring, and provisions to fund an MMF liaison position to support greater capacity building and increase transmission of information to Métis citizens.	Engagement activities with the MMF in regards to developing a relationship agreement are included in Section 4.2.4.2.1. CNL revised Section 6.9.6.2.2 to add various measures that CNL took in collaboration with Indigenous communities to enhance Indigenous capacity and participation in contracting and employment opportunities at the WL site.	CNL has partially addressed this interest and will continue to seek opportunities for increasing Indigenous participation in the project. Implementation of the Relationship Agreement should result in increased economic participation in the project by RRM citizens.
Traditional Land Use			
The MMF is concerned that the Project may have potential negative impacts on socio-cultural and economic systems associated with traditional land use, including the trade and sharing of resources or products from traditional land-use practices in the surrounding area. This is a project-specific concern.	CNL incorporated RRM traditional land use practices and traditional food consumption data into WR-1 environmental assessment and confirmed there are no predicted negative effects to RRM traditional land users. The environmental assessment of the normal evolution, extreme events, and accident scenarios concluded that there are no impacts on the environment, including plants and wildlife relied on by the RRM, and that the Métis citizens can safely practice traditional activities near the WL site. A relationship agreement between the MMF and CNL has been drafted, but not yet signed off. It will include provisions for economic participation in the Whiteshell Laboratories Closure Project, continued participation in site monitoring, and provisions to fund an MMF liaison position to support greater capacity building and increase transmission of information to Métis citizens and reduce fear and avoidance of traditional land use practices and harvesting near the site. CNL will also continue to support MMF's participation in monitoring at the site. CNL also agreed to notify the MMF of any construction related activities on-site that would impact nearby harvesting activities.	Engagement activities with the MMF in regards to developing a relationship agreement are included in Section 4.2.4.2.1.CNL documented its commitment to establishing a communication protocol for reportable events with the MMF so that Métis harvesters are notified in the unlikely event of any off-site effects such as noise or other activities that may impact harvesting activities in Section 4.2.4.2.2. CNL used the MTKLOUS and Métis harvester food intake study to validate and refine its Harvester receptor model in the assessment of human health in Section 6.7.1.7. CNL has confirmed that Traditional Land and Resource Use by Indigenous People is a VC in the assessment in Section 6.8 and that it assessed continued opportunity for, and willingness to engage in, traditional activities such as hunting, fishing, swimming, drinking surface water, trapping and plant, berry, wild rice and medicine gathering by Indigenous Peoples with no detrimental effects.	CNL and the MMF still need to finalize a list of binding commitments and submit that list to the CNSC. An assessment to confirm the implemented commitments adequately address MMF concerns will need to be completed by the MMF and CNL.
The MMF noted that regulators may notice and flag the absence of Métis Traditional Knowledge in the EIS. The MMF has a catalogue of Traditional Knowledge but does not have the capacity to analyze it for gaps and relevance to the WL site. The MMF notes that a Traditional Knowledge study should be undertaken as neither the previous Comprehensive Study Report nor the current monitoring reports consider Métis harvesting. The species of traditional importance identified in the MTKLUOS should be thoroughly assessed for any effects. This is both a site-wide and project-specific concern. The MMF wants to ensure their Section 35 rights to use lands and resources near the WL site are considered by CNL and to have confirmation that they are not impacted by site and Project activities.	CNL, with support from the CNSC, funded the WR-1 Decommissioning Manitoba Métis TKLUOS. In addition, CNL supported an RRM harvester consumption survey. CNL incorporated information from both studies into the draft EIS. This includes confirming that species of traditional importance identified by the RRM Citizens were either already included in the assessment through representative species or added to the assessment, such as moose. In cases where species were not included in the assessment, CNL provided an explanation of why they were not. CNL also verified a list of VCs for the RRM with the MMF and incorporated the VCs into the assessment chapters of the EIS. The ecological health assessment results indicate that there would be no negative effects on the health or population of the representative species, and thus no effect to the species of importance to RRM Citizens.	Section 6.6.3 was updated to include the assessment of species of importance to the Indigenous communities, including the RRM, and how they were represented in the assessment. The assessment model for the Harvester, representing a traditional land use receptor, was updated and validated using the results of the MTKLOUS Section 6.7.1.7.1.1 and 6.7.1.7.2.1. Section 6.7.2 was updated with assessment results for moose, as well as confirmed that there is not likely to be any effects on the representative species due to the Project. Traditional Land and Resource Use by Indigenous People is a VC in the assessment in Section 6.8 and it assesses continued opportunity for, and willingness to engage in, traditional activities such as hunting, fishing, swimming, drinking surface water, trapping and plant, berry, wild rice and medicine gathering by Indigenous Peoples with no detrimental effects. Section 6.8.1 was updated with the relevant information on traditional land use from the RRM TKLOUS.	CNL has partially addressed this matter within the Project context and will continue to ensure RRM values, interests, and traditional knowledge are meaningfully incorporated into the Project. CNL and the MMF are finalizing a relationship agreement to ensure MMF's continued involved in their areas of interest related to the Project and the overall closure of the site.The MMF will review and comment on this commitment when it is included as a formal commitment submitted to the CNSC. This concern will not be considered addressed until the MMF has had the opportunity to review and comment on this document and agrees that the concern is addressed. Further engagement on the topic of Traditional Knowledge is not expected to impact the assessment or its conclusions; however, it may result in additional CNL commitments to the MMF related to environmental monitoring activities.

Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
The MMF indicated that CNL should include culturally important terrestrial species in its monitoring program to confirm that the WL site and Project do not affect the health of the environment through radiological releases. This is both a site-wide and project-specific concern. The MMF wants to ensure that RRM Section 35 rights to use lands and resources near the WL site are not impacted by site and Project activities.	Monitoring for the Project will be incorporated into the overall WL site program, which already monitors a number of terrestrial and aquatic species. CNL has also committed to develop an Indigenous stewardship monitoring initiative, which will allow Indigenous Nations to participate in environmental monitoring at the WL site. Some of the key elements of the initiative may include: ▪ Expansion and evolution of the monitoring program at WL through incorporation of feedback, recommendations, and Traditional Knowledge. ▪ Capacity development including training in environmental monitoring. ▪ Opportunities for monitors from each First Nation and the MMF to collect samples on-site and in the surrounding area.	Section 11.2 was updated with CNL commitment to reviewing and adapting the existing Environmental Assessment Follow-up Program for the WL site to incorporate Indigenous Traditional Knowledge that has been collected through the environmental assessment for the Project. Section 11.4 was updated to include CNL commitments to working with the First Nations and the MMF to develop an Indigenous stewardship monitoring initiative.	CNL's perspective is that this interest has been addressed to the extent possible by adjusting CNL's Environmental Monitoring Program based on the MMF's input, and commitments to incorporate Traditional Knowledge into the environmental monitoring program or help MMF develop its own program. The interest will only be addressed once the MMF has reviewed and agreed to the monitoring program and binding commitments are made by CNL and/or conditions of approval. Further engagement on this is not expected to have any impact on the assessment or its conclusions but it may result in additional CNL commitments to the MMF related to environmental monitoring activities.
In Situ Disposal			
The MMF has a project-specific concern about the ISD approach and stated that they prefer complete removal of the facility from the WL site so there would be no potential for impacts on human and ecological health and the land would be fully available for traditional use and practice of Section 35 rights.	CNL assessed all the economically and technically feasible WR-1 decommissioning options and chose ISD as the preferred alternative. CNL explained the alternative means assessment conducted by CNL to the MMF, including its findings that ISD is an appropriate approach because it reduces the nuclear liabilities at the WL site by disposing of WR-1 in a safety assessed facility without the need for major demolition and nuclear waste extraction and transportation work. CNL explained the alternative means assessment conducted by CNL to the MMF. CNL prepared a safety case and a decommissioning safety assessment that examine the ISD approach as proposed and demonstrates that it will effectively contain and isolate the waste, ensuring protection of human and ecological health. CNL also assessed the impacts to traditional land use around the WL site. The assessments indicate that Métis citizens can safely practice traditional activities near the WL site with no impact to traditional land use. CNL and the MMF met to discuss the details of the proposed ISD Project during a technical workshop on February 9, 2021. This included a detailed walkthrough of the proposed in situ design and the protective barriers in place to protect the environment.	To acknowledge the MMF's concerns, CNL included the MMF's position on the proposed ISD and their preferred alternative (full dismantlement) has been noted in Section 2.7. CNL assessed human and ecological health in Section 6.7 and confirmed no effects. CNL has confirmed that Traditional Land and Resource Use by Indigenous People is a VC in the assessment in Section 6.8 and that it assessed continued opportunity for, and willingness to engage in, traditional activities such as hunting, fishing, swimming, drinking surface water, trapping and plant, berry, wild rice and medicine gathering by Indigenous Peoples with no detrimental effects.	CNL and the MMF do not agree on the method of decommissioning. The parties have agreed to continue to work collaboratively to ensure any outstanding concerns are resolved to the extent possible.

1.3.5 Black River First Nation, Hollow Water First Nation, and Brokenhead Ojibway Nation Engagement

Date	Activity	Attendance	Description	Key EA Topics									
				Baseline Conditions	Alternative Means	Project Components	Effects Assessment3	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Interests and Concerns	Engagement Methods
August 3, 2016	Email/Letter	Brokenhead Ojibway Nation Black River First Nation Hollow Water First Nation	Project Introductory Letter and request for community input on any potential adverse impacts from project activities.								✓		✓
December 15, 2016	In-person meeting	7 representatives from the First Nations 4 representatives from CNL 1 representative from CNL contractor	Discussed project engagement regarding overall closure plans for Whiteshell Laboratories, and specifically to review the proposed changes to the WR-1 Reactor and associated EA process.			✓	✓	✓		✓	✓	✓	
February 21, 2017	In-person meeting	13 members from Brokenhead Ojibway Nation 11 members from Black River First Nation 13 members from Hollow Water First Nation 6 representatives from CNL 1 representative from CNL Contractor	Discussed WR-1 In-situ decommissioning. CNL presented about the overall site and closure plan. Review of the Student Job Description.	✓		✓		✓	✓				
February 22, 2017	Site Visit and WR-1 tour	13 members from Brokenhead Ojibway Nation 11 members from Black River First Nation 13 members from Hollow Water First Nation 6 representatives from CNL 1 representative from CNL Contractor	Participants were invited to the site to tour the facility and learn about the WR-1 In-Situ Decommissioning Project. Participants and CNL HR staff also discussed job advertising.	✓		✓		✓	✓	✓			
June 27, 2017	In-person Meeting	5 representatives from Black River First Nation 2 representatives from CNSC 1 representative from AECL 2 representatives from CNL	CNL, CNSC and AECL presented on the WR-1 In-Situ Decommissioning Project to Black River and Hollow Water First Nation's Chief and Councils.			✓		✓					
June 28, 2017	In-person meeting	5 representatives from Brokenhead Ojibway Nation 2 representatives from CNSC 1 representative from AECL 1 representative from CNL	The CNSC led a meeting with Brokenhead Ojibway Nation to discuss the Project and to discuss the environmental assessment process.	✓		✓			✓	✓			
July 6, 2017	In-person meeting	Open to all Indigenous communities	CNL hosted an industry day, presentation of Whiteshell Laboratories.									✓	
October 5, 2017	Email/Letter	Brokenhead Ojibway Nation Black River First Nation Hollow Water First Nation	Notification of public comment period on the draft EIS and invitation to engage.										✓

3 including VC, spatial and temporal boundaries for the assessment

Date	Activity	Attendance	Description	Key EA Topics									
				Baseline Conditions	Alternative Means	Project Components	Effects Assessment3	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Interests and Concerns	Engagement Methods
November 1, 2017	E-mail/Letter	Brokenhead Ojibway Nation Black River First Nation Hollow Water First Nation	Mailed hard copies of Community specific report and draft EIS executive summary.	✓		✓	✓	✓			✓		✓
November 27, 2017	In-person meeting	1 member from Black River First Nation 2 representatives from CNL	Meeting with Black River, Brokenhead Ojibway Nation and Hollow Water First Nation regarding consultation coordination.			✓							✓
April 3, 2018	In-person benchmarking trip	2 representatives from Black River First Nation 2 representatives from Brokenhead Ojibway Nation 1 representative from Sagkeeng First Nation 2 representatives from Wabaseemoong Independent Nations 2 representatives from MMF	Communities attended the In situ disposal facility in Hallam to learn more about in situ design, monitoring and what the local community thinks. This was a relationship building trip and enabled Indigenous communities to be able to better inform their communities.	✓	✓		✓	✓	✓	✓	✓	✓	
September 26, 2018	In-person meeting	3 representatives from Black River First Nation 1 representative from Brokenhead Ojibway Nation 2 representatives from Hollow Water First Nation 4 representatives from CNL 4 representatives from CNSC	A project update, discuss the trip to Hallam and introduction of Kevin Bird as project coordinator for the three communities.									✓	✓
December 4, 2018	In-person meeting	25 representatives from Black River First Nation 4 representatives from CNSC 3 representatives from CNL	CNL provided updates on the WL site and Project. CNSC presented the Whiteshell Laboratories Closure Project Overview.			✓		✓	✓	✓			
February 05, 2019	In-person meeting and site tour	2 representatives from SERDC 2 representatives from CNL	Southeast Regional Development Council (SERDC) meeting and tour of WL site for site information and to discuss economic opportunities									✓	
February 15, 2019	In-person meeting and site tour	1 representative from Black River First Nation 1 representative from CNL	Black River First Nation came to site for a site tour and discussed the in-situ decommissioning project.		✓	✓							
March 3-7, 2019	In-person Conference: Waste Management Symposia	1 representative from Black River First Nation	Trip with Black River First Nation to attend and participate in several panels at the Waste Management Symposia in Phoenix, AZ for relationship building, nuclear and information gathering on nuclear decommissioning and waste management									✓	
June 3, 2019	WL site tour	22 representatives from Black River First Nation, Brokenhead Ojibway Nation, Hollow Water First Nation 3 representatives from CNL 3 representatives from HTFC Planning and Design	The site tour was the Traditional knowledge kick-off.								✓		

Date	Activity	Attendance	Description	Key EA Topics									
				Baseline Conditions	Alternative Means	Project Components	Effects Assessment3	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Interests and Concerns	Engagement Methods
June 4, 2019	In-person meeting	22 representatives from Black River First Nation, Brokenhead Ojibway Nation, Hollow Water First Nation 3 representatives from CNL 3 representatives from HTFC Planning and Design 2 representatives from CNSC	Traditional knowledge study workshop.								✓		
September 25, 2019	Email	1 representative from Black River First Nation 1 representative from Brokenhead Ojibway Nation 1 representative from Hollow Water First Nation 1 representative from HTFC Planning and Design 1 representative from CNSC 1 representative from CNL	Invitation to a TK study wrap-up meeting.								✓		✓
December 5, 2019	In-person meeting	21 representatives from Black River First Nation, Brokenhead Ojibway Nation, Hollow Water First Nation 3 representatives from CNL 2 representatives from HTFC Planning and Design 3 representatives from CNSC 2 representatives from AECL	Roll-out of Traditional Knowledge Study.								✓		✓
March 16, 2020	Teleconference	3 representatives from Black River First Nation 2 representatives from CNL	Discussed next steps and meeting to review the IR responses.			✓	✓	✓		✓			✓
April 3, 2020	Teleconference	Black River First Nation Brokenhead Ojibway Nation Hollow Water First Nation CNL CNSC	Discuss the decommissioning of the Whiteshell Site.		✓	✓		✓		✓			
August 26, 2020	Teleconference	1 representative from Black River First nation and Hollow Water First Nation 2 representatives from CNL	Meeting with Consultant representing Black River First Nation, Brokenhead Ojibway Nation, and Hollow Water First Nation. Discussed initial thoughts on the Indigenous Advisory Committee – Participation Agreement.									✓	
September 2, 2020	Teleconference	1 representative from Black River First Nation and Hollow Water First Nation 2 representatives from CNL	Meeting to discuss the Indigenous Advisory Committee and Black River and Hollow Water First Nations Engagement Organizational Framework.									✓	

Date	Activity	Attendance	Description	Key EA Topics									
				Baseline Conditions	Alternative Means	Project Components	Effects Assessment3	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Interests and Concerns	Engagement Methods
September 16, 2020	Email	1 representative from Black River First Nation 1 representative from Hollow Water First Nation 1 representative from CNL	CNL sent out an invitation to community members to attend the breakfast session on development and test results of the WR-1 grout.			✓							
October 20, 2020	Site Visit	2 representatives from Black River First Nation 4 representatives from CNL	Community representatives observed fish processing on site and the environmental monitoring team provided an overview presentation.				✓			✓			
October 27, 2020	Teleconference	2 representatives from Black River First Nation 1 representative from CNL	HTFC and CNL met to discuss their proposed engagement structure and budget proposal.										✓
November 2, 2020	Teleconference	2 representatives from Black River First Nation and Hollow Water First Nations, 1 representative from CNL	HTFC presented an overview of their engagement structure and budget proposal. CNL asked preliminary questions about their proposal.										✓
November 12, 2020	Teleconference	4 representatives from Black River First Nation and Hollow Water First Nations, 4 representatives from CNL	CNL met to discuss their engagement structure and budget proposal.										✓
December 14, 2020	Teleconference	4 representatives from Black River First Nation and Hollow Water First Nation 2 representatives from CNL	CNL, HTFC, Black River and Hollow Water met to discuss the communities' comments on the EIS and CNL's responses and proposed next steps.	✓	✓	✓	✓			✓	✓		
December 14, 2020	Teleconference	4 representatives from Black River First Nation 5 representatives from CNSC 4 representatives from CNL	CNL met with the Chief and councillor from Black River First Nation, CNSC, HTFC to discuss funding.										✓
January 11, 2021	Email/Letter	2 representatives from Black River First Nation 1 representative from Hollow Water First Nation 4 representatives from CNL	CNL provided CNL's final responses on the EIS.	✓		✓		✓	✓	✓	✓	✓	✓
January 19, 2021	Email	2 representatives from Black River First Nation 1 representative from Hollow Water First Nation 4 representatives from CNL	CNL provided a draft copy of the contribution agreement for their review and signature.										✓
January 25, 2021	Email	2 representatives from Black River First Nation 1 representative from Hollow Water First Nation 4 representatives from CNL	CNL provided an advanced draft copy of the IER.								✓	✓	✓
January 29, 2021	Email	2 representatives from Black River First Nation 1 representative from Hollow Water First Nation 4 representatives from CNL	CNL provided a link to a summer student job position at CNL.									✓	

Date	Activity	Attendance	Description	Key EA Topics									
				Baseline Conditions	Alternative Means	Project Components	Effects Assessment3	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Interests and Concerns	Engagement Methods
February 1, 2021	Teleconference	1 representative from Black River First Nation and Hollow Water First Nation 2 representatives from CNL	CNL met with the communities' technical consultants, HTFC, to verify CNL's understanding of the changes to the contribution agreement put forward by Black River First Nation and Hollow Water First Nation.										✓
April 6, 2021	E-mail	4 representatives from Black River and Hollow Water First Nations 3 representatives from CNL	CNL received a signed relationship agreement from Black River and Hollow Water First Nations to fund an agreed to two-year engagement plan.					✓				✓	
April 12, 2021	Email	2 representatives from Black River First Nation 1 representative from Hollow Water First Nation 2 representatives from CNL	CNL sent each Nation a copy of the 2021 environmental monitoring scheduled and requested to host a teleconference to discuss how they would like to be involved.							✓		✓	
April 19, 2021	Email	2 representatives from Black River First Nation 1 representative from Hollow Water First Nation 1 representative from CNL	CNL invited each Nation to participate in a webinar focused on the Project and how CNL will protect the environment before, during, and after the decommissioning of WR-1.	✓		✓	✓			✓			
May 11, 2021	E-mail/Letter	4 representatives from Black River First Nation 1 representative from Hollow Water First Nation 2 representatives from CNL	CNL reached out to Black River First Nation and Hollow Water First Nation requesting the communities to verify that their Valued Components, and Summary Table of Interests and Concerns appropriately captured the communities' interests and concerns.									✓	✓
May 19, 2021	Teleconference	4 representatives from Black River First Nation, 1 representative from Hollow Water First Nation, 2 representatives from CNL	CNL, HTFC consultants, Black River and Hollow Water First Nations and their liaison officer met to confirm an onboarding plan for the liaison officer and discuss community engagement.			✓						✓	✓
May 25, 2021	On Site Tour	1 representative from Black River First Nation and Hollow Water First Nation 5 representatives from CNL	Black River and Hollow Water First Nations' liaison officer visited the site in order to receive a high-level overview of the WR-1 reactor and Whiteshell site, as a part of the liaison onboarding plan.	✓		✓						✓	
June 1, 2021	Teleconference	1 representative from Black River First Nation and Hollow Water First Nation 3 representatives from CNL	Black River and Hollow Water First Nations' liaison officer received a one-on-one training session on nuclear energy and radiation, as a continuation of the liaison onboarding plan.									✓	
June 23, 2021	Teleconference	3 representatives from Black River First Nation and Hollow Water First Nation 3 representatives from CNL	CNL's Section Head, Environmental Protection Program Manager gave an overview of upcoming monitoring activities on site for Black River and Hollow Water First Nations to participate in.									✓	
June 30, 2021	E-mail	1 representative from Brokenhead Ojibway Nation 1 representative from CNL	CNL followed-up with the community to request a meeting to discuss the summary of interests and concerns table and list of valued components to ensure they accurately characterized the community's interests and concerns.										✓

Date	Activity	Attendance	Description	Key EA Topics									
				Baseline Conditions	Alternative Means	Project Components	Effects Assessment3	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Interests and Concerns	Engagement Methods
July 6, 2021	Teleconference	3 representatives from Black River First Nation and Hollow Water First Nation 2 representatives from CNL	Black River and Hollow Water's liaison officer and CNL met to finalize the environmental monitoring schedule and to discuss any specific areas of interest for community members.	✓	✓	✓	✓	✓	✓	✓	✓	✓	
July 8, 2021	E-mail	4 representatives from Black River First Nation and Hollow Water First Nation 2 representatives from CNL	The community's returned the revised copy of the summary of interests and concerns table with their comments for CNL's review.	✓									
July 14, 2021	On site Environmental Monitoring	1 representative from Black River First Nation and Hollow Water First Nation 6 representatives from CNL	Participants from Black River and Hollow Water came on site to participate in the exit bat survey in order to determine whether bats are burrowing in building 100.									✓	
August 16, 2021	On site Environmental Monitoring	1 representative from Black River First Nation and Hollow Water First Nation 4 representatives from CNL	CNL welcomed participants from Black River and Hollow Water on site to observe River Sediment, Soil and Vegetation Sampling and Collection.									✓	
August 16, 2021	E-mail/Letter	1 representative from Brokenhead Ojibway Nation 1 representative from CNL	CNL provided responses to questions from the community's technical review of the EIS and requested to meet and discuss whether CNL's responses had adequately address the community's concerns.									✓	
August 19, 2021	Teleconference	3 representatives from Black River First Nation and Hollow Water First Nation 3 representatives from CNL	CNL, Black River and Hollow Water and consultation met to review and discuss the edits made to the summary of interests and concerns table.	✓	✓	✓	✓	✓	✓	✓	✓	✓	
August 24, 2021	E-mail	2 representatives from Brokenhead Ojibway Nation 1 representative from CNL	Brokenhead Ojibway Nation confirm receipt of the summary table of interest and concerns and list of valued components.										
August 26, 2021	E-mail	4 representatives from Black River First Nation and Hollow Water First Nation 3 representatives from CNL 1 representative from CNSC	CNL provided Black River and Hollow Water with a revised copy of their Summary Table of Interests and Concerns and VCs for their verification and confirmation that interests, concerns and valued components have been properly captured.	✓	✓	✓	✓	✓	✓	✓	✓	✓	
August 30, 2021	Email	2 representatives from Brokenhead Ojibway Nation 1 representative from CNL 1 representative from CNSC	CNL provided Brokenhead Ojibway Nation with a revised copy of their summary table of interests and concerns based on revisions provided by Black River First Nation and Hollow Water First Nation. CNL also resent CNL's responses to the community's questions from the community's technical review of the EIS.	✓	✓	✓	✓	✓	✓	✓	✓	✓	
September 1, 2021	E-mail	4 representatives from Black River First Nation and Hollow Water First Nation, 2 representatives from CNL 1 representative from CNSC	CNL reached out to follow up and inquire about any additional feedback on the Summary of Interests and Concerns and Valued Components.										✓
September 2, 2021	E-mail	5 representatives from Black River First Nation and Hollow Water First Nation, 3 representatives from CNL 1 representative from the CNSC	HTFC provided their review of the summary of interests and concerns and valued components, for CNL's revision. Black River First Nation and Hollow Water First Nation confirmed that Appendix A properly characterized the communities' interests and suggested language edits to Appendix B which CNL incorporated and sent final copies back to each Nation.	✓	✓	✓	✓	✓	✓	✓	✓	✓	

Date	Activity	Attendance	Description	Key EA Topics									
				Baseline Conditions	Alternative Means	Project Components	Effects Assessment3	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Interests and Concerns	Engagement Methods
September 9, 2021	E-mail	4 representatives from Black River First Nation 1 representative from Hollow Water First Nation 3 representatives from CNL	CNL reached out to Black River First Nation and Hollow Water First Nation in order to verify that CNL had adequately captured their valued components, interests and concerns.				✓				✓		
September 9, 2021	E-mail	2 representatives from Brokenhead Ojibway Nation 1 representative from CNL	CNL provided Brokenhead Ojibway Nation with a revised copy of their summary table of interests and concerns based on revisions provided by Black River First Nation and Hollow Water First Nation.										✓
September 13, 2021	Email	1 representative from Brokenhead Ojibway Nation 4 representatives from CNL	CNL followed up with Brokenhead Ojibway Nation requesting a meeting to go over the revised summary of interests and concerns table and list of valued components.										✓
September 20, 2021	Teleconference	4 representatives from Black River First Nation 5 representatives from CNL	CNL held a teleconference to provide an update on site decommissioning activities. CNL and participants also had a preliminary discussion on land use and end state for the site.	✓								✓	✓
September 27, 2021	Email & Phone call	2 representatives from Brokenhead Ojibway Nation 1 representative from CNL	CNL called Brokenhead Ojibway Nation and left a message as well as followed-up with an e-mail to request a meeting to discuss the summary of interest and concerns table and list of valued components.										✓
October 6, 2021	Email/Letter	2 representatives from Brokenhead Ojibway Nation 4 representatives from CNL	CNL provided Brokenhead Ojibway Nation with a copy of the revised summary table of interests and concerns that included information from their community's technical review of the EIS. CNL requested a meeting to go over the updated table and list of valued components and offered capacity funding to support their review. CNL requested the community let them know by October 14, 2021 whether they intended to review the documents.										✓
October 13, 2021	Teleconference	2 representatives from Black River First Nation 2 representatives from Black River First Nation and Hollow Water First Nation 2 representatives from CNL	CNL, Black River and Hollow Water and consultation met to review the relationship agreement, determine budgetary needs moving forward and setting milestones for the next three months and six months in regards to Black River and Hollow Water's relationship with CNL.										
October 18, 2021	Email/Letter	1 representative from Brokenhead Ojibway Nation 2 representatives from CNL 4 representatives from CNSC	CNL provided a letter to Brokenhead Ojibway Nation to let the community know CNL would be incorporating the list of valued components and summary table of interests and concerns into Section 4.0 of the EIS.										✓
November 10, 2021	Teleconference	2 representatives from Black River First Nation 2 representatives from Black River First Nation and Hollow Water First Nation 3 representatives from CNL	CNL, Black River First Nation, and Hollow Water First Nation held a teleconference to go over their budget for the Relationship Agreement to and set next milestones and target dates.									✓	✓

Date	Activity	Attendance	Description	Key EA Topics									
				Baseline Conditions	Alternative Means	Project Components	Effects Assessment3	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Interests and Concerns	Engagement Methods
November 26, 2021	E-mail	1 representatives from Black River First Nation 1 representative from Hollow Water First Nation 3 representatives from Black River First Nation and Hollow Water First Nation 4 representatives from CNL	CNL asked BRFN and HWFN to review Section 4.0 (Indigenous Engagement) to make sure that CNL had documented their information correctly.									✓	✓
November 26, 2021	E-mail	1 representative from Brokenhead Ojibway Nation 3 representatives from CNL	CNL asked BON to review Section 4.0 (Indigenous Engagement) to make sure that CNL had documented their information correctly.									✓	✓
November 30, 2021	E-mail	2 representatives from Black River First Nation and Hollow Water First Nation 2 representatives from CNL	CNL followed-up via e-mail to confirm BRFN and HWFN had received Section 4.0 (Indigenous Engagement) and were planning to review.										✓
November 30, 2021	E-mail	1 representatives from Brokenhead Ojibway Nation 1 representatives from CNL	CNL followed-up via e-mail to confirm BON had received Section 4.0 (Indigenous Engagement) and were planning to review										✓
December 1, 2021	Phone	1 representatives from Black River First Nation and Hollow Water First Nation 1 representatives from CNL	CNL followed-up via phone to confirm BRFN and HWFN had received Section 4.0 (Indigenous Engagement) and were planning to review.										✓
December 1, 2021	Phone	1 representatives from Brokenhead Ojibway Nation 1 representatives from CNL	CNL followed-up via phone to confirm BON had received Section 4.0 (Indigenous Engagement) and were planning to review.										✓
December 8, 2021	E-mail	4 representatives from Black River First Nation and Hollow Water First Nation 2 representatives from CNL	CNL received feedback from Black River First Nation and Hollow Water First Nation on Section 4.0 (Indigenous Engagement).	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
December 13, 2021	Phone	1 representative from Black River First Nation and Hollow Water First Nation 1 representatives from CNL	BRFN provided an update on the first BRFN and HWFN Liaison Committee Meeting.										✓
February 8, 2022	Teleconference	2 representatives from Black River First Nation 2 representatives from Black River First Nation and Hollow Water First Nation 1 representative from CNL	CNL met with Black River First Nation to discuss the status of the WR-1 submission and next steps for engagement in the environmental assessment process. CNL also discussed priority engagement items for the community.			✓							✓
February 16, 2022	Teleconference	2 representatives from Black River First Nation and Hollow Water First Nation 2 representatives from CNL	CNL met with Black River First Nation to discuss the development of community specific communication material. Black River First Nation provided a list of topics that they would like to communicate to the community. The discussion centred around a one-age infographics and short video productions.			✓							✓
March 15, 2022	E-mail	4 representatives from Black River First Nation and Hollow Water First Nation 2 representatives from CNL	CNL informed the communities that CNL would be repackaging their interest and concerns table. The communities confirmed they would like to review the table prior to submission.									✓	✓

Date	Activity	Attendance	Description	Key EA Topics									
				Baseline Conditions	Alternative Means	Project Components	Effects Assessment3	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Interests and Concerns	Engagement Methods
April 13, 2022	Teleconference	1 representatives from Black River First Nation and Hollow Water First Nation 1 representative from CNL	CNL, BRFN, and HWFN discussed setting up a site tour with the core engagement team and CNL's environmental monitoring team.										✓
May 11, 2022	Teleconference	2 representatives from Black River First Nation 2 representatives from Black River First Nation and Hollow Water First Nation 5 representatives from CNL	CNL met with BRFN and HWFN to discuss the status of the WR-1 submission, walkthrough their revised interest and concerns table, environmental assessment process, development of communication materials and other areas of interest.	✓		✓				✓	✓	✓	✓
May 25, 2022	Teleconference	2 representatives from Black River First Nation and Hollow Water First Nation 1 representative from CNL	CNL, BRFN, and HWFN discussed the logistics for the upcoming site tour.										✓
June 9, 2022	In-person	9 representatives from Black River First Nation and Hollow Water First Nation 4 representatives from CNL	CNL hosted the BRFN and HWFN Core Engagement Team for their first site tour.	✓	✓	✓	✓	✓	✓	✓	✓		✓
June 13, 2022	E-mail	5 representatives from Black River First Nation and Hollow Water First Nation 3 representatives from CNL	CNL requested confirmation from the communities that the table was reflective of their interests and concerns.									✓	✓
July 13, 2022	Teleconference	1 representative from Black River First Nation and Hollow Water First Nation 1 representative from CNL	CNL, BRFN, and HWFN discussed the upcoming Treaty days and how CNL could participate.										✓
July 13, 2022	Letter	1 representative from Brokenhead Ojibway Nation 2 representatives from CNL	CNL sent out a letter of notice to BON's Chief informing them that CNL has submitted a draft EIS and requested a meeting to engage on the project.										✓
July 28, 2022	In-person	3 representatives from Black River First Nation and Hollow Water First Nation 3 representatives from CNL	BRFN and HWFN participated in berry picking near the underground research laboratory site.							✓			✓
August 17, 2022	Teleconference	3 representatives from Black River First Nation and Hollow Water First Nation 2 representatives from CNL	CNL, BRFN, and HWFN met to discuss upcoming engagements, explore areas of interest, and updates on decommissioning work.			✓							✓
August 30, 2022	E-mail	5 representatives from Black River First Nation and Hollow Water First Nation 3 representatives from CNL	CNL sent a copy of CNL's monitoring program schedule and requested BRFN and HWFN to identify any activities they would like to participate in.							✓			✓
September 8, 2022	In-person	3 representatives from Black River First Nation and Hollow Water First Nation 3 representatives from CNL	BRFN and HWFN participated in mushroom collection from three locations around the Whiteshell Laboratories Site.							✓			✓
September 14, 2022	Teleconference	2 representatives from Black River First Nation and Hollow Water First Nation 3 representatives from CNL	CNL, BRFN, and HWFN discussed extending the existing relationship agreement and coordinating future environmental monitoring activities.							✓			✓
September 20, 2022	E-mail	4 representatives from Black River First Nation and Hollow Water First Nation 3 representatives from CNL	CNL sent invitation to BRFN & HWFN to participate in a webinar on WR-1 Decommissioning Project.			✓							✓

Date	Activity	Attendance	Description	Key EA Topics									
				Baseline Conditions	Alternative Means	Project Components	Effects Assessment3	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Interests and Concerns	Engagement Methods
September 29, 2022	In-person	9 representatives from Black River First Nation and Hollow Water First Nation 5 representatives from CNL	BRFN and HWFN Knowledge Holders participated in a medicinal plant walk at the Whiteshell Laboratories site							✓	✓		

1.3.6 Black River First Nation (BRFN), Hollow Water First Nation (HWFN), and Brokenhead Ojibway Nation (BON) – Key Interests and Concerns

The Nations' interests go well beyond strict impacts on Aboriginal and treaty rights. They extend to the health of all waters, lands, and beings in the traditional lands; to respectful information-sharing across cultures; and to equitable distribution of project impacts and benefits. We recognize that this table focuses on legal responsibilities relative to impacts on Aboriginal and treaty rights, but the community's concerns should not be interpreted strictly focused on their rights.

For more information on specific interests and concerns expressed by Black River First Nation, Hollow Water First Nation, and Brokenhead Ojibway Nation, refer to their Traditional Knowledge and Land Use Study report and Appendix B of the Indigenous Engagement Report. The First Nations' perspectives are informed by a world view that is distinct from, yet equally valuable to, western science. This includes a holistic perspective on how site impacts may affect the surrounding region; a skepticism about the accuracy of technical predictions; and a humility with respect to human plans to predict and manage future conditions.

In many cases, it may not be possible to alleviate community concerns with scientific answers and discussion. The Nations believe that we have agreed on a path forward focused on ongoing dialogue, engagement, information sharing, and relationship building. The Indigenous Advisory Committee, Community Liaison, and Core Engagement Team are venues to support listening and learning on both sides.

Table Verification

On May 11, 2021, CNL sent BRFN, HWFN, BON a letter requesting their review of the summary of interests and concerns and list of VCs that CNL had developed based on engagements and the communities' TKLUS. CNL asked BRFN and HWFN to verify whether CNL had adequately characterized their interests and concerns. In the letter, CNL offered to provide capacity funding and to meet with communities to discuss the table and list of VC.

On July 7, 2021, BRFN and HWFN provided feedback on the summary of interests and concerns table and list of VCs. CNL met with BRFN and HWFN on August 19, 2021, to go through the feedback received on the summary of interests and concerns table and list of VCs.

CNL incorporated their feedback and on August 26, 2021, CNL provided a revised copy to the communities to show how their feedback was incorporated.

The communities provided additional feedback on September 2, 2021. CNL incorporated the additional feedback and sent the final copy back to the communities on September 9, 2021, along with a thank you letter, extending CNL's appreciation to the communities for participating in the verification process for their summary table of interests and concerns and list of VCs. CNL received a response from Hollow Water First Nation stating that the summary of interest and concerns report was satisfactory with the inclusion of one minor change.

BON confirmed that had received the summary of interests and concerns table and list of VCs but did not confirm whether they intended to participate in the verification process. CNL provided BON with updated copies of the Summary of Interest and Concerns Table and list of VCs on August 30, 2021 and advised BON that BRFN and HWFN had revised the table and list of VCs. CNL asked whether their revisions were also reflective of BON's interests and concerns and VCs. CNL did not receive a response.

Throughout the summer of 2021 reached out by phone and e-mail on May 31 (email), June 17 (phone), June 30 (email), July 13 (phone), August 16, 24, 30, Sept 9, October 6, and 13 (email).

CNL sent an updated copy of the summary of interests and concerns table to include specific references with the BON's technical review of the 2020 draft EIS on October 6, 2021. On October 18, 2021, CNL issued a letter to BON informing them that CNL would be incorporating the table into the EIS and move forward with submission. CNL has not received a response from the community.

On March 7, 2022, CNL informed the Nations that CNL would be repackaging the interest and concerns table to better meet the needs of the CNSC, and requested a meeting to walk through the changes of the table. CNL sent the repackaged table on April 21, 2022 and met with a representative from BRFN and HWFN on May 11, 2022. During the meeting, CNL revised the table based on feedback from BRFN and HWFN. After the meeting, CNL sent a copy of the table to show how CNL had incorporated the Nation's revisions. On May 12, CNL sent a final copy of the table. CNL received confirmation from BON via e-mail on May 5, 2022, that they had conducted their review and found the table still reflected the concerns of BON that were shared during discussions and meetings. Additional updates were made to the status column only of the interests and concerns table and these adjustments were forwarded to the Nations on October 20, 2022. The Nations provided their feedback on November 2, 2022 indicating they had no concerns.

Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
Business and Employment Opportunities			
Brokenhead Ojibway Nation (BON), Hollow Water First Nation (HWFN), and Black River First Nation (BRFN) expressed an interest in Canadian Nuclear Laboratories' (CNL's) procurement requirements for Indigenous businesses. Recognizing that no BRFN, HWFN or BON community members are currently employed at Whiteshell Laboratories (WL), the Nations also expressed an interest in further information regarding employment or business opportunities at the WL site, the potential for directly negotiated contracts with Indigenous businesses, and a concern about their ability to compete with larger businesses for opportunities at the Whiteshell Laboratories Closure Project (WLCP). This is a site-wide interest in enabling BON, HWFN, and BRFN members to participate in the socio-economic benefits resulting from the WL site and the WLCP.	Regarding the WL site's procurement requirements, CNL adjusted the evaluation criteria for competitive bids to encourage greater economic participation by contractors that are Indigenous owned or have Indigenous employees or subcontractors. This was also completed to help address the Nations' concern raised about their ability to compete with larger businesses for contracts at the site. As of 2021, CNL is working to develop an Indigenous procurement strategy to support greater participation of Indigenous owned business and support more Indigenous people in CNL's workforce. The Nations recommended that CNL meet with the Southeast Regional Development Corporation (SERDC) as the best method to explore First Nation capabilities and CNL procurement opportunities. CNL toured SERDC at the WL site, provided details on CNL's procurement requirements, and discussed opportunities for contracting and employment. As a result of engagement with SERDC, SERDC has partnered with Golder Associates Inc. to increase their ability to contract to CNL. To support the Nations' interest in employment opportunities at the site, CNL provided a list of employment opportunities at the WL site and added the Nations' representatives to the employment mailing list to receive updates on employment opportunities at the WL site.	Employment and business opportunities for Indigenous Nations and the Red River Métis (RRM) have been added to the Project VCs in Section 6.9.3: Valued Components. CNL updated Section 6.9.6.2.2: Secondary Pathways and added a discussion of Project impacts on the employment and contract opportunities for Indigenous communities and the Red River Métis (RRM) as well as mitigations that were put in place by CNL to help address socio-economic impacts resulting from the accelerated decommissioning schedule. CNL acknowledges contracting and employment opportunities as priority areas of interest for BON, HWFN, and BRFN and has revised Section 4.2.4.3.2: Interests and Concerns to reflect this.	CNL responded to all questions related to this interest. CNL will continue to engage on the matter of contracting and employment with the Nations through the Chiefs and Councils and the newly hired Community Coordinator in BRFN and HWFN, and will continue to work to remove barriers community members may face in applying for positions. CNL and the Nations will have discussions to review past approaches to supporting Indigenous business and employment, and confirm the best approaches moving forward. Future engagements on this topic are not anticipated to change the assessment outcomes, but may result in additional commitments to the communities.
BON expressed a concern that the Environmental Impact Statement (EIS) does not include data on BON's labour force, employment, and income conditions in the regional baseline and does not inherently link community well-being to the land. This is a project-specific concern by BON that the Whiteshell Reactor-1 (WR-1) Project does not adequately represent BON in the socio-economic assessment and may affect their socio-economic well-being or their Aboriginal and treaty rights.	CNL provided responses to BON's Technical Report on the Revised EIS for the Project in September 2020 and identified it would revise the EIS with current socio-economic data and include data from BON on labour force, employment, and income conditions where available. CNL linked Indigenous well-being to land use by including the concern that the Indigenous communities expressed about the Project potentially limiting their participation in land and resource use activities, which would affect their well-being through the ability to express their culture or exercise Aboriginal and treaty rights in the Community Well-Being Valued Component (VC). CNL then assessed this VC by analyzing any effects the presence of long-lived radioactive material in the In Situ Disposal (ISD) may have on community well-being by assessing the changes to the suitability of the site for future uses, the continued inability to exercise stewardship, and governance over land and resource management decisions. The assessment indicated that there would be no significant residual effects on the community well-being as a result of the presence of WR-1 ISD.	CNL revised Section 6.9.5.2.3.2: Employment by Sector to include all available data on BON's labour force, employment, and income conditions into the regional baseline, as well as noting community well-being is inherently linked to the land. CNL revised Section 6.9.3: Valued Components to link Indigenous communities' well-being to their ability to express their culture and exercise Aboriginal and treaty rights though participation in land and resource use activities. Section 6.9.6.2.2: Secondary Pathways has been revised to make the effects of WR-1 on Indigenous well-being a secondary pathway, acknowledging that the long-term presence of nuclear materials in the region, along with other historical industrial developments in the local study area, had the potential to result in fear, stigma, and anxiety, and that psychosocial effects are legitimate impact pathways affecting the Indigenous community well-being.	CNL addressed this concern by revising the assessment and responding to BON. Future engagement on this topic is not expected to affect the assessment or its outcomes, but may result in additional commitments to BON.
Future Land Use and Tenure of the WL Site			
The Nations are interested in knowing if the WL site land and its resources will be safe, healthy, and available in the future for Indigenous people to re-establish connection to this land for traditional use or economic development using the seven generations approach to land stewardship subsequent to the decommissioning process. This is a site-wide interest.	CNL explained that the liability and land remain with the federal government (Atomic Energy of Canada Limited (AECL)). Decisions on future uses of the land of the whole site are not under the scope of the WR-1 Environmental Assessment (EA) and licence amendment. However, CNL and AECL plan to begin engagement on end state and future land use in 2022. The Nations will be invited to participate in that process. CNL also shared that there is a community regeneration partnership that was formed to develop both nuclear and non-nuclear opportunities for the WL site after the site is decommissioned. CNL participates and supports the partnership. CNL invited Indigenous communities to join.	CNL revised Section 4.2.4.3.2: Interests and Concerns to discuss this interest and to indicate that CNL is committed to engagement on future land use and end-state planning of the site. Section 6.9.6.2.2: Secondary Pathways was also revised to describe the comprehensive relationship agreement signed with BRFN and HWFN to help communities participate in discussions on future land use of the WL site.	While future land use and tenure is out of scope for the assessment for WR-1, CNL will be contacting the communities to participate in discussions on the site wide end state. Planned engagements on future land use and tenure are not expected to impact the conclusions of the assessment; however, may result in additional commitments to the Nations.
The Nations expressed an interest in discussions with the Federal Government about the future of the WL site and potential accommodation, because the WL site occupies a large parcel of land that was removed from Treaty 1 territory without adequate consultation, and the current proposal does not return it in its past condition for unrestricted traditional land use. Future land use decisions, therefore, have the potential to impact their Aboriginal and treaty rights. This is a site-wide interest.	CNL acknowledged that engagement practices in the past were below today's engagement standards and CNL and the Nations agreed that the primary duty to consult on this Project lies with the Crown (Canadian Nuclear Safety Commission (CNSC)). To help address historical concerns with WL siting and future land use, CNL is committed to helping facilitate discussions between CNL, AECL, and the Nations. CNL signed a comprehensive relationship agreement with BRFN and HWFN that supports the establishment of a community committee and a community liaison position, provides support to participate in the Indigenous Advisory Committee and provides capacity support to ensure the communities are able to continue to participate in discussions on future land use of the WL site. BON has opted out of this process, but CNL continues to provide project updates to BON and will respond to any residual concerns they may have regarding the historical siting of the Project. CNL also explained its position that the safety assessment predicts no impact to land, water, traditional foods, or people. However, should impacts resulting from this Project be identified, accommodations would be discussed with impacted communities.	Section 4.2.4.3.2: Interests and Concerns was revised to discuss this interest and to indicate that CNL is committed to engagement on future land use and end-state planning of the site. Section 6.9.5.2.1.1: Indigenous Community Perspectives on and Observations of the Whiteshell Laboratories Site was created to recognize First Nations' and RRM's perspectives on the establishment of the WL site.	CNL has acknowledged the historical lack of engagement in citing the laboratories and will continue to facilitate dialogue between CNL, AECL, and the Nations and will continue to engage the Nations on the Project and closure of the WL site.

Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
BRFN and HWFN wanted to know more about potential plans for a small modular reactor on the WL site. Use of the site for this purpose has the potential to impact their Aboriginal and treaty rights and to prevent or delay restoration of the site to natural conditions. BRFN and HWFN said it was essential that they were engaged as part of this process. This is a site-wide interest.	CNL discussed a potential on-going industrial use and other areas available for agriculture or recreation. A small modular reactor could potentially fit in the proposed end state in the area identified as “industrial use”. CNL explained that any new nuclear project on the WL site, such as a small modular reactor, would need to go through a full licensing process that would include Indigenous engagement. CNL provided BRFN and HWFN with the contact of the Regeneration Partnership Committee who is looking into the potential for having a small modular reactor on site.	Section 4.2.4.3.2: Interests and Concerns was revised to include a commitment that CNL will engage the Nations on the land use and end state of the site. Section 6.9.6.2.2: Secondary Pathways was revised to include a description of potential small modular reactors at the WL site and to state that any such development would require a separate review and approval by CNSC, which would involve Indigenous consultation.	CNL responded to this question to the extent possible at this time. Engagement on the future land use of the site is forthcoming.
Potential Impacts on Winnipeg River Water Quality			
The Nations expressed a concern that the WL site experienced radiological releases in the past, as well as the potential for the Project to release hazardous and radiological materials into the Winnipeg River, which would endanger human and ecological health. The Nations’ holistic worldview highlights the site’s connection to waters and beings along the river system, and the potential for wide-spread impacts from site activities. The Winnipeg River is part of the Nations’ traditional territories where the Nations exercise Aboriginal and treaty rights. Most of the community’s concerns about the historical spills were that people in the community were not aware of these until recently and that past releases from the site have reduced the Nations’ confidence in scientific predictions about its future safety. This is a project-specific and a site-wide concern.	CNL explained that the Project assessed the effects resulting from maximum potential releases of radionuclides from the WR-1 disposal facility, taking into account existing sediment contamination from historical releases, and found that there were no expected health effects, as all potential human and ecological doses were orders of magnitudes below regulatory limits. CNL also confirmed that while historical releases were typically liquid, the WR-1 waste consists primarily of reactor metals, and the release of radiological and hazardous materials is controlled by the slow metals corrosion rate. The Project therefore cannot release significant volumes of liquid waste that would be mobile in the environment and endanger human or ecological health. Movement of the radionuclides from the WR-1 facility through the environment would be detected through groundwater monitoring long before reaching the river or any receptors. CNL explained that the assessments for the Project use conservative estimates for all aspects of the Project, ensuring that the worst case scenarios are assessed. The assessment indicated that even using a conservative modeling approach, human and ecological health will not be endangered in the future by the presence of WR-1. CNL explained that there were releases to the river in the past, and that the river sediments were investigated and assessed during the 2001 Comprehensive EA. The assessment concluded that using the most conservative methods, doses to humans and non-human biota are below accepted guidelines. The analysis methodology and results were peer-reviewed and are available in the open publication of the Comprehensive Study Report. CNL has provided the Nations with a short summary report of the historical spills, which have now been shared with the Core Engagement Teams and CNL is working on preparing infographics for the communities to better communicate information like this to community members in the future. The Summary report on the historic spills consisted of information on an independent task force that consisted of Sagkeeng First Nation, Indian and Northern Affairs, Health Canada, and Environment Canada that assessed the impact from WL site. In its 1995 report, the Task Force concluded that *“it is unlikely that the AECL Whiteshell Laboratories has ever posed a significant threat to the health of Sagkeeng residents, nor is there apparently any prospect of such a threat in the future.”* The CNSC conducted an independent monitoring campaign in 2017 with assistance from Sagkeeng First Nation. This independent program included collecting and analyzing fish caught near Sagkeeng First Nation. The results of the assessment conclude that the public and the environment in the vicinity of WL are protected and there are no expected health impacts. CNL also explained how it proposes to use future groundwater monitoring to confirm the modeling predictions and verify that the releases to the environment pose no danger.	CNL had previously assessed past releases from the WL site and included a summary in Section 6.7: Human and Ecological Health of the EIS. The radiological inventory was confirmed to be localized in the reactor core metals and is presented in Section 3.3.3: Waste Classification, Inventory and Characterization of the EIS. CNL had already identified water quality as a VC (Section 6.5: Aquatic Environment of the EIS) and considered various pathways for radionuclide release in Section 6.7: Human and Ecological Health of the EIS. CNL expanded the description of the proposed monitoring program in Section 11: Summary of Monitoring and Follow-up Programs of the EIS and included Section 11.4 Indigenous Engagement and Participation in Environmental Monitoring, which includes the CNL commitment to involve BRFN and HWFN in long-term monitoring at the WL site.	Recognizing that historical releases into the Winnipeg River will continue to be an area of interest for the communities, CNL has established an Indigenous Advisory Committee and funding Core Engagement Teams in HWFN and BRFN to be forums to discuss and further address this area of interest from both the western scientific and Indigenous knowledge perspectives. Future engagement on this topic is not anticipated to change the outcome of the assessment; however, may result in additional environmental monitoring commitments to the Nations.
The Nations were concerned that the close proximity of the WL site and the Project to the river will contaminate the river through contamination of the soil. They were also interested in the CNL spill detection process. The Nations want to ensure their traditional lands as well as their Aboriginal and treaty rights to use lands, water, and resources are not impacted by site and Project activities. Again, the Nations’ holistic worldview highlights the site’s connection to waters and beings along the river system, and the potential for wide-spread impacts from site activities. Past releases have reduced the Nations’ confidence in scientific predictions about its future safety. This is both a site-wide and project-specific concern.	CNL explained that the Project provides multiple barriers to ensure that the environment and the river remain safe and that the EIS assesses the Project’s impact on the river and determined it will remain safe. CNL explained that the soil properties at the WL site determine how well releases are contained in the soil and that for ISD of WR-1, contaminant releases are primarily limited by a significant portion of the contaminants being contained within the metals of the reactor, which corrode very slowly. CNL further explained that other barriers (such as the low-permeability clays surrounding the WR-1) provide additional resistance to contaminant movement. CNL explained that groundwater monitoring wells around the ISD facility would be the primary means of monitoring for contaminant releases. CNL has modelled how much contaminants will be released during normal life of the facility, and if contaminants are being released in quantities of concern above the expected amount, this would show up in the groundwater monitoring and remedial actions would be taken. With respect to the rest of the WL site, all radioactive waste at the site is safely and securely stored in the site’s Waste Management Area (WMA) and are covered by the 2001 Comprehensive Study Report, which assessed their impact on the river and determined it will remain safe.	CNL confirmed that the assessment predicts no impact to the river in Section 6.4.2.7.2: Application Case Results. Section 6.3: Geological and Hydrogeological Environment of the EIS confirms the low permeability of the surrounding geosphere. CNL also assessed the likelihood and consequence of spills in Section 7.3.3: Material Handling Accidents of the EIS and confirmed that if spills do occur during closure activities, CNL has sufficient experience and controls in place to limit negative effects on human health and the environment. CNL expanded the description of the proposed monitoring program in Section 11: Summary of Monitoring and Follow-up Programs of the EIS and included Section 11.4: Indigenous Engagement and Participation in Environmental Monitoring, which includes the CNL commitment to support BRFN and HWFN in long-term monitoring at the WL site.	CNL has addressed this concern to the extent possible at this time. Staff will continue to engage in dialogue with the Nations, looking to build trust through sharing scientific analyses, and listening Indigenous knowledge-holder perspectives. Future engagement on this topic is not anticipated to change the outcome of the assessment; however, may result in additional environmental monitoring commitments to the Nations.

Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
The Nations expressed that some of their primary concerns with the Project relate to the potential for the contamination of groundwater which, due to its close proximity to the Winnipeg River, could also contaminate the river. The Nations exercise their Aboriginal and treaty rights to use lands and resources along the Winnipeg River and adjacent lands. The Nations have recommended independent Indigenous-led monitoring to confirm and build trust in scientific monitoring results. This is a project-specific concern.	During site tours with the Nations, CNL explained that the Project incorporates multiple barriers to ensure the river remains safe and the EIS assesses the Project's impact on the river and determined it will remain safe. During the institutional control period, surface water and ditch system water is planned to be sampled on a semi-annual basis at one upstream and two downstream locations, with frequency of recurrence being assessed based on the data collected. Predicted groundwater concentrations of non-radiological contaminants were screened against various federal and provincial drinking and aquatic life water quality guidelines, with cadmium, HB-40, lead, and xylene being the only contaminants requiring further investigation. Further investigation identified that the predicted groundwater concentrations would be protective of humans and animals. Groundwater concentrations of radionuclides were not directly assessed as there is no realistic pathway for humans or animals to come into contact with contaminated groundwater; however, river water concentrations were assessed and shown to be protective of humans and animals. The unlikely scenario of a farmer having a groundwater well halfway between WR-1 and the Winnipeg River was assessed as an upset conditions and was found be acceptable. CNL has committed to adding additional groundwater monitoring well(s) between WR-1 and the river as a result of Indigenous engagement, and welcomes a discussion with the Nations on preferred locations. CNL has prepared a memo that includes a complete list of openings and services that penetrate through the building foundation, material recommendations, and recommended procedures to sever these services and seal the penetrations. This memo will guide the contractor responsible for the grout filling of the WR-1 building, who will prepare detailed engineering designs to execute this work. CNL explained that during closure activities, there is a very low potential for the transport of uncontrolled site runoff to the Winnipeg River. Any liquid effluent collected inside the WR-1 building during decommissioning activities will be held, tested, and processed by the Low Level Liquid Waste Treatment System. Any effluent coming through groundwater sumps is routed through the storm water system to the outfall station, where all liquid effluent from the WL site is sampled and tested. Surface water from around the WR-1 building is intercepted by a series of road gutters, where it is captured and routed through the site storm water system. After the WR-1 building systems are taken offline, any construction sump water will be collected and tested prior to release. At community meetings and site tours, CNL has explained the proposed decommissioning process and how the proposed ISD facility uses many barriers to safely contain the waste.	CNL confirmed that the health of the Winnipeg River and those who depend on it is a VC for the Project and was determined to be safe through the assessment of: ▪ Section 6.4.2 (Surface Water Quality) ▪ Section 6.5 (Aquatic Environment) ▪ Aquatic biota in Section 6.7.2.7.2 (Application Case – Post-closure Phase). ▪ Health of humans that consume aquatic biota, drink Winnipeg River water, and may be exposed to groundwater through a well in an unlikely case in Section 6.7.1.7.2 (Application Case – Post-closure Phase). CNL added Section 11.4 (Indigenous Engagement and Participation in Environmental Monitoring), which includes CNL's commitment to support BRFN and HWFN's participation in long-term monitoring at the WL site, as well as commitments to improve CNL's environmental monitoring program by providing additional groundwater well(s) and sampling and monitoring of country harvested food.	Recognizing that environmental monitoring will continue to be an area of interest for the communities, CNL has addressed this concern to the extent possible at this time by signing a relationship agreement with HWFN and BRFN and identifying monitoring opportunities for the Nations. CNL will continue to communicate its monitoring procedures and outcomes with the Nations and has committed to further discussion about the concept of Indigenous-led independent monitoring at the site. Future engagement on this topic is not anticipated to change the outcome of the assessment; however, may result in additional environmental monitoring commitments to the Nations.
Waste Management			
BON, HWFN and BRFN expressed an interest in the types and quantities of waste that will be transported to Chalk River. The Nations are concerned about a potential waste transportation accident impacting human health and the environment. BRFN and HWFN community members also wanted to learn more about the environmental and social implication of moving this waste to the traditional lands of other First Nations. This is both a project-specific and site-wide concern.	CNL explained the amount of waste material that will be transported to Chalk River Laboratories (CRL) for storage as part of the Project. Approximately 3,000 m^3 (5.4 Mg) of radioactive waste is estimated to be shipped to the CRL site as part of the Project. The shipment of nuclear materials is a highly regulated process. CNL has procedures in place to ship the waste in accordance with the federal Packaging and Transport of Nuclear Substances Regulations. CNL maintains a response plan and a team that works together with Transport Canada emergency services to respond to any road accident involving nuclear materials. All waste is transported in packages that are selected based on the nature, form, and quantity or radioactivity of the waste. There are design requirements that apply to all waste package types to ensure that they can be handled safely and easily, that they can be secured properly, and that they are able to withstand routine transport conditions. The WL site possesses over 50 years of experience in shipping and receiving radioactive material and has never had an incident that compromised the safety of workers, the public, or the environment. The EIS assessed the risks resulting from transportation of Project waste off-site and determined that the risk and consequence severity of transportation accidents involving nuclear materials is low due to existing controls on transport of nuclear materials and the requirements for waste packaging. CNL provided support to BRFN and HWFN that would allow their Core Engagement Team to support greater community engagement and relationship building between the Nations and CNL. This would also support the Core Engagement Team to meet (virtually) with representatives of First Nations associated with the CRL site to learn more about their perspectives on nuclear waste in their lands. CNL also provided contact information of First Nations, with the First Nation's permission, near CRL.	CNL confirmed that the risk and consequence severity of transportation accidents involving nuclear materials was assessed to be low in Section 7.3.4: Off-site Transportation Accidents; no changes to the assessment were required. CNL updated Section 3.4.8: Waste Generation and Management with a reference to the Detailed Decommissioning Plan as this is where the waste volume estimates are documented.	CNL has responded to this interest to the extent possible at this time, but will continue to answer any further questions related to waste management as they arise. Future engagement on this topic is not anticipated to change the outcome of the assessment; however, may result in additional environmental monitoring commitments to the Nations.

Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
Monitoring			
The Nations expressed an interest in CNL's monitoring activities, specifically related to the contamination in the sediment at the Winnipeg River bed. In their Traditional Knowledge and Land Use Study (TKLUS), the Nations expressed an interest in further discussing the rationale for river sediment sampling at 20-year intervals, believing that more frequent sampling is likely needed. This is a site-wide concern. The communities want to ensure that human and ecological health in their traditional lands is not affected by past or future contamination of the riverbed because the river and surrounding lands and waters support exercising of Aboriginal and treaty rights in the vicinity of the project site.	CNL explained that the sediment is sampled annually at the locations up and down stream of the outfall station, near the WL site. The 20-year interval refers to a wider program that is used to establish and update the baseline to determine possible wider effects from the WL site. The Project assessed the effects resulting from maximum potential releases of radionuclides from the WR-1 disposal facility taking into account existing sediment contamination from historical releases, and found that there were no expected health effects, as all potential human and ecological doses were orders of magnitudes below regulatory limits. CNL confirmed that historical releases were typically liquid, and the WR-1 waste consists primarily of reactor metals. This means that release of radiological and hazardous materials is controlled by the slow metals corrosion rate. The Project therefore cannot release significant volumes of liquid waste that would be mobile in the environment and endanger human or ecological health. Movement of the radionuclides from the WR-1 facility through the environment would be detected through groundwater monitoring long before reaching the river or any receptors. Contamination present in the riverbed sediments as a result of past releases does not present a hazard to aquatic life or humans that consume fish. CNL tests fish twice a year at two locations downstream of the WL site and confirmed that there is no significant accumulation of radioactivity in the fish flesh, indicating that there is no hazard to human health from consumption of fish. CNL also tested the sediment, and organisms that live in and on the sediment near the WL outfall station, and the results indicated that the contamination in these organisms is well below the benchmarks and thresholds that would cause effects on human or aquatic life health. Since the past releases, which can no longer occur, have been shown to not affect the health of the environment, and the future releases predicted to be negligible, CNL does not expect additional sediment monitoring to be beneficial. However, to help mitigate concerns over the health of the Winnipeg River and overall environment, CNL is committed to working with the Nations to support their participation in long-term monitoring at the WL site.	CNL documented its assessment of historical sediment contamination in Section 6.4.2.5.2.2: Surface Water and Sediment Quality. CNL documented its assessment of the effects of sediment on the aquatic environment in Section 6.5.5.2.4: Benthic Macroinvertebrates and Zooplankton. CNL documented its current proposed monitoring plan in Section 11.0: Summary of Monitoring and Follow-up Programs of the EIS. CNL added Section 11.4: Indigenous Engagement and Participation in Environmental Monitoring, which includes CNL's commitment to support BRFN and HWFN's participation in long-term monitoring at the WL site.	CNL has responded to this interest to the extent possible at this time, and anticipates this interest to be fully addressed once the monitoring program is implemented with Indigenous Nations participation, and through ongoing dialogue between CNL environmental staff and local knowledge-holders. Future engagement on this topic is not anticipated to change the outcome of the assessment; however, may result in additional environmental monitoring commitments to the Nations.
The Nations are interested in knowing more about the current and future monitoring plans, particularly about how plant, fish and wildlife will be tested, and how Nation members and youth can participate in environmental monitoring, independently and as part of the CNL program. The Nations want to ensure that a robust monitoring program is in place to confirm the safety of all beings in the region, and that Aboriginal and treaty rights to use lands and resources near the WL site are not impacted by the Project activities. The TKLUS report recommends extending site monitoring from the proposed 300 years to a 1,000 year timeframe. It also recommends funding the Nations to conduct independent monitoring of the site, drawing on technical and traditional knowledge-based monitoring. This is a site-wide and a project-specific interest.	CNL explained the current monitoring program and how it is carried out to confirm that site operations and closure work do not impact the environment. The 2001 Comprehensive Study Report, which enables decommissioning of the WL site, includes an EA Follow-up Program (EAFP). This is a commitment made by AECL, and executed by CNL, that provides ongoing environmental monitoring. This program is committed to continue following site closure. The current monitoring program includes testing the following for radiological and non-radiological contaminants: ▪ Air Monitoring on and off-site; ▪ Air Effluent from WL site facilities; ▪ Noise; ▪ Topography (site fencing and ditches); ▪ Surface Water (Winnipeg River, WMA ditches and facilities, Lagoon, Main Campus facilities); ▪ Atmospheric Deposition (off-site); ▪ Groundwater (WMA, Main Campus, Landfill, Lagoon); ▪ Liquid Effluents (Buildings 100/300 tanks, Outfall Station, Sewage Lagoon, ditches); ▪ Sediment (Winnipeg River); ▪ Fish and wildlife (Deer, Bear, Rabbit, Grouse); ▪ Garden Crops (off-site); ▪ Honey/Canola (off-site); ▪ Beef/Pork/Lamb/Poultry (off-site); ▪ Native Vegetation (site perimeter, WMA); ▪ Soil/Sediments (WMA, Lagoon, Landfill); ▪ Species at Risk (Barn Swallows, Bats, on site); ▪ Wildlife Mortality (site access road). CNL already samples and tests some of the fish, plants and animals that the Nations expressed a concern about. To help address the Nation's concerns and include specific feedback on the existing environmental monitoring activities, CNL is committed to reviewing and adapting the existing EAFP for the WL site to incorporate Indigenous Traditional Knowledge that has been collected through the EA for the Project, as well as ongoing engagement and relationship building, in order to provide each community with the information that is relevant and important to them. The program will be modified to include monitoring of traditional foods as identified by Indigenous peoples. For example, one of the Indigenous communities' recommendation was to include mushroom collection into the sampling program. CNL since adjusted its environmental protection program to include mushroom collection and CNL continues to look for additional ways to improve their monitoring program.	Section 4.2.4.3.4: Next Steps was updated with CNL commitments to establish an Indigenous Advisory Committee and to support Indigenous participation in environmental monitoring. Section 11.1: Environmental Assessment Follow-up Program was revised to provide an updated description of the proposed monitoring program for the Project and the overall WL site. Section 11.2: Adaptive Management was updated with a CNL commitment to review and adapt the existing EA Follow-up Program for the WL site to incorporate Indigenous Traditional Knowledge that has been collected through the EA for the Project. Section 11.4: Indigenous Engagement and Participation in Environmental Monitoring was updated to include CNL commitments to work with the First Nations and the RRM to develop an Indigenous stewardship monitoring initiative.	CNL has responded to this interest to the extent possible at this time and anticipates it to be fully addressed once the monitoring program is implemented with Indigenous Nations participation. CNL has committed to ongoing dialogue with the Nations, including a discussion about possible independent monitoring by BRFN, HWFN, and BON. Future engagement on this topic is not anticipated to change the outcome of the assessment; however, may result in additional environmental monitoring commitments to the Nations.

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	CNL is also committed to including members from the Nations in its ongoing environmental monitoring program and will: ▪ Continue to send a list of environmental monitoring activities and continue to invite the communities to participate; ▪ Host a workshop to discuss how CNL can meaningfully include Traditional Knowledge and different ways of knowing into CNL's environmental protection programs; ▪ Engage with the Nations on the end state of the WL site; and ▪ Send the communities the annual monitoring reports along with an easy-to-read summary page explaining the results and main conclusions. CNL explained the monitoring program proposed for the Project during and after closure. The post-closure program for the Project is currently proposed to operate for 100 years as part of the Institutional Controls; however, it will continue until the Canadian Nuclear Safety Commission agrees that institutional controls are no longer needed. CNL proposes the 100 year period because it is sufficient to verify the predicted effects, and it is reasonable to assume that current institutional systems will remain in place until then. Beyond 100 years there is less certainty that the institutional systems will continue to exist. Monitoring activities will be adaptive in nature, increasing or decreasing in scope and frequency depending on the results. Monitoring activities for the Project will be coordinated with and integrated into the existing EAFP, over and above the current monitoring activities, and will be carried out through the existing Environmental Monitoring programs. Monitoring activities for the Project were proposed based on the only credible exposure pathway being through groundwater releases, and will primarily include: ▪ Physical Monitoring (erosion, vegetation, drainage, fencing); and ▪ Groundwater sampling and testing (additional wells around WR-1). To provide an opportunity for the Indigenous Nations and the RRM to be involved in ongoing environmental monitoring for the site and the Project, CNL has committed to supporting the Nations' participation in long-term environmental monitoring at the WL site. Some of the key elements of the initiative may include: ▪ Expansion and evolution of the monitoring program at WL through incorporation of feedback, recommendations, and Traditional Knowledge (e.g., how future monitoring on the WL site could incorporate Indigenous interests, such as locations where the community fishes or harvests in proximity to the WL site); ▪ Capacity development including training in environmental monitoring; and ▪ Opportunities for monitors from each First Nation and the RRM to collect samples on-site and in the surrounding area. CNL, BRFN, and HWFN signed a comprehensive relationship agreement, on April 6, 2021, to support greater community involvement in the Project. While BON has opted out of this process, CNL continues to make efforts to engage on the Project.		
In Situ Disposal of WR-1 Technical Approach			
BON, HWFN, and BRFN are concerned that the Project may impact the environment in the long term. Their Indigenous world view teaches that all land, water, and beings are intricately connected and that humans must be humble and modest in their attempts to influence/control nature. They were interested in understanding the scientific perspective on the proposed ISD of WR-1, including how long radioactive materials will take to decay, to ensure the safety of all beings in traditional lands stewarded by these Nations. Any environmental impacts would have the potential to impact on Aboriginal and treaty rights to use lands and resources near the WL site. This is a Project-specific concern.	CNL provided details to the Nations that the amount of time for radioactive materials to decay depends on the specific radioactive material. Some of the radioactive material associated with WR-1 will decay away in less than a year; other radioactive material will take approximately 140,000 years to decay away. Typically, the radioactive materials that take longer to decay away are contained within the metals of the reactor, which corrode very slowly, limiting releases to safe levels. WR-1 and its systems will be permanently encased, below grade, in grout, and a reinforced concrete cap and a multi-layered engineered cover (earthen cover) will be constructed on top of the grouted area. The grout and WR-1 will eventually saturate with groundwater and WR-1 will begin its very slow corrosion. CNL explained that ISD is safe and that even if the concrete foundation significantly fails (for example, from a very large earthquake), doses to the most exposed receptors are estimated to be much less than the doses received from natural background radiation from just living on the Earth. At community meetings, CNL explained the proposed decommissioning process and how the proposed ISD facility uses many barriers to safely contain the waste. In 2018, CNL invited the communities to send representatives on the benchmarking trip to Hallam, Nebraska. Collectively, BRFN, BON, and HWFN sent representatives from BRFN and BON. This trip included a tour of a reactor that underwent ISD in 1969. The trip attendees were able to speak to the Mayor of the local community, the state and federal regulators that monitor the facility, and the company that owns the site and performs the ongoing monitoring work. In March 2019, CNL supported a Councillor from BRFN to attend the Waste Management Symposia in Phoenix, Arizona. This trip was intended to provide a cooperative learning opportunity for BRFN. Councillor Johnston was able to attend conference presentations and interact with regulators,	This interest did not change the outcome of the EIS; however, more information related to this interest can be found in the following sections: ▪ Section 9.3: Summary summarizes the results of the EA. ▪ Section 3.4.6: In Situ Disposal provides information on what will happen to WR-1. Section 6.7.1.7.2.2: Results provides information on the impact of a significant failure of the concrete foundation.	CNL addressed this concern to the extent possible at this time. Recognizing that environmental protection and the design and integrity of the ISD will continue to be an area of discussion with the Nations, and with the relationship agreement in place, CNL has put in place a forum to share information, hear knowledge-holder perspectives and make efforts to address residual areas of concern. Future engagements on this topic are not likely to affect the assessment or its conclusions; however, they may result in additional environmental monitoring commitments to the Nations. CNL will continue to provide Project updates to BON.

Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
	government representatives, and contractors. Councillor Johnston also participated on a panel session regarding Indigenous engagement in nuclear projects.		
BON, HWFN, and BRFN are concerned that the Project may impact the environment. The TKLUS report notes that the Laboratories have been in their traditional lands, uninvited, for over 60 years. The Nations are concerned that in contrast to a complete removal, in-situ decommissioning will maintain the footprint of the site for thousands of years, with the potential for future contamination from decaying materials. They were interested in learning how ISD was chosen as the preferred decommissioning method and considering its impacts compared to other decommissioning options. They want to ensure maximum safety for waters, lands, and beings in their traditional lands and those of other Nations. The Nations do not want their Aboriginal and treaty rights to use lands and resources near the WL site to be impacted by the Project. This is a Project-specific concern.	CNL met with the Nations and discussed how ISD was chosen as the preferred decommissioning method for WR-1 through an assessment of alternatives conducted consistently with the CNSC's Generic Guidelines for the Preparation of an EIS and the Canadian Environmental Assessment Act's (CEAA's) Operational Policy Statement: Addressing the "Purpose of" and "Alternative Means" under CEAA, 2012. CNL explained how ISD was determined to be safe and practical given the characteristics of the land and the site as well as a safe option for workers. The multi-barrier design ensures the environment will remain safe. Feedback from nearby communities on the chosen decommissioning method may lead to additional measures to mitigate or accommodate potential impacts of the Project. In 2018, CNL invited the communities to send representatives on the benchmarking trip to Hallam, Nebraska. Collectively, BRFN, BON, and HWFN sent representatives from BRFN and BON. This trip included a tour of a reactor that underwent ISD in 1969. The trip attendees were able to speak to the Mayor of the local community, the state and federal regulators that monitor the facility, and the company that owns the site and performs the ongoing monitoring work. On April 6, 2021, CNL, BRFN, and HWFN signed a comprehensive relationship agreement to support greater community involvement on the Project. The relationship agreement supports the establishment of a community committee and a community liaison position, provides support to participate in the Indigenous Advisory Committee, and provides capacity support to ensure meaningful participation and engagement throughout the EA process. BON opted out of this process, but CNL has continued to make efforts to engage on the Project.	The assessment criteria for evaluating safety and environmental effects were expanded and additional details were added through the development of the EIS as a result of feedback from the public and Indigenous peoples at engagement events, where discussion and evaluation of alternatives and assessment criteria were presented. Furthermore, the analysis was revised to clarify that this assessment is not intended to try to determine a "best" alternative, which is highly subjective. It instead considers only alternatives that can all safely achieve the Project goals and identifies the alternative that makes the most sense given the current circumstances. More information related to this interest can be found in the following sections: ▪ Section 9.3: Summary summarizes the results of the EA. ▪ Sections 2.5: Alternative Means of Carrying out the Project to 2.7: Conclusion provides the details of CNL's alternative means assessment.	CNL addressed this concern to the extent possible at this time. Recognizing that environmental protection and the design and integrity of the ISD will continue to be an area of concern for the Nations, and with the relationship agreement in place, CNL has put in place a forum to share information, hear community perspectives, and discuss ongoing areas of concern. Future engagements on this topic are not likely to affect the assessment or its conclusions; however, they may result in additional environmental monitoring commitments to the Nations. CNL will continue to provide Project updates to BON.
BON, HWFN, and BRFN are concerned that the Project may impact the environment. They were interested in possible effects of climate change and natural disasters on the Project and specifically on the grout as they want to ensure that their traditional lands are safe for all beings. They believe that any radiation affecting the environment could in turn affect Aboriginal and treaty rights to use lands and resources near the WL site. This is a Project-specific concern.	CNL discussed the use of grout in the ISD design and explained that ISD is safe and that even if the concrete foundation significantly fails (for example, from a very large earthquake), doses to the most exposed receptors are estimated to be much less than the doses received from natural background radiation from just living on the Earth. CNL provided details on how climate change was assessed in the ISD design stating that Climate change has been assessed through specific scenarios such as the low river stage scenario for drought conditions and the alternative model boundary for the cover scenario for erosion of the engineered cover as a result of flooding. For the low river stage scenario, the stage of the river was set 2 m below current conditions, increasing groundwater velocities in the bedrock pathway; however, radiological releases were not significantly impacted and doses to receptors would still be much less than the public limit. For the alternative model boundary for the cover scenario, the infiltration rate of surface water through the cover was significantly increased, increasing water flow through the grout; however, radiological releases did not see a proportion increase and doses to receptors would still be much less than the public limit. A seismic hazard analysis was completed for the WL site and found that for a 1 in 10,000-year earthquake, there should be no cracking or displacement of any portion of the facility. However, significant failure of the concrete foundation (for example, from a very large earthquake) was still assessed and doses to the most exposed receptors are estimated to be much less than the doses received from natural background radiation from just living on the Earth. At community meetings, CNL explained the proposed decommissioning process and how the proposed ISD facility uses many barriers to safely contain the waste. The EIS assessed the Project's impact on the environment in the face of climate change and natural disasters and determined the environment will remain safe.	CNL updated the description of grout, properties, and material testing carried out in Sections 3.4.6.2: Grouting of Below-Grade Structures and Systems and 3.4.9.1.2: Grout. Section 6.7.1.7.2.2: Results provides information on the impact of a significant failure of the concrete foundation. Sections 10.4: Seismic Events and 10.5: Climate Change provide information on seismic events and climate change. Section 9.3: Summary summarizes the results of the EA.	CNL addressed this concern to the extent possible at this time. Recognizing that environmental protection and the design and integrity of the ISD will continue to be an area of concern and discussion with the Nations, and with the relationship agreement in place, CNL has put in place a forum to share information, listen, and make efforts to address residual areas of concern. Future engagements on this topic are not likely to affect the assessment or its conclusions; however, they may result in additional environmental monitoring commitments to the Nations. CNL will continue to provide Project updates to BON.

Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
The Nations expressed a number of concerns about the Project Accident and Malfunction assessment. Concerns ranged from the safety, condition and integrity of the concrete barriers, to bank stabilization and permanent erosion control measures, to the validity of CNL computer models. Accidents and malfunctions pertaining to any of these elements can result in releases of radiological and hazardous materials into the environment, affecting human and ecological health. Impacts on ecological health have the potential to impact Aboriginal and treaty rights to use lands and resources near the WL site. This is a Project-specific concern.	CNL met with the Nations and discussed the Project design in detail. CNL provided responses to questions on the integrity of the grout and explained that CNL evaluated the integrity of the existing concrete foundation and extensively tested the grout fill material to confirm they meet the required properties. CNL also used modelling to confirm the safety of the disposal facility even if the concrete barriers degrade rapidly or if the facility suffers significant damage. All assessments indicated that the health of the environment and humans would be protected. CNL also provided information on how the EIS compiled a study of the geological environment surrounding the WR-1 disposal facility. Erosion potential of the riverbank at WL was deemed low and the river may be restricted to its current position by geologic features. CNL also carried out assessments to determine the effect of potential erosion bringing the shore of the river closer to the WR-1 facility and found that it will not have significant effects on the releases from the facility. CNL validated its assessment by using industry specialists to carry out the modeling and through multiple reviews of the model inputs and results. The models were validated through physical studies of the WR-1 facility, local geology, grout and concrete properties and by comparing model outputs to current conditions. Modeling included not only the typical scenarios but also extreme conditions, where rapid facility degradation or major external events were assessed. Human and ecological health were confirmed to be safe through all of the assessed conditions. This provides confidence in the predicted results and the modelling approach.	CNL updated the description of grout, properties, and material testing carried out in Sections 3.4.6.2: Grouting of Below-Grade Structures and Systems and 3.4.9.1.2: Grout. CNL included these concerns in Section 6.7.1.2: Indigenous Engagement Feedback – Key Interests and Concerns and confirmed that there would be no significant negative effects on human and ecological health resulting from rapid failure of the facility, including grout, in Sections 6.7.1.7.2.1: Methods and 6.7.2.7.2.1: Methods. The risk of riverbank erosion affecting the safety of the WR-1 ISD is assessed in Section 6.3.1.5.2.2: Local Geological Conditions.	CNL addressed this concern to the extent possible at this time. Recognizing that environmental protection and the integrity and design of the ISD will continue to be an area of sharing and discussion for the Nations, and with the relationship agreement in place, CNL has put in place a forum to discuss and make efforts to address residual areas of concern. Future engagements on this topic are not likely to affect the assessment or its conclusions; however, they may result in additional environmental monitoring commitments to the Nations. CNL will continue to provide Project updates to BON.
BON, HWFN, and BRFN are concerned about the accuracy of CNL's scientific models, and are skeptical of the ability of technical experts to predict and manage all future scenarios because the Project is making predictions thousands of years into the future. Anishinaabe knowledge cautions against human arrogance in trying to control, manage, or predict the future of the natural environment. Anishinaabe Traditional Knowledge holders identified that they have seen that when predicting hundreds or thousands of years in the future, it is difficult to be confident in scientific predictions. The Nations want to ensure that the Project does not impact the health of waters, lands, and beings in the region. Impacts to the environment have the potential to affect Aboriginal and treaty rights to use lands and resources near the WL site. This is a Project-specific concern.	CNL engaged the Nations on the modeling used in the assessments of the Project and CNL agrees that predicting hundreds or thousands of years into the future is difficult. To build confidence in these predictions, CNL has: ▪ Designed the model based on actual measured site and building properties. ▪ Identified which features and properties of the WR-1 disposal facility have the greatest potential effect on the safety through sensitivity analyses. ▪ Used conservative values in the assessment wherever a range of values was possible. ▪ Assessed various alternative scenarios (Sensitivity Analysis Cases) to directly examine the effect of important uncertainties in the models and data. ▪ Modelled a normal evolution scenario for the most likely life of the facility, as well as various disruptive events, which confirmed that human and ecological health would be safe even under unlikely extreme events. ▪ Compared the Project to natural and man-made analogues to provide supporting evidence. ▪ Compared the Project to other ISD projects. ▪ Subjected safety analysis documentation to third party reviews. At community meetings, CNL explained the proposed decommissioning process and how the proposed ISD facility uses many barriers to safely contain the waste. In 2018, CNL invited the communities to send representatives on the trip to Hallam, Nebraska, to see a completed ISD reactor decommissioning project. Collectively, BRFN, BON, and HWFN sent representatives from BRFN and BON. This trip included a tour of a reactor that underwent ISD in 1969. The trip attendees were able to speak to the Mayor of the local community, the state and federal regulators that monitor the facility, and the company that owns the site and performs the ongoing monitoring work.	This concern did not impact the EIS; however, more information related to this concern can be found in the following sections: ▪ Section 3.4.9: End-State and Post-closure Activities contains the description of the ISD system, its properties, and the defense-in-depth strategy. ▪ Section 6.3.1.5: Description of the Environment for the geological studies carried out for the Project. ▪ Section 6.3.2.5: Description of the Environment for the hydrogeological studies carried out for the Project. ▪ Section 6.4.2.7.2: Application Case Results provides the results of the surface water quality assessment. ▪ Sections 6.3.2.8: Prediction Confidence and Uncertainty, 6.4.2.8: Prediction Confidence and Uncertainty, 6.7.1.8: Prediction Confidence and Uncertainty, and 6.7.2.8: Prediction Confidence and Uncertainty provide information on the prediction confidence and the relevant sensitivity analyses.	CNL addressed this concern to the extent possible at this time. Recognizing that environmental protection and the integrity and design of the ISD will continue to be an area of discussion with the Nations, and with the relationship agreement in place, CNL has put in place a forum to discuss, listen, learn, and make efforts to address residual areas of concern. Future engagements on this topic are not likely to affect the assessment or its conclusions; however, they may result in additional environmental monitoring commitments to the Nations. CNL will continue to keep BON informed on the Project.
The Nations are interested in re-evaluating the decommissioning approach in favour of full removal of waste from the WL site but are also concerned that removing waste would mean moving it to other Nations' traditional territories. The TKLUS report notes that the Laboratories have been in their traditional lands, uninvited, for over 60 years. In contrast to a complete removal, in-situ decommissioning will maintain the footprint of the site for thousands of years, with the potential for future contamination from decaying materials. They want to ensure that the presence of WR-1 waste does not harm the environment or impact the ability of their or other Nations to exercise Aboriginal and treaty rights in their traditional lands. This is a project-specific concern.	CNL met with the Nations to discuss the alternative means assessment used in the Project. ISD was chosen as the preferred decommissioning method for WR-1 through an assessment of alternatives conducted consistently with the CNSC's Generic Guidelines for the Preparation of an EIS and the CEAA's Operational Policy Statement: Addressing the "Purpose of" and "Alternative Means" under CEAA, 2012. CNL received feedback from the Nations on full removal being the preferred alternative. CNL used this feedback to conduct a critical review and reflection of CNL's alternative means assessment and working assumptions. CNL concluded that its own alternative means assessment and findings remain valid because the proposed ISD approach fulfills the wider objectives for the Project than simply removing the radioactive material from the WL site. CNL stated that full dismantling, as described in the 2001 Comprehensive Study Report, is not a guarantee of removal of all waste from the WL site because there currently is no available storage facility at the CRL site. Dismantling will therefore not ensure immediate removal of waste from the site, full access to the lands, or necessarily a reduction in associated stigma. Setting up a permanent disposal facility elsewhere would require a similar EA and consultation effort with the nearby Indigenous Nations. The Project incorporates multiple barriers to ensure the environment remains safe and the EIS assesses the Project's impact on the environment and human health and determined the ISD to be safe. CNL also reviewed its assessment against TKLUSs provided by Indigenous Nations and the RRM and updated or validated the assessment modelling with Traditional Knowledge and values. The validated assessment confirmed that the ISD alternative is not predicted to have a measurable effect	The assessment criteria for evaluating safety and environmental effects were expanded and additional details were added through the development of the EIS as a result of feedback from the public and Indigenous peoples at engagement events, where discussion and evaluation of alternatives and assessment criteria were presented. Furthermore, the analysis was revised to clarify that this assessment is not intended to try to determine a "best" alternative, which is highly subjective. It instead considers only alternatives that can all safely achieve the Project goals and identifies the alternative that makes the most sense given the current circumstances. Section 9.3: Summary summarizes the results of the EA. Sections 2.5: Alternative Means of Carrying Out the Project to 2.7: Conclusion provides the details of CNL's alternative means assessment.	Recognizing that environmental protection and the integrity and design of the ISD will continue to be an area of discussion with the Nations, and with the relationship agreement in place, CNL has addressed to the extent possible. CNL has put in place a forum, the community liaison committee, to discuss and make efforts to address residual areas of concern. CNL will continue to keep BON informed on the Project.

Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
	on the environment or the elements important to Indigenous Nations, which provides confidence that there should be minimal impacts to rights, cultural practices, and traditional land and resource use. In 2018, CNL invited the communities to send representatives on the benchmarking trip to Hallam, Nebraska. Collectively, BRFN, BON, and HWFN sent representatives from BRFN and BON. This trip included a tour of a reactor that underwent ISD in 1969. The trip attendees were able to speak to the Mayor of the local community, the state and federal regulators that monitor the facility, and the company that owns the site and performs the ongoing monitoring work.		
BON is concerned that climate change is not considered in the assessment to be adding to the cumulative effects on VC populations, and this may lead to underestimation of cumulative effects. This is a project-specific concern that the Project may impact the health of the environment or BON's Aboriginal and treaty rights to use lands and resources near the WL site.	CNL explained that the Reasonably Foreseeable Development (RFD) case includes the Base Case, plus other projects that are currently under application review or that have officially entered a regulatory application process and are therefore, considered reasonably foreseeable and may affect the environment. Climate change, while having potential to affect the environment and local VC populations is not considered a reasonably foreseeable project and thus not included in the RFD case explicitly but is instead already considered as part of the Base Case. CNL definitely considered climate change in the design of the Project components and the assessment model through the consideration of Features, Events and Processes, which include environmental processes such as climate change. Climate Change is also one of the Project VCs identified in Section 6.1.3: Valued Components, and its consideration in the assessment is discussed in Section 6.1.4.2: Temporal Boundaries. Results of the assessment concluded that no effect on terrestrial or aquatic species is expected as doses were below the limit at which no effects on populations are expected. Overall, cumulative effects from the Project in combination with the decommissioning of the remaining WL site and reclamation of the affected areas are anticipated to positively affect the environment. Thus, there are no negative effects from the Project to add to the potential impact from climate change. Section 10.0: Assessment of the Effects of the Environment on the Project of the EIS details how the assessment of effects resulting from climate change was originally completed following the guidance provided by the Federal Provincial Territorial Committee on Climate Change and EA (FPTCCCEA 2003), and was later updated with a climate change resiliency assessment conducted for the Project based on the requirements of Strategic Assessment of Climate Change, Revised October 2020 (Government of Canada 2020). Specific to the safety assessment modeling, inputs from climate change models were incorporated in the groundwater flow model, the design of the cap and cover system and into consideration of extreme temperature and precipitation, growing season length, forest fires, and drought, which can have potential impacts on the Project. Climate change patterns also impacted the assessment of extreme climatic events such as glaciation. Where uncertainty remained in the assessment modeling about the validity of long-range climate change forecasts, CNL used sensitivity analyses to test whether the WR-1 ISD would be sensitive to various environmental changes, such as extreme erosion, higher precipitation rates (higher groundwater infiltration) or shorter path to the Winnipeg River. The assessment confirmed that the safety of the environment and humans largely depends on the slow release of contaminants through corrosion of reactor metals and is not significantly affected by environmental conditions, including those resulting from climate change.	Section 6.7.1.7.2.1: Methods was revised with an updated description of the assessment cases, including the sensitivity analysis cases carried out for the Project, and includes a reference to the Decommissioning Safety Assessment Report (DSAR) where the details of the assessment modeling are provided. Section 10.5: Climate Change was revised with the new climate change resiliency assessment, and describes various Project mitigations in place to address potential effects from climate change. Description of climate change effects on the glaciation potential was revised in Section 10.6: Glaciation.	CNL addressed this concern to the extent possible at this time. Future engagements on this topic are not likely to affect the assessment or its conclusions; however, they may result in additional environmental monitoring commitments to the Nations.
The Nations expressed an interest in whether compensation is being offered to other First Nations for storing nuclear waste in their traditional territories. They want to understand how materials leaving their territory will affect other Indigenous Nations, and want to ensure that the nuclear liabilities of the site are equitably managed. This is a project-specific and site-wide interest in the socio-economic impacts of the WL site and the Project.	Similar to the approach taken at the WL site, CNL is engaging with First Nations near the CRL site to discuss areas of interest and concern, support their participation environmental monitoring of the surrounding area, and develop relationship agreements. In addition, CNL has also adjusted the evaluation criteria for competitive bids to favour contracts that are Indigenous owned or have Indigenous employees to support greater Indigenous economic participation. While compensation is not being offered for storing waste, as no effects are anticipated, CNL is working on a relationship agreement with local First Nations near the CRL Site. The closest First Nation to CRL is the Algonquins of Pikwakanagan First Nation (AOPFN). The CRL area is in the traditional territory of First Nations represented by the Algonquins of Ontario. CRL is the site where some waste from the WL site is being transported and stored. CNL has asked AOPFN about their interest in being contacted by BRFN and HWFN to discuss their collective experience with the nuclear industry. CNL has indicated that AOPFN is amicable to having a discussion on matters pertaining to storage of nuclear materials and provided BRFN and HWFN with AOPFN's contact information.	Section 4.2.4.3.4: Next Steps was revised to include a commitment to continue engagement with the Nations with the objective of addressing or resolving any outstanding issues or concerns with the Project including through a series of workshops scheduled in the coming months. Section 6.9.6.2.2: Secondary Pathways was revised to add various measures that CNL, in collaboration with Indigenous Nations and local municipalities, took to mitigate socio-economic impacts resulting from the accelerated decommissioning schedule.	CNL addressed this concern to the extent possible at this time. Future engagements on this topic are not likely to affect the assessment or its conclusions; however, they may result in additional environmental monitoring commitments to the Nations.

Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
Consultation, Engagement and Regulatory Processes			
The Nations expressed a concern over the lack of engagement during the original siting and operations of the WL site. This adversely impacted their Aboriginal and treaty rights for over 60 years through the creation of an environmental footprint and through unplanned releases from a nuclear facility established without permission, engagement, or knowledge of Indigenous Nations. This is a site-wide concern.	CNL acknowledged that engagement practices in the past were below today's engagement standards. On April 1, 2021, CNL, and BRFN and HWFN signed a relationship agreement to support a Liaison Officer, and to establish a community liaison committee to increase engagement on the Project. CNL has demonstrated it is committed to incorporating feedback from the Nations regarding historical siting issues and to helping facilitate discussions between AECL and the Nations to work to address these issues. During engagement activities, CNL expressed that while ISD does not undo the historic developments in the area, it will help address some of the environmental footprint impacts, as it reduces the nuclear liabilities at the WL site by disposing of WR-1 in a design-reviewed, safety assessed facility without the need for major demolition and nuclear waste extraction and transportation work. This minimizes the impact to the surrounding environment and in turn may build confidence that the rights, cultural practices, and traditional land and resource use by Indigenous Nations will not be impacted at the present or the future time. The Nations and CNL also discussed that the Project is being assessed under the framework of the CEAA 2012 and Section 5 (1) (c) of the CEAA 2012 states that the assessment of effects is limited to *"the current use of lands and resources for traditional purposes*." To confirm that there would be no effects in the future, CNL is committed to a minimum of 100 years of institutional control and environmental monitoring. CNL is also committed to working in collaboration with Indigenous Nations on developing a post-closure monitoring program that ensures that environmental aspects important to Indigenous Nations are monitored and timely results provided.	Section 4.2.4.3.4: Next Steps was created to document CNL's commitment to continuing engagement with the Nations, to establish an Indigenous Advisory Committee, to support Indigenous participation in the EA, to support a liaison position, and the creation of a community liaison committee. Section 6.8.1.5.2.2.1: Historical and Present Day Traditional Land Use was revised to provide additional information on traditional land use by Indigenous Nations and include discussion of impacts on communities as a result of establishment of the WL site, among other developments in the area. Section 6.9.6.2.2: Secondary Pathways of Socio-economic Environment has been revised to make the effects of WR-1 on Indigenous well-being a secondary pathway, acknowledging that the long-term presence of nuclear materials in the region, along with other historical industrial developments in the local study area, have the potential to result in fear, stigma, and anxiety, and that psychosocial effects are legitimate impact pathways affecting the Indigenous community well-being.	CNL has acknowledged this concern, and recognizes historical siting remains relevant to ethical relations with the Nations in the present. Future engagements on this topic are not likely to affect the assessment or its conclusions; however, they may result in additional environmental monitoring commitments to the Nations.
Communities expressed a concern about a lack of participant funding to BON, BRFN, and HWFN. This is a Project-specific concern about the Nations' ability to effectively participate in the Project and confirm that their lands and Aboriginal and treaty rights are being considered.	CNL has increased the level of engagement with the Nations in response to this concern to promote meaningful and timely mutual learning and understanding. CNL has supported each of the communities' technical review of the EIS as well as their TKLUS. CNL is committed to continued engagement with the Nations with the objective of addressing or resolving any outstanding issues or concerns with the Project. CNL and BRFN and HWFN signed a relationship agreement that will help increase the communities' capacity and allow for greater participation in the EA process. The relationship agreement supports the communities' involvement in the Indigenous Advisory Committee and supports a liaison position and the creation of a community liaison committee. BON has opted out of this process; however CNL continues to send relevant Project information and updates to BON.	Section 4.2.4.3.4: Next Steps was created to document CNL's commitment to continued engagement with the Nations, to establish an Indigenous Advisory Committee, to support Indigenous participation in the EA, to support a liaison position, and to support the creation of a community liaison committee.	CNL addressed this concern to the extent possible at this time. Future engagements on this topic are not likely to affect the assessment or its conclusions; however, they may result in additional participation funding commitments to the Nations.
BON, BRFN, and HWFN expressed an interest in the CEAA 2012 and its requirements for soliciting information from nearby communities. This is a project-specific interest that the Nations had related to being adequately represented in the CNL EA.	The EA is being conducted under the CEAA 2012 and Section 5 (1) (c) of the CEAA 2012 states that the assessment of effects is limited to *"the current use of lands and resources for traditional purposes*." To better understand the current land and resource use by Indigenous Nations, CNL engaged with the Nations and communities in the region and facilitated their input into the assessment through direct engagement, obtaining and incorporating Traditional Knowledge through various TKLUS by the Nations, and obtaining feedback on the EIS. CNL is fully committed to ensuring adequate engagement with BRFN, HWFN, and BON on this EA. As such, CNL approached engagement activities with the intent to provide sufficient background information and context, to establish relationships for future engagement efforts, and to support the overall EA process. This included providing overall background information about the WL site, the previously approved WL Decommissioning project, and the current Project. The process was designed to reflect the interests, issues and concerns expressed by Indigenous Nations and the RRM, and to be adaptive in nature. Engagement with Indigenous peoples was designed based on feedback from the communities and included the following types of mechanisms: ▪ Meetings with leadership. ▪ Community meetings. ▪ The production of community specific newsletters. ▪ A site benchmarking trip. ▪ The production of easy to understand graphics and poster boards. ▪ Provision of funding by CNSC and CNL for TKLUS. ▪ Tours of the WL site. ▪ Industry days and workshops. ▪ Soliciting direct feedback on sections of the EIS.	Section 4.2.4.3.1: Engagement was created to document the engagement between CNL and the Nations that facilitated the information transfer from the Nations to CNL and its EA. Section 4.3: Influence of Traditional Knowledge on the Environmental Assessment was created to document how Traditional Knowledge was gathered through engagement and the four TKLUS carried out by Indigenous Nations and the RRM, and subsequently incorporated into the assessment. Sections 6.2: Atmospheric Environment through 6.9: Socio-economic Environment were updated throughout with consideration of Indigenous Traditional Knowledge, VCs, and feedback on the assessment.	CNL addressed this concern to the extent possible at this time. Future engagements on this topic are not likely to affect the assessment or its conclusions; however, they may result in additional environmental monitoring commitments to the Nations.

Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
The Nations were interested in understanding how the regulator works, and how the independent commission is selected. There is concern about conflict of interest with a federal licensing body reviewing a federally-funded project. This is a project-specific interest.	CNL and the CNSC engaged with the Nations and discussed the roles and responsibilities of the CNSC, as the regulator. In addition, the CNSC also described the selection, roles, and responsibilities of the commission, and the key steps in the EA process for the Project. Through ongoing engagements, CNL has stated that it is the regulator's responsibility to complete a rights impact assessment on the Project, a process that is informed by engagement with the Nations. During these discussions, it was stated that the Governor in Council appoints the Commission members and that the Commission is an independent, quasi-judicial tribunal that operates at arm's length from the nuclear industry. CNL reiterated that it will remain responsible for the Project, the WL site closure, the ongoing monitoring activities, and for any remedial actions should they be required. The federal government, through AECL, will remain responsible for funding CNL throughout the closure work and ongoing post-closure monitoring.	Sections 1.0: Introduction and 1.4: Proponent were revised to clarify the relationships and history between CNL, AECL, and Canadian National Energy Alliance.	CNL has addressed this concern to the extent possible, recognizing ongoing engagement between the regulator and the Nations throughout the EA process will need to continue to enhance transparency, relationships, and trust.
Traditional Knowledge, Culture, and Ceremony			
The Nations identified in their TKLUS that, over time, they have seen changes to the health of the animals they harvest and that hunting and trapping are getting harder to do as many traditional areas have been converted to other land uses over time. They suggest that the WL development is one piece in the cumulative effects of development that has slowly taken away their traditional way of life. The Nations are concerned that the Project will impact the future health of the water, land, fish, and animals as well as their Aboriginal and treaty rights to use lands and resources near the WL site. This is a project-specific concern. See the IER Appendix D3 Comment #113 (#7) for more information about traditional knowledge, culture and ceremony.	The Project incorporates multiple barriers to ensure that the water, land, fish, and animals remain safe in the future and the EIS assesses the Project's long-term impact on the water, land, fish, and animals, and determined they will remain safe. The WR-1 disposal facility is designed in accordance with all applicable Canadian codes and standards as well as international best practices to ensure protection of the environment and safety throughout the life of the facility. In 2018, CNL invited the Nations to send representatives on the benchmarking trip to Hallam, Nebraska. Collectively, BRFN, BON, and HWFN sent representatives from BRFN and BON. This trip included a tour of a reactor that underwent ISD in 1969. The trip attendees were able to speak to the Mayor of the local community, the state and federal regulators that monitor the facility, and the company that owns the site and performs the ongoing monitoring work. The group had a discussion on environmental monitoring and saw that the results from monitoring showed no levels of radioactivity. CNL has committed to supporting the Nations' participation in long-term monitoring at the WL site.	CNL confirmed that the assessment predicts no impact to the water (Section 6.4.2.7.2: Application Case Results), land (Section 6.3.1.6.2.2: Secondary Pathways), fish (Section 6.7.2.7.2: Application Case – Post-closure Phase), or animals (Section 6.7.2.7.1: Application Case – Closure Phase). CNL added Section 11.4: Indigenous Engagement and Participation in Environmental Monitoring, which includes CNL's commitment to supporting the Nations' participation in long-term monitoring at the WL site. CNL added text to Section 6.8.1.5.2.2.1: Historical and Present Day Traditional Land Use to provide more information on traditional land use by the Nations and the impacts historical industrial development and systemic discrimination has had on their ability to express their rights and culture.	CNL's perspective is that this concern will be addressed through the Nations' continued participation in environmental monitoring at the WL site.
The Nations expressed a concern about protecting traditional and spiritual places, such as the Whiteshell Petroforms, from disappearing due to changes in the land and its uses. This is a site-wide and project-specific concern about protecting the land for traditional uses, such as food harvesting, ceremonies, and exercising Aboriginal and treaty rights.	CNL acknowledged this concern and has included Cultural and Archaeological Sites as a VC in the assessment of Land and Resource Use. This VC is representative of the values identified by Sagkeeng First Nation; the Red River Métis; Brokenhead Ojibway Nation, Black River First Nation, and Hollow Water First Nation; and Wabaseemoong Independent Nations, as identified through TKLUSs, engagement with CNL, and verification discussions. The assessment confirmed that there are no cultural sites within the WL site and that the nearby sites and areas are not likely to be affected by the closure activities or by the presence of the ISD in the area in the post-closure phase.	This concern was already captured through the Cultural and Archaeological Sites VC in Section 6.8.1.3: Valued Components, and assessed in Section 6.8.1.6.2: Results.	CNL's perspective is that this concern has been addressed; however, CNL recognizes that spiritual sites and traditional lands will continue to be of high value to the First Nations and may require further discussion in the future. CNL is making efforts to establish an Indigenous Advisory Committee and will collaborate and engage on this and other topics of interest and concern.
BON and HWFN noted the importance of traditional and cultural perspectives with regard to the Project as they were concerned that their knowledge, interests, and Aboriginal and treaty rights were not being adequately considered in the EA for the Project. This is a project-specific concern.	CNL supported the TKLUS that was conducted by the three Nations and used its content to revise sections of the EIS. On April 6, 2021, CNL, BRFN, and HWFN signed a comprehensive relationship agreement to support greater community involvement on the Project. The relationship agreement supports the establishment of a community committee and a community liaison position, provides support to participate in the Indigenous Advisory Committee, and provides capacity support to ensure meaningful participation and engagement throughout the EA process. While BON has chosen not to participate in these processes, CNL continues to make efforts to engage and provides regular Project specific updates.	CNL revised Sections 6.2: Atmospheric Environment through 6.9: Socio-economic Environment to include the Nations' feedback, interests, and concerns in the Indigenous Engagement Feedback tables and confirmed that the feedback, interests, and concerns were addressed in the assessment or provided rationale for why they were not applicable. CNL updated Section 6.8.1: Traditional Land and Resource Use to capture the Nations' Traditional Knowledge provided to CNL through the TKLUS.	CNL's perspective is that this concern has been addressed; however, CNL recognizes that traditional knowledge, culture, and ceremony will have much to offer the project as it moves forward. CNL is making efforts to establishan Indigenous Advisory Committee and will support input from traditional and cultural perspectives.
In their Technical Report, BON made numerous comments and recommendations pertaining to Traditional Knowledge, culture, and ceremony. BON was interested in further incorporation of traditional values in the seed mix for remediation of the site, in the monitoring and testing of harvested species, and in the traditional diet considerations of the assessment to ensure their Aboriginal and treaty rights are supported in the future. This is both a project-specific and site-wide interest.	CNL committed to using only native seeds for revegetation efforts and will engage with interested Indigenous Nations on the seed mix and potential sources. CNL will be expanding and evolving the monitoring program at the WL site through incorporation of feedback, recommendations, and Traditional Knowledge from Indigenous Nations, and has already included mushroom collection into its sampling and analysis program based on the recommendation of another Indigenous Nation. CNL conducted food intake surveys with two other Indigenous Nations to understand the types and quantities of local food consumed. This information along with information from various TKLUSs was used to validate and refine the assumptions made for wild game, fish, and plant ingestion rates for the subsistent harvester receptors in the EA.	CNL revised Section 3.4.6.5: Final Site Restoration to include the commitment of using only native seeds for revegetation efforts. CNL added Section 11.4: Indigenous Engagement and Participation in Environmental Monitoring, which discusses CNL's plan to incorporate feedback, recommendations, and Traditional Knowledge from Indigenous Nations into the WL monitoring program. CNL revised Section 6.7.1.7.1.1: Methods to discuss the food intake surveys and their impact on the assessment.	BON has confirmed that they are not interested in further engagement with CNL on the Project. CNL respects this position and remains interested in future engagement on this and other topics of interest and concern if they choose to re-engage. CNL continues send BON updates on the Project to keep them informed.

1.3.7 Wabaseemoong Independent Nations Engagement

Date	Activity	Attendance	Description	Key EA Topics4									
				Baseline Conditions	Alternative Means	Project Components	Effects assessment5	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Topics of Interest	Engagement Methods
August 3, 2016	Letter from CNL to multiple communities	1 representative from Wabaseemoong Independent Nations 2 representatives from CNL	Project Introductory Letter and request for community input on any potential adverse impacts from project activities.								✓	✓	
August 21, 2017	Meeting with CNL, Wabaseemoong Independent Nations, CNSC and AECL	CNL CNSC AECL Wabaseemoong Independent Nations	Meeting regarding WR-1 In-Situ Decommissioning Project. CNSC, AECL and CNL presentations.			✓		✓		✓			
May 17, 2017	Meeting with CNL, Sagkeeng, Wabaseemoong Independent Nations, CNSC and AECL	Sagkeeng First Nation Wabaseemoong Independent Nations CNL AECL CNSC CNL contractor	CNSC led meeting about engagement and presented on the CNSC's role and the Project.			✓	✓	✓			✓		
June 28, 2017	Site tour and meeting	Wabaseemoong Independent Nations CNL AECL CNL contractor	Introductory meeting between CNL and Wabaseemoong Independent Nations regarding the WR-1 Reactor In-Situ Decommissioning Project.			✓		✓	✓	✓	✓		
July 6, 2017	First Nation Industry Day	Open to all Indigenous communities	CNL hosted an industry day, presentation of Whiteshell Laboratories.								✓		
October 5, 2017	Letter from CNL to multiple communities	Sagkeeng First Nation Brokenhead Ojibway Nation Black River First Nation Hollow Water First Nation Shoal Lake #40 First Nation Iskatewizaagegan #39 Independent First Nation (Shoal Lake #39 First Nation) Wabaseemoong Independent Nations Manitoba Metis Federation Grand Council of Treaty 3	Notification of public comment period on the draft EIS and invitation to engage.									✓	
November 1, 2017	Letter from CNL to multiple communities	Sagkeeng First Nation Brokenhead Ojibway Nation Black River First Nation Hollow Water First Nation Wabaseemoong Independent Nations	Mailed hard copies of Community specific report and draft EIS executive summary.										

4 Per CNSC guidance laid out in E-DOC # 6467843, 2021.
5 including VC, spatial and temporal boundaries for the assessment

Date	Activity	Attendance	Description	Key EA Topics4									
				Baseline Conditions	Alternative Means	Project Components	Effects assessment5	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Topics of Interest	Engagement Methods
November 30, 2017	WL site tour	Wabaseemoong Independent Nations CNL	Email correspondence announcing the asset donation program and inviting people to a tour of the WL site.										
April 3, 2018	Benchmarking trip to Hallam, Nebraska in situ site	Black River First Nation Brokenhead Ojibway Nation Sagkeeng First Nation Wabaseemoong Independent Nations Manitoba Metis Federation	Communities attended the In situ disposal facility in Hallam to learn more about in situ design, monitoring and what the local community thinks. This was a relationship building trip and enabled Indigenous communities to be able to better inform their communities.										
August 19, 2020	Letter	1 representative from Wabaseemoong Independent Nations 4 representatives from CNL	CNL submitted CNL's responses to Wabaseemoong comments on the EIS and requested a meeting to discuss.	✓	✓		✓	✓	✓	✓	✓		
September 10, 2020	Invitation - Email	1 representative from Wabaseemoong Independent Nations 1 representative from CNL	CNL provided a list of all fall environmental monitoring activities and invited the community to participate.	✓							✓		✓
September 16, 2020	Invitation – Email	1 representative from Wabaseemoong Independent Nations 1 representative from CNL	CNL sent out an invitation to community members to attend the breakfast session on development and test results of the WR-1 grout.			✓		✓					
October 8, 2020	Email – Site Tour	2 representatives from Wabaseemoong Independent Nations 2 representatives from CNL	CNL proposed a date for the site tour and requested a meeting to discuss Wabaseemoong's comments on the EIS.										✓
October 29, 2020	Email – Site Tour	2 representatives from Wabaseemoong Independent Nations 2 representatives from CNL	CNL followed up to determine whether Wabaseemoong wanted to discuss CNL's responses to their comments. CNL to date has not received a response.										✓
February 8, 2021	Letter	2 representatives from Wabaseemoong Independent Nations 2 representatives from CNL	CNL provided notice that CNL was submitting a draft EIS and requested to engage the community on the project.										✓
May 11, 2021	E-mail	2 representatives from Wabaseemoong Independent Nations 2 representatives from CNL	CNL reached out to Wabaseemoong in order to verify that their valued components, and summary table of interests and concerns have been appropriately captured.										✓

Date	Activity	Attendance	Description	Key EA Topics4									
				Baseline Conditions	Alternative Means	Project Components	Effects assessment5	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Topics of Interest	Engagement Methods
June 9, 2021	Phone Call	1 representative from Wabaseemoong Independent Nations 1 representative from CNL	Wabaseemoong's representative updated CNL on their participation in the Indigenous Advisory Committee, and agreed to join as an observer until permission from the Chief is received. CNL requested a timeline for the review of the Summary Table of Interests and Concerns, Wabaseemoong confirmed that the review could be completed by the end of the week. CNL also offered capacity funding to support the review.										✓
July 20, 2021	Teleconference	1 representative from Wabaseemoong Independent Nations 2 representatives from CNL	CNL and Wabaseemoong Independent Nations met via teleconference and walked through the community's summary table of interests and concerns. The community representative provided feedback during the meeting which was also incorporated during the meeting.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
July 22, 2021	E-mail	1 representative from Wabaseemoong Independent Nations 2 representatives from CNL 1 representative from CNSC	CNL provided a revised copy of the community's summary of interests and concerns table to the community to show how CNL had incorporated the community's feedback from the July 20th, 2021 meeting.										✓
July 23, 2021	Phone Call	1 representative from Wabaseemoong Independent Nations 1 representative from CNL	CNL provided a revised copy of the community's list of valued component to the community to show how CNL had incorporated the community's feedback from a phone call earlier that day, July 23, 2021.										✓
July 23, 2021	E-mail	1 representative from Wabaseemoong Independent Nations 2 representatives from CNL 1 representative from CNSC	CNL provided a revised copy of the community's list of valued component to the community to show how CNL had incorporated the community's feedback from a phone call earlier that day, July 23, 2021.				✓						
September 9, 2021	E-mail	CNL Wabaseemoong Independent Nations	CNL sent Wabaseemoong Independent Nations a thank you letter for their participation in verifying that CNL had adequately characterized their interests and concerns.										✓
May 6, 2021	Teleconference	1 representative from Wabaseemoong Independent Nations 2 representatives from CNL	CNL walkthrough the revisions to the interests and concerns table and made changes based on WIN's feedback during the meeting.									✓	✓

Date	Activity	Attendance	Description	Key EA Topics4									
				Baseline Conditions	Alternative Means	Project Components	Effects assessment5	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Topics of Interest	Engagement Methods
June 13, 2022	E-mail	1 representative from Wabaseemoong Independent Nations 2 representatives from CNL	CNL asked WIN to confirm they have completed verification of their interest and concerns table.										✓
July 12, 2022	Phone	1 representative from Wabaseemoong Independent Nations 1 representative from CNL	CNL and WIN discussed current events and upcoming availability for a site tour. CNL also confirmed the contact information for the Chief.										✓
July 13, 2022	Letter	2 representatives from Wabaseemoong Independent Nations 2 representative from CNL	CNL sent a letter to WIN's Chief notifying him that CNL had submitted the draft EIS.									✓	✓
August 26, 2022	Phone	1 representative from Wabaseemoong Independent Nations 1 representative from CNL	CNL and WIN discussed setting up a date for a tour. WIN suggested calling in a few weeks to confirm interest in attending a tour.										✓
August 30, 2022	E-mail	1 representative from Wabaseemoong Independent Nations 2 representatives from CNL	CNL sent a copy of CNL's monitoring program schedule and requested WIN to identify any activities they would like to participate in.										✓
September 23, 2022	E-mail	1 representative from Wabaseemoong Independent Nations 1 representatives from CNL	CNL followed-up with WIN to determine interest in participating in a WL site tour.										✓

1.3.8 Wabaseemoong Independent First Nations (WIN) – Key Interests and Concerns

For specific Wabaseemoong Independent Nations' comments on the WR-1 EIS refer to the Appendix B 'Full Tables of Indigenous Comments on the EIS and CNL's Responses.'

Table Verification

On May 11, 2021, CNL sent a letter to Wabaseemoong's leadership asking for their verification on whether CNL had documented the community's interests and concerns and list of VCs correctly. On July 20, 2021, CNL and a representative from Wabaseemoong Independent Nations held a teleconference to go through the table to ensure CNL had addressed their interests and concerns. During the meeting, CNL revised the summary of interests and concerns table. CNL sent back a copy on July 22, 2021 and the revised list of VCs on July 23, 2021. On September 9, 2021, CNL sent a thank you letter to Wabaseemoong, thanking them for verifying that CNL had adequately captured their interests and concerns (Appendix D.6 and D.7)

On March 7, 2022, CNL informed Wabaseemoong that CNL would be repackaging the interest and concerns table to better meet the needs of the CNSC, and requested a meeting to walk through the changes of the table. CNL sent the repackaged table on April 14, 2022 and met with a representative from Wabaseemoong on May 6, 2022. During the meeting, CNL revised the table based on feedback from Wabaseemoong. After the meeting, CNL sent a copy of the table to show how CNL had incorporated Wabaseemoong's revisions. On May 9, CNL sent a final copy of the table. Additional updates were made to only the status column of the interests and concerns table and these adjustments were forwarded to Wabaseemoong on October 20, 2022. Wabaseemoong did not provide feedback on the updates.

Key Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
Regulatory Process			
Wabaseemoong Independent Nations (WIN) expressed concern that they were not consulted during the siting of Whiteshell Laboratories (WL) and not consulted earlier in the Whiteshell Reactor 1 (WR-1) Project as they have a right to be consulted on projects that might adversely impact Aboriginal and treaty rights. This is both a site-wide and project-specific concern.	Canadian Nuclear Laboratories (CNL) acknowledged that engagement practices in the past were well below today's engagement standards. CNL provided information on past attempts to contact and engage with the community. In August 2016, CNL sent a letter to all identified Indigenous Nations, including WIN, introducing the Project and inviting them to engage on the Project. CNL followed up with WIN via telephone and email to determine their interest in participating in engagement activities. Communication between WIN and CNL has improved since initial outreach on the Project in 2016. CNL has held an information session in the community and continues to provide regular updates on the Project by teleconference and email. WIN also participated in the Hallam site visit to see a completed In Situ Disposal (ISD) Project. CNL continues to offer capacity funding to support WIN's participation in the Environmental Assessment (EA) process for WR-1.	There were no changes to the outcome of the assessment; a summary of engagement with WIN is provided in Section 4.2.4.4 (Wabaseemoong Independent Nations).	CNL's perspective is that this concern has been addressed. CNL will continue to engage WIN through the EA process.
Engaging the Community			
WIN expressed interest in having an engagement event in their home community with CNL, Atomic Energy of Canada Limited (AECL), and the CNSC as they want their membership to be informed during the regulatory process for the Project so that their knowledge, interests, concerns, and Aboriginal and treaty rights are considered in the EA. This is a project-specific interest.	In August 2017, CNL, AECL, and the CNSC participated in a one day event to discuss the Project in the WIN community. In October 2017, CNL sent a letter to WIN notifying them of the public comment period for the draft Environmental Impact Statement (EIS) and invited them to review and submit comments. In November 2017, CNL sent a hard copy of the draft EIS executive summary to the community. WIN provided comments on the draft EIS at that time. Since then and while the effects of the COVID-19 pandemic have limited direct community engagement opportunities, CNL has continued to reach out to WIN at critical milestones in the Project's development to encourage WIN's continued participation in the regulatory process.	CNL revised Sections 6.2 (Atmospheric Environment) through 6.9 (Socio-economic Environment) to include WIN's feedback, interests, and concerns in the Indigenous Engagement Feedback tables and confirmed that the feedback, interests, and concerns were addressed in the assessment or provided rationale for why they were not applicable. CNL updated Section 6.8.1 (Traditional Land and Resource Use) to capture WIN's traditional knowledge provided to CNL through WIN's Traditional Knowledge and Environmental Impact Assessment Report.	This interest has been addressed. CNL will continue to send information on the Project and will seek the direction of WIN's Chief and Council related to engagement with their membership.
Business and Employment Opportunities			
WIN expressed interest in employment opportunities at the WL site, including seasonal employment and the proportion of the workforce that is Indigenous, in the interest of increasing their economic participation. WIN noted that employment at the WL site may be difficult for members due to the distance between the community and the WL site. This is a site-wide interest.	CNL updated WIN's community employment contacts and provides WIN with information on employment opportunities, including seasonal employment, when they become available. CNL created an Indigenous summer student position to provide a youth employment opportunity at the site. CNL explained that approximately 13% of the WL workforce has self-identified as Indigenous. CNL has worked to enhance options to better match Indigenous capabilities with CNL contracting needs, added provisions to CNL procurement process to encourage the use of Indigenous and local businesses, and considers single source contracting opportunities with Indigenous companies where well suited to the work. CNL has also adjusted the evaluation criteria for competitive bids to favour contracts that are Indigenous owned or have Indigenous employees. CNL acknowledged the long commute from WIN and offered to help any job candidates find appropriate housing in the region.	CNL revised Section 6.9.6.2.2 (Secondary Pathways) to provide more information on CNL initiatives to support Indigenous contracting opportunities. CNL revised Section 6.9.5.2.3.1 (CNL Whiteshell Laboratories Employment) to provide information on the proportion of the WL workforce that has self-identified since 2017. This interest does not affect the outcome of the EA.	This interest has been addressed. CNL will continue to seek opportunities to increase Indigenous participation in the economics of the site.

Key Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
Ecological Health			
WIN is concerned that animals may be impacted by the Project. WIN wants to ensure their Aboriginal and treaty rights to hunt, fish, and gather are not impacted by the Project. This is a project-specific concern.	The Project incorporates multiple barriers to ensure that animals remain safe and that the EIS assesses the Project's impact on terrestrial and aquatic animals, and determined they will remain safe under normal and upset conditions. CNL acknowledged that animals do not obey the same boundaries as humans and explained that there were no Project activities or outcomes that would result in a residual adverse effect to wildlife so species of importance to traditional land and resources use will not be affected. In 2018, WIN participated in a trip to Hallam, Nebraska to see a completed In Situ Disposal (ISD) Project. The group had a discussion on environmental monitoring and saw that the results from monitoring showed no levels of radioactivity. CNL recognizes that much of the concern expressed will need to be addressed through participation in ongoing monitoring and has committed to supporting Indigenous participation in long-term monitoring at the WL site.	CNL confirmed that the assessment predicts no impact to terrestrial or aquatic animals (Sections 6.7.2.7.1 (Application Case – Closure Phase) and 6.7.2.7.2 (Application Case – Post-closure Phase)). CNL added Section 11.4 (Indigenous Engagement and Participation in Environmental Monitoring), which includes CNL's commitment to support Indigenous participation in long-term monitoring at the WL site.	CNL's perspective is that this concern will be addressed further through provision of plain language site monitoring results and with WIN's participation in environment monitoring at the site.
Monitoring			
WIN is concerned that WR-1's close proximity to the river will contaminate the river and the fish, now and over time. WIN was interested in knowing more about fish monitoring as WIN members use the Winnipeg River to fish and would like to ensure their Aboriginal and treaty rights to fish are not impacted by the Project. This is a project-specific concern.	CNL explained how the ISD design incorporates multiple barriers to ensure that the river and the fish remain safe and the EIS assesses the Project's impact on the river and the fish, and determined they will remain safe. In 2017, CNL met with WIN in their community and provided information on WL's monitoring program. Fish are caught at one location upstream of the WL site (Sylvia Lake; upstream of the Seven Sisters Falls Hydro Dam) and two locations downstream (2.0 km and 5.0 km downstream). The length and weight of the fish are recorded and the fish are filleted and sent to an external laboratory for analysis. Contaminants can accumulate over time, but recent fish monitoring results show that the radioactivity (< 0.001 mGy/d) is well below the benchmark recommended by the CNSC (0.6 mGy/d). In 2018, WIN participated in a trip to Hallam, Nebraska to see a completed ISD Project. The group had a discussion on environmental monitoring and saw that the results from monitoring showed no levels of radioactivity. In September 2020, CNL sent an invitation to WIN inviting them to participate in CNL's fall monitoring activities, which include fish monitoring. CNL sent a "What We Hear Report" to WIN that included questions and responses on monitoring.	CNL confirmed that the assessment predicts no impact to the river (Section 6.4.2.7.2 (Application Case Results)) or fish (Section 6.7.2.7.2 (Application Case – Post-closure Phase)). CNL added Section 11.4 (Indigenous Engagement and Participation in Environmental Monitoring), which includes CNL's commitment to support Indigenous participation in long-term monitoring at the WL site.	CNL's perspective is that this concern will be addressed further through the provision of plain language monitoring results and with WIN's participation in environmental monitoring at the site.
WIN expressed interest in the WL air emissions monitoring practices as there is the potential for contamination to be released to the atmospheric environment during Project demolition work. This could impact the health of WIN members and the environment. This is a project-specific concern.	In 2017, CNL met with WIN in their community and provided information on WL's monitoring program. CNL explained where air monitoring occurs, both on- and off-site, and explained the historic WL site results and the low impact of the site. CNL pointed to where the annual results are available online and provided information on the CNSC independent monitoring program that confirmed the low impact of the site. CNL explained the proposed demolition approach for the WR-1 building, the results of the atmospheric assessment for the Project, and that no impacts to the environment are predicted. CNL confirmed that past monitoring verified the protection of wildlife and that the assessment indicates there will be no impact to wildlife from airborne emissions. CNL invited WIN to participate in environmental monitoring during the 2020 summer and fall seasons.	CNL confirmed that the assessment predicts no impact to the atmospheric environment (Section 6.2.1.7.2 (Application Case Results)), human health (Section 6.7.1.7.1 (Application Case – Closure Phase)), or the health of wildlife (Section 6.7.2.7.1 (Application Case – Closure Phase)). CNL added Section 11.4 (Indigenous Engagement and Participation in Environmental Monitoring), which includes CNL's commitment to support Indigenous participation in long-term monitoring at the WL site.	CNL answered WIN's questions regarding air emissions monitoring practices. Any further concerns should be addressed through WIN's participation in environmental monitoring at the site.
WIN is concerned that the Project may impact the environment in the long-term. WIN was interested in learning more about CNL's long-term monitoring plan for WR-1 to ensure their Aboriginal and treaty rights to use lands and resources near the WL site is not impacted by the Project for generations to come. This is a project-specific concern.	CNL provided information on how the Project incorporates multiple barriers to ensure that the environment remains safe in the long-term and the EIS assesses the Project's long-term impact on the environment and determined the environment will remain safe. After WR-1 is decommissioned, the only way contaminants can enter the environment is through releases to groundwater and groundwater movement to the Winnipeg River. CNL plans to monitor the expected performance of the WR-1 Disposal Facility using groundwater monitoring wells for at least 100 years, at which point the performance of the facility is expected to be confirmed. CNL will stop monitoring only when the CNSC finds it acceptable. To enable this monitoring, CNL has created a groundwater monitoring well network that will be used to detect any movement of contaminants from the WR-1 Disposal Facility towards the river. CNL has already committed to additional groundwater monitoring well(s) as recommended during Indigenous engagements. In 2018, WIN participated in a trip to Hallam, Nebraska to see a completed ISD Project. The group had a discussion on environmental monitoring and saw that the results from monitoring showed no levels of radioactivity. CNL has committed to Indigenous participation in long-term monitoring at the WL site.	CNL confirmed that the assessment predicts no impact to the environment (Section 9.3 (Summary)). Sections 6.7.1.7 (Residual Effects Analysis) and 6.7.2.7 (Residual Effects Analysis) describe the pathways by which releases can get into the environment. CNL updated Section 11.0 (Summary of Monitoring and Follow-up Programs) to better describe the current proposal for the closure and post-closure monitoring activities as well as the integration of the Project monitoring into the existing site-wide program. CNL added Section 11.4 (Indigenous Engagement and Participation in Environmental Monitoring), which includes CNL's commitment to support Indigenous participation in long-term monitoring at the WL site.	CNL's perspective is that this concern will be addressed further through sharing of monitoring results and with WIN's participation in environmental monitoring at the site.
Future Land Use and Tenure			
WIN requested more information about the proportion of the land that would be available post-closure of the WL site as they are interested in re-establishing connection within the WL site for traditional use purposes as this land base has been unavailable since the site was established in the early 1960s. This is a site-wide interest.	WIN was provided a map with perspective on the proportion of the WL site that would be potentially available for future use. CNL explained that discussions on future land use and final clean-up criteria are forthcoming.	CNL revised Section 4.2.4.4.2 (Interests and Concerns) to discuss engagement on future land use and end-state planning for the WL site. Engagements on future land use and tenure will not impact the conclusions of the EIS.	CNL's perspective is that this interest is outside the scope of the EA, but has been adequately addressed at this time, recognizing that engagement on future land use for the WL site is forthcoming.

Key Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
Management of the Whiteshell Laboratories Site			
WIN expressed interest in the history of CNL and how it is related to AECL and the WL site as WIN wanted to understand the different roles and responsibilities of each company to ensure they were dealing with the appropriate party in regards to their interests and concerns. This is both a project-specific and site-wide interest.	CNL explained that AECL, a federal Crown corporation, is responsible for managing Canada's radioactive waste and decommissioning liabilities, and enabling nuclear science and technology. Following a restructuring process, AECL now operates under a Government Owned, Contractor Operated model. Under this model, while AECL retains ownership of the sites, facilities, assets, and liabilities, it delivers its mandate through a long-term contract with the private sector for the management and operation of its sites. AECL has a contract with CNL for the decommissioning and closure of the WL site as well as the operations of other sites across Canada (including the Chalk River Laboratories in Ontario, which remains an active nuclear science and technology complex).	There were no changes to the outcome of the assessment; information on the relationship between CNL, AECL, and the WL site is provided in Section 1.4 (Proponent).	This interest has been addressed.
Waste Management			
WIN expressed concern with the transport of waste off-site as transportation accidents could impact the health of the public and the environment. WIN was interested in more detailed information about how much radioactive waste would remain on the WL site and where the radioactive waste that was being transported off-site would be stored as this waste has the potential to impact their Aboriginal and treaty rights to use lands and resources near the WL site. This is both a project-specific and site-wide concern.	CNL explained that the vast majority of radioactive materials from the WL site will be transported to the Chalk River Laboratories site in Ontario for interim storage or disposal in the proposed Near Surface Disposal Facility. Disposal in the proposed Near Surface Disposal Facility remains contingent upon approval of the EA for that Project, which is under review. The WL site possesses over 50 years of experience in shipping and receiving radioactive material and has never had an incident that compromised the safety of workers, the public, or the environment. The shipment of nuclear materials is a highly regulated process. CNL has procedures in place to ship the waste in accordance with the federal Packaging and Transport of Nuclear Substances Regulations. CNL maintains a response plan and a team that works together with the Transport Canada emergency services to respond to any road accident involving nuclear materials. All waste is transported in packages that are selected based on the nature, form, quantity, and radioactivity of the waste. There are design requirements that apply to all waste package types to ensure that they can be handled safely and easily, secured properly, and withstand routine transport conditions. The EIS assesses the risks resulting from the transportation of Project waste off-site and determined that the risk and consequence severity of transportation accidents involving nuclear materials is low due to existing controls on transport of nuclear materials and the requirements for waste packaging. Likewise, the Waste Management Area trenches will undergo a rigorous safety assessment to ensure the safety of the environment. Approximately 2,800 m^3 (4,000 Mg) of radioactive waste is estimated to remain on the WL site as part of the Project.	CNL confirmed that the risk and consequence severity of transportation accidents involving nuclear materials was assessed to be low in Section 7.3.4 (Off-site Transportation Accidents); no changes to the assessment were required. CNL updated Section 3.4.8 (Waste Generation and Management) with a reference to the Detailed Decommissioning Plan as this is where the waste volume estimates are documented.	CNL's perspective is that they adequately responded to these questions and concerns; however, CNL recognizes that WIN will continue to have concerns about the transportation of radioactive waste and will be pleased to respond to those concerns as they come forward.
WIN expressed interest in CNL's waste transportation methods and how waste transportation is communicated to potentially affected communities. WIN is concerned about a potential waste transportation accident near their reserve and on their traditional territory impacting human health and the environment, particularly the potential impact on the water, as there are many water crossings of the highway near their traditional and treaty territory. This is both a project-specific and site-wide concern.	CNL provided information on waste transportation include that all waste is transported in packages that are selected based on the nature, form, quantity, and radioactivity of the waste. There are design requirements that apply to all waste package types to ensure that they can be handled safely and easily, secured properly, and withstand routine transport conditions. There are also federal regulations for how nuclear materials can be shipped and CNL maintains a set of procedures for packaging and transporting nuclear materials. CNL maintains a response plan and a team that works together with the Transport Canada emergency services to respond to any road accident involving nuclear materials. CNL explained that the WL site possesses over 50 years of experience in shipping and receiving radioactive material and has never had an incident that compromised the safety of workers, the public, or the environment. The EIS assesses the risks resulting from the transportation of Project waste off-site and determined that the risk and consequence severity of transportation accidents involving nuclear materials is low due to existing controls on transport of nuclear materials and the requirements for waste packaging. For security reasons, information about individual shipments of nuclear materials is kept confidential.	CNL confirmed that the risk and consequence severity of transportation accidents involving nuclear materials was assessed to be low in Section 7.3.4 (Off-site Transportation Accidents); no changes to the assessment were required.	CNL recognizes this concern will be ongoing. CNL will continue to provide waste management updates including information on waste transportation process.
Accidents and Malfunctions			
WIN was interested in past releases and the potential for future releases of hazardous and radioactive material into the Winnipeg River as they are concerned that the close proximity of the WL site to the river will contaminate the river. WIN uses the Winnipeg River for traditional harvesting activities and wants to ensure their Aboriginal and treaty rights to use lands and resources near the WL site are not impacted by site activities. This is both a project-specific and site-wide concern.	CNL provided WIN with information on how the Project incorporates multiple barriers to ensure that the river remains safe and the EIS assesses the Project's impact on the river and determined it will remain safe. Other activities on the WL site are covered by the 2001 Comprehensive Study Report, which assesses their impact on the river and determined it will remain safe. CNL explained that any events that occurred in the past were reported to the CNSC (or previously the Atomic Energy Control Board) and that no employees or members of the public have been negatively affected by the operation emissions of the WL site. As part of AECL's application to the CNSC for a decommissioning licence in 2001, AECL conducted a Comprehensive Environmental Assessment. This included an investigation of the surrounding environment and the Winnipeg River sediments to look for any radioactive contamination that may have occurred over the history of the site. River sediments were surveyed for radioactivity at hundreds of locations. The assessment concluded that *"using the most conservative dose estimation methods, doses to non-human biota and humans are below accepted guidelines."* The analysis methodology and results were peer-reviewed, presented in public meetings, and are available in the open publication of the Comprehensive Study Report. CNL continues to monitor the river sediment near the site and downstream. CNL also explained that in late 1994, the Winnipeg River Task Force was created. Representatives from Indian and Northern Affairs Canada, Environment Canada, Health Canada, and Sagkeeng First Nation took part in the Task Force. The objective of the Task Force was to look at potential sources of Winnipeg River water quality degradation near the community of Sagkeeng.	CNL confirmed that the assessment predicts no impact to the river (Section 6.4.2.7.2 (Application Case Results)). CNL added Section 11.4 (Indigenous Engagement and Participation in Environmental Monitoring), which includes CNL's commitment to support Indigenous participation in long-term monitoring at the WL site.	CNL recognizes that WIN's concern for the health of the Winnipeg River will continue and has invited WIN to participate in on-site monitoring to help address this concern. CNL will also share ongoing monitoring results with WIN.

Key Interest/Concern	How the Interest/Concern is Being Addressed	Impact on the Environmental Impact Statement	Status
	The Task Force report concluded that the drinking water quality met Canadian guidelines and that it was unlikely that the WL site had ever posed or would pose a significant threat to the health of Sagkeeng community members. CNL developed plain language materials to support their communication of past spills.		
WIN was interested in how releases could be contained in the soil and how CNL detects spills as they are concerned that the close proximity of the WL site to the river will contaminate the river through contamination of the soil. WIN wants to ensure their Aboriginal and treaty rights to use lands and resources near the WL site is not impacted by site activities. This is a site-wide concern.	CNL provided information on how the Project incorporates multiple barriers to ensure that the river remains safe and the EIS assesses the Project's impact on the river and determined it will remain safe. Other activities on the WL site are covered by the 2001 Comprehensive Study Report, which assesses their impact on the river and determined it will remain safe. The properties of a site determine how well releases are contained in the soil; however for ISD of WR-1, contaminant releases are primarily limited by a significant portion of the contaminants being contained within the metals of the reactor, which corrode very slowly. Other barriers (such as the building walls, the grout, and the concrete cap and engineered cover) further limit contaminant releases and the low-permeability clays surrounding the WR-1 building provide additional resistance to contaminant movement. Groundwater monitoring wells around the ISD facility will be the primary means of monitoring for contaminant releases. If contaminants are being released in quantities of concern, this would show up in the groundwater monitoring and remedial actions would be taken.	CNL confirmed that the assessment predicts no impact to the river (Section 6.4.2.7.2 (Application Case Results)). CNL assessed the likelihood and consequence of spills in Section 7.3.2 (Spills and Leaks) and confirmed that if spills do occur during closure activities, CNL has sufficient experience and controls in place to limit negative effects on human health and the environment. CNL added Section 11.4 (Indigenous Engagement and Participation in Environmental Monitoring), which includes CNL's commitment to support Indigenous participation in long-term monitoring at the WL site.	CNL recognizes that WIN's concern for the health of the Winnipeg River will continue; CNL is committed to sharing monitoring results to keep WIN apprised of the health of the river. CNL has also invited WIN to participate in on-site monitoring to help address this concern.
WIN expressed the view that potential adverse impacts on fisheries from the Project would negatively impact the ability of WIN members to collect fishery resources and damage their relationship with them. Moreover, changes to concentrations of contaminants in fish tissues (for example, from nuclear spills) could have negative consequences on human health. WIN is concerned that the close proximity of WR-1 to the river will contaminate the river and the fish. As stewards of the land, members of WIN have a responsibility to protect ecosystems and ensure ecosystem function including trophic impacts of contamination. WIN wants to ensure their Aboriginal and treaty rights to fish is not impacted by the Project. This is a project-specific concern.	CNL provided information on how the Project incorporates multiple barriers to ensure that the river and the fish remain safe and the EIS assesses the Project's impact on the river and the fish, and determined they will remain safe. CNL shared that radioactivity levels for WR-1 are within the range of other reactors that have safely gone through the ISD process. In 2018, WIN participated in a trip to Hallam, Nebraska to see a completed ISD Project. The group had a discussion on environmental monitoring and saw that the results from monitoring showed no levels of radioactivity. In September 2020, CNL sent an invitation to WIN inviting them to participate in CNL's fall monitoring activities, which include fish monitoring. CNL has committed to supporting WIN's participation in monitoring at the site.	CNL confirmed that the assessment predicts no impact to the river (Section 6.4.2.7.2 (Application Case Results)) or fish (Section 6.7.2.7.2 (Application Case – Post-closure Phase)). CNL added Section 11.4 (Indigenous Engagement and Participation in Environmental Monitoring), which includes CNL's commitment to support Indigenous participation in long-term monitoring at the WL site.	CNL's perspective is that this concern will be further addressed through the sharing of monitoring results and through WIN's participation in the site environmental monitoring activities.
Long-Term Safety			
WIN expressed concern about the longevity of the nuclides and the long-term nature of the Project. WIN is concerned that the Project may impact the environment in the long-term and wants to ensure their Aboriginal and treaty rights to use lands and resources near the WL site is not impacted by the Project. This is a project-specific concern.	CNL provided information on how the WR-1 Disposal Facility is designed in accordance with all applicable Canadian codes and standards as well as international best practices to ensure protection of the environment and safety throughout the life of the facility. CNL shared that radioactivity levels for WR-1 are within the range of other reactors that have safely gone through the ISD process. In 2018, WIN participated in a trip to Hallam, Nebraska to see a completed ISD Project. The group had a discussion on environmental monitoring and saw that the results from monitoring showed no levels of radioactivity. CNL has committed to supporting WIN's participation in long-term monitoring at the WL site.	CNL confirmed that the assessment predicts no impact to the environment (Section 9.3 (Summary)). CNL added Section 11.4 (Indigenous Engagement and Participation in Environmental Monitoring), which includes CNL's commitment to support Indigenous participation in long-term monitoring at the WL site.	CNL's perspective is that this concern will be further addressed through the sharing of monitoring results and through WIN's participation in the site environmental monitoring activities.
WIN expressed concern that climate change or natural disasters could affect the integrity of the grouted encapsulation and result in un-anticipated releases of hazardous material, which could impact their Aboriginal and treaty rights to use lands and resources near the WL site. WIN wanted to know how the disposal facility would be constructed to ensure that it is safe. This is a project-specific concern.	CNL provided information to WIN on how the normal evolution of the disposal facility was assessed over 10,000 years along with credible abnormal event or disaster that could affect the safety of the disposal facility. The assessment considered climate change in the normal evolution scenario and considered the effects of an unlikely major seismic event. Even if some future event causes significant damage to the disposal facility, the assessment determined that there would be no negative effects on the environment. The WR-1 Disposal Facility is designed in accordance with all applicable Canadian codes and standards as well as international best practices to ensure protection of the environment and safety throughout the life of the facility. WIN participated in a Hallam trip to see a fully decommissioned ISD reactor and see how effective ISD was at protecting the environment. A post-trip survey found that almost everyone had a better understand of ISD and that their confidence in this technique increased.	CNL confirmed that the assessment scenarios in Section 6.7.1.7.2 (Application Case – Post-closure Phase) encompass the potential effects of natural disasters described in Section 10.0 (Assessment of Effects of the Environment on the Project), and that human and ecological health is protected even under severe adverse conditions such as glaciation or earthquakes.	CNL has answered all questions related to this area of interest/ concern, but recognizes that environmental protection and the integrity of the ISD design will continue to be an area of interest for WIN. CNL's perspective is that this concern will be further addressed through ongoing information sharing and engagement with WIN and their participation in monitoring.

1.3.9 Shoal Lake #40 First Nation Engagement

Date	Activity	Attendance	Description	Key EA Topics6									
				Baseline Conditions	Alternative Means	Project Components	Effects assessment including VCs7	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Topics of Interest of the community	Engagement Methods
August 3, 2016	Letter from CNL to multiple communities	Sagkeeng First Nation Brokenhead Ojibway Nation Black River First Nation Hollow Water First Nation Shoal Lake #40 First Nation Iskatewizaagegan #39 Independent First Nation (Shoal Lake #39 First Nation) Wabaseemoong Independent Nations Manitoba Metis Federation Grand Council of Treaty 3	Project Introductory Letter and request for community input on any potential adverse impacts from project activities.										✓
July 6, 2017	First Nation Industry Day	Open to all Indigenous communities	CNL hosted an industry day, presentation of Whiteshell Laboratories.										
October 5, 2017	Letter from CNL to multiple communities	Sagkeeng First Nation Brokenhead Ojibway Nation Black River First Nation Hollow Water First Nation Shoal Lake #40 First Nation Iskatewizaagegan #39 Independent First Nation (Shoal Lake #39 First Nation) Wabaseemoong Independent Nations Manitoba Metis Federation Grand Council of Treaty 3	Notification of public comment period on the draft EIS and invitation to engage.										✓
February 8, 2021	E-mail/Letter	CNL Shoal Lake #40	CNL provided notice that CNL was submitting a draft EIS and requested to engage the community on the project.										✓
July 13, 2022	E-mail/Letter	CNL Shoal Lake #40	CNL sent out a letter of notice to each Nation's chief informing them that CNL has submitted a draft EIS and requested a meeting to engage on the project.									✓	

6 Per CNSC guidance laid out in E-DOC # 6467843, 2021.
7 including VC, spatial and temporal boundaries for the assessment, and adverse impacts to rights

1.3.10 Iskatewizaagegan No. 39 Independent First Nation Engagement

Date	Activity	Attendance	Description	Key EA Topics8									
				Baseline Conditions	Alternative Means	Project Components	Effects assessment including VCs9	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Topics of Interest of the community	Engagement Methods
August 3, 2016	Letter from CNL to multiple communities	Sagkeeng First Nation Brokenhead Ojibway Nation Black River First Nation Hollow Water First Nation Shoal Lake #40 First Nation Iskatewizaagegan #39 Independent First Nation (Shoal Lake #39 First Nation) Wabaseemoong Independent Nations Manitoba Metis Federation Grand Council of Treaty 3	Project Introductory Letter and request for community input on any potential adverse impacts from project activities.										✓
July 6, 2017	First Nation Industry Day	Open to all Indigenous communities	CNL hosted an industry day, presentation of Whiteshell Laboratories.										
October 5, 2017	Letter from CNL to multiple communities	Sagkeeng First Nation Brokenhead Ojibway Nation Black River First Nation Hollow Water First Nation Shoal Lake #40 First Nation Iskatewizaagegan #39 Independent First Nation (Shoal Lake #39 First Nation) Wabaseemoong Independent Nations Manitoba Metis Federation Grand Council of Treaty 3	Notification of public comment period on the draft EIS and invitation to engage.										✓
February 8, 2021	E-mail/Letter	CNL Iskatewizaagegan #39 Independent First Nation	CNL provided notice that CNL was submitting a draft EIS and requested to engage the community on the project.										✓
July 13, 2022	E-mail/Letter	CNL Iskatewizaagegan #39 Independent First Nation	CNL sent out a letter of notice to each Nation's chief informing them that CNL would be submitting a draft EIS and requested a meeting to engage on the project.									✓	

8 Per CNSC guidance laid out in E-DOC # 6467843, 2021.
9 including VC, spatial and temporal boundaries for the assessment, and adverse impacts to rights

1.3.11 Northwest Angle No. 33 (Treaty No. 3) Engagement

Date	Activity	Attendance	Description	Key EA Topics10									
				Baseline Conditions	Alternative Means	Project Components	Effects assessment11	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Topics of Interest of the community	Engagement Methods
August 3, 2016	Letter from CNL to multiple communities	Sagkeeng First Nation Brokenhead Ojibway Nation Black River First Nation Hollow Water First Nation Shoal Lake #40 First Nation Iskatewizaagegan #39 Independent First Nation (Shoal Lake #39 First Nation) Wabaseemoong Independent Nations Manitoba Metis Federation Grand Council of Treaty 3	Project Introductory Letter and request for community input on any potential adverse impacts from project activities.										✓
July 6, 2017	First Nation Industry Day	Open to all Indigenous communities	CNL hosted an industry day, presentation of Whiteshell Laboratories.									✓	
October 5, 2017	Letter from CNL to multiple communities	Sagkeeng First Nation Brokenhead Ojibway Nation Black River First Nation Hollow Water First Nation Shoal Lake #40 First Nation Iskatewizaagegan #39 Independent First Nation (Shoal Lake #39 First Nation) Wabaseemoong Independent Nations Manitoba Metis Federation Grand Council of Treaty 3	Notification of public comment period on the draft EIS and invitation to engage.									✓	
February 8, 2021	E-mail/Letter	CNL Northwest Angle No. 33 (Treaty 3)	CNL provided notice that CNL was submitting a draft EIS and requested to engage the community on the project.									✓	
July 13, 2022	E-mail/Letter	CNL Northwest Angle No. 33 (Treaty 3)	CNL sent out a letter of notice to each Nation's chief informing them that CNL would be submitting a draft EIS and requested a meeting to engage on the project.									✓	

10 Per CNSC guidance laid out in E-DOC # 6467843, 2021.
11 including VC, spatial and temporal boundaries for the assessment, and adverse impacts to rights

1.3.12 Grand Council Treaty #3 Engagement

Date	Activity	Attendance	Description	Key EA Topics12									
				Baseline Conditions	Alternative Means	Project Components	Effects assessment13	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Topics of Interest of the community	Engagement Methods
August 3, 2016	Letter from CNL to multiple communities	Sagkeeng First Nation Brokenhead Ojibway Nation Black River First Nation Hollow Water First Nation Shoal Lake #40 First Nation Iskatewizaagegan #39 Independent First Nation (Shoal Lake #39 First Nation) Wabaseemoong Independent Nations Manitoba Metis Federation Grand Council of Treaty 3	Project Introductory Letter and request for community input on any potential adverse impacts from project activities.										✓
October 5, 2017	Letter from CNL to multiple communities	Sagkeeng First Nation Brokenhead Ojibway Nation Black River First Nation Hollow Water First Nation Shoal Lake #40 First Nation Iskatewizaagegan #39 Independent First Nation (Shoal Lake #39 First Nation) Wabaseemoong Independent Nations Manitoba Metis Federation Grand Council of Treaty 3	Notification of public comment period on the draft EIS and invitation to engage.									✓	
April 18, 2018	Meeting and site tour	Grand Council of Treaty 3 CNL	Tour of site, followed by a CNL Whiteshell Laboratories Closure Project presentation.	✓	✓	✓	✓	✓	✓	✓	✓	✓	
July 21, 2020	Site tour	Grand Council of Treaty 3 CNL	Tour of WR-1 and the WMA.	✓	✓	✓	✓	✓	✓	✓	✓	✓	
August 12, 2020	Meeting with CNL and Grand Council of Treaty 3	Grand Council of Treaty 3 CNL	Introductory meeting between Grand Council Treaty 3 and CNL's Indigenous Engagement Officer to discuss the WR-1 ISD project.	✓	✓	✓	✓	✓	✓	✓	✓	✓	
February 8, 2021	E-mail/Letter	CNL Grand Council Treaty #3 – Territorial Planning Unit	CNL provided notice that CNL was submitting a draft EIS and requested to engage the community on the project.									✓	
March 4, 2021	Teleconference	CNL Grand Council Treaty #3 – Territorial Planning Unit	CNL presented an overview of the project including end state, VC, alternative means, site history, WR-1 follow-up monitoring.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

12 Per CNSC guidance laid out in E-DOC # 6467843, 2021.
13 including VC, spatial and temporal boundaries for the assessment, and adverse impacts to rights

Date	Activity	Attendance	Description	Key EA Topics12									
				Baseline Conditions	Alternative Means	Project Components	Effects assessment13	Proposed Mitigation Measures	Residual Effects	Follow-up Monitoring Program	Aboriginal and Treaty Rights / Traditional Land Use	Specific Topics of Interest of the community	Engagement Methods
July 7, 2022	E-mail	CNL Grand Council Treaty #3 – Territorial Planning Unit	CNL reached out to GCT#3 to confirm current Chiefs and their appropriate contact information.										✓
September 23, 2022	Teleconference	CNL Grand Council Treaty #3 – Territorial Planning Unit	CNL provided an overview of the Whiteshell Laboratories site and a status update for the WR-1 Project, highlighting engagement with Treaty #3 members. CNL and GCT#3 discuss future engagements.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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APPENDIX 6.1-1

Project-Environment Interactions Matrix

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List of Tables

Table 6.1-1-1: Project Interactions with Valued Components – Biophysical Environment and Human Health 1

Table 6.1-1-2: Project Interactions with Valued Components – Land and Resource Use and Socio-Economic Environment 1

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Table 6.1-1-1: Project Interactions with Valued Components – Biophysical Environment and Human Health

Project Phase	Key Project Component/Activity[a]	Atmospheric Environment		Geologic and Hydrogeologic Environment		Surface Water Environment		Aquatic Environment	Terrestrial Environment	Human Health		Ecological Health
		Air Quality	Greenhouse Gases	Geology	Hydrogeology (Groundwater Quantity and Quality)	Hydrology	Surface Water Quality	Fish and Fish Habitat	All Valued Components	Public Health	Worker Health	All Valued Components
Closure	General closure activities, including preparation for in situ disposal, grouting of below-grade structures and systems, and removal of above-grade the WR-1 structures and systems. Also includes vehicle and equipment use on-site, and construction and operation of temporary supporting infrastructure during decommissioning (e.g., batch mixing plant for preparation of grout).	■	●	●			●	●	●	● ■ (a)	● ■ (a)	● ■ (a)
	Installation of engineered cover system, restoration and grading of the site.					●	●	●	●			
	Decommissioning of remaining infrastructure and support facilities at the WL site as per the existing decommissioning licence.	●			●	●	●	●				
Post-closure	Release of chemical and radiological contaminants as the grout and reactor components gradually deteriorate over time.			●	■		■	●	●	■		■
	Release of chemical and radiological contaminants in the long-term from the previous activities completed at the WL site.				●		●	●		●		●

Notes:

a) Some project activities have more than one effects pathway; consequently, there can be more than one type of project interaction.

■ – Primary Pathway; ● – Secondary Pathway or No Linkage; Blank cell – No interaction anticipated or interaction is anticipated to result in positive effects.

Table 6.1-1-2: Project Interactions with Valued Components – Land and Resource Use and Socio-Economic Environment

Project Phase	Key Project Component/Activity	Land and Resource Use					Socio-economic Environment					
		Land Tenure	Outdoor Recreation and Tourism	Cultural and Archaeological Sites	Traditional Land and Resource Use by Indigenous Peoples	Winnipeg River	Employment and Income	Business Opportunities	Government Finances	Community Services and Infrastructure	Community Well-Being	Public Safety
Closure and Post-closure	General closure activities, including preparation for in situ disposal, grouting of below-grade structures and systems, and removal of above-grade WR-1 structures and systems. Also includes vehicle and equipment use on-site, and construction and operation of temporary supporting infrastructure during decommissioning (e.g., batch mixing plant for preparation of grout).		●	●	●	●	●	●		●	●	●
	Preparation for and implementation of institutional control	●	●		●		●	●	●	●	■	
	Closure of the entire WL site	●	●		●							

Notes:

a) Some project activities have more than one effects pathway; consequently, there can be more than one type of project interaction.

■ – Primary Pathway; ● – Secondary Pathway or No Linkage; Blank cell – No interaction anticipated or interaction is anticipated to result in positive effects.

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APPENDIX 6.2-1

Baseline Air Quality and Meteorology

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1.0 INTRODUCTION

This Appendix was prepared to support the Environmental Impact Statement (EIS) for the proposed Canadian Nuclear Laboratories (CNL) In Situ Decommissioning of WR-1 at the Whiteshell Laboratories Site (the Project). This Appendix presents the meteorology and air quality baseline data used in the assessment to predict changes in non-radiological indicator compound emissions. The available ambient air quality monitoring data from air quality monitoring stations (Figure 1) located near the Project, as well as the meteorological conditions at the Whiteshell Laboratories (WL) site and surrounding area. As described in Section 6.2.1.4.1 Spatial Boundaries of the EIS, the Local Study Area (LSA) is defined to encompass activities and sources of emissions associated with the Project. The LSA is equivalent to approximately 8-kilometre (km) by 8 km square that includes the Site Study Area (SSA) and the WL site. The Regional Study Area (RSA) is defined as the area within which the potential effects of the Project may interact with the effects of other existing or reasonably foreseeable projects. The RSA is equivalent to approximately a 12 km by 12 km square surrounding the LSA, centered on the WL Site. The SSA, LSA and RSA are presented on Figure 2.

This Appendix documents the methods, data and assumptions that were used to assess the non-radiological background meteorology and air quality at the Project and in the LSA and RSA. The background meteorology documented in this Appendix provides a summary of the review of the:

- climate data sources; and
- weather parameters, including; temperature, relative humidity, precipitation, wind speed and direction, atmospheric pressure and solar radiation.

The background air quality assessment was carried out by:

- identifying the non-radiological indicator compounds expected to be emitted from the Project;
- identifying and comparing non-radiological air quality guidelines in Manitoba and Canada for the indicator compounds;
- identifying existing emission sources located within 50 km of the SSA with shared indicator compounds;
- assessing air quality data sources for use in the background air quality assessment; and
- comparing air quality monitored data to the applicable air quality guidelines.

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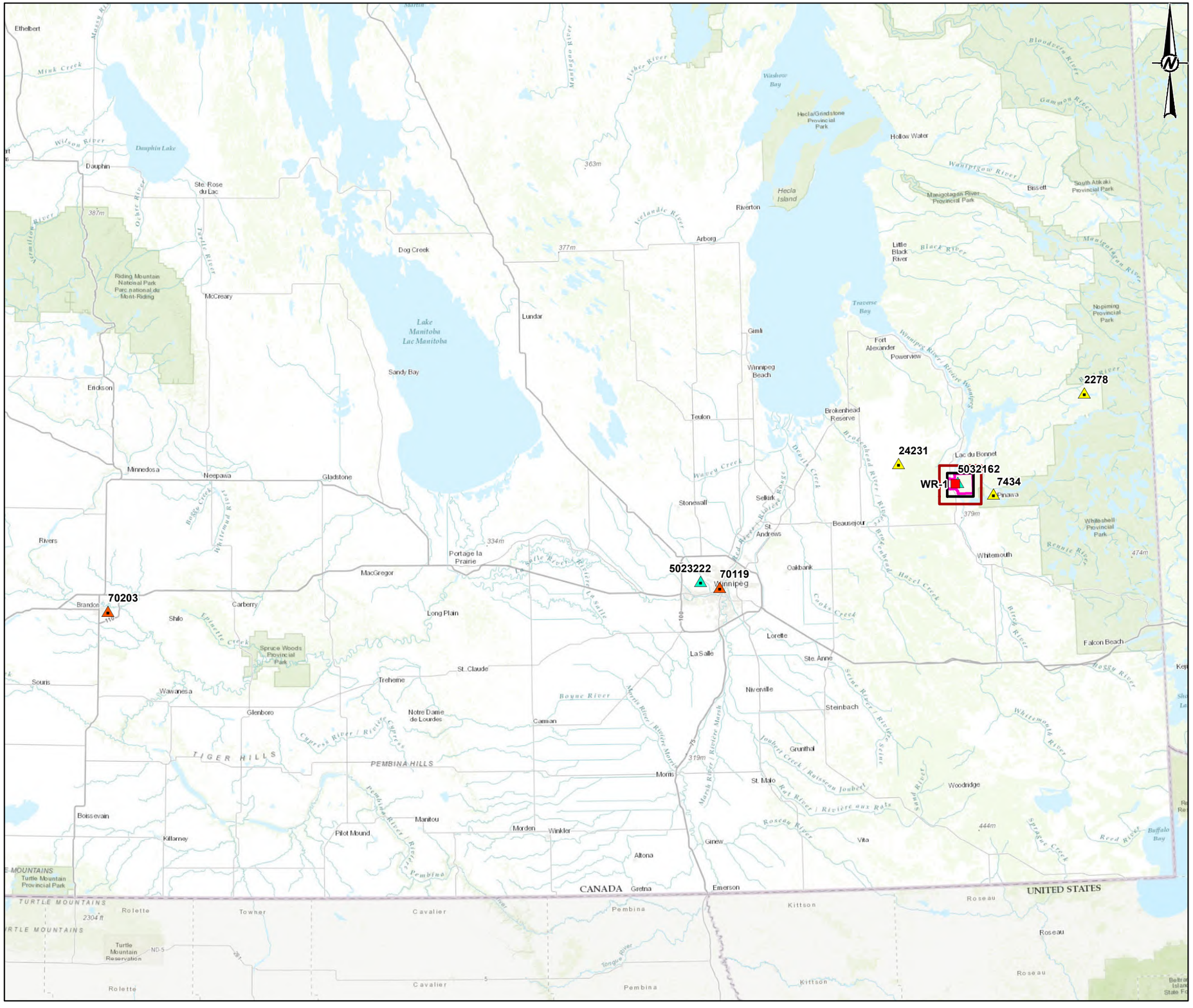

LEGEND

- WR-1 BUILDING (SITE STUDY AREA)
- METEOROLOGY STATION
- NAPS STATION
- NPRI FACILITY
- WHITESHELL LABORATORIES SITE
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

BASE FEATURES

- MAJOR ROAD
- WATERCOURSE
- WATERBODY

0 25 50 75

1:1,250,000 KILOMETRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY PROVIDED BY CNL (2016-11-22)
3. TOPOGRAPHIC MAP - SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT

CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT

EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE

AIR QUALITY ASSESSMENT - LOCATION OF NAPS STATIONS, METEOROLOGY STATIONS AND NPRI REPORTING FACILITIES

CONSULTANT

WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/PR/RRD
REVIEWED	KL
APPROVED	SC

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0008	2	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm 0

Path: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0008_EIS_Sec_6.2\20145046-0008-RAA001_App_6_2-1_Figure 1 AQ Assessment - NAPS Meteorology and NPRI.mxd

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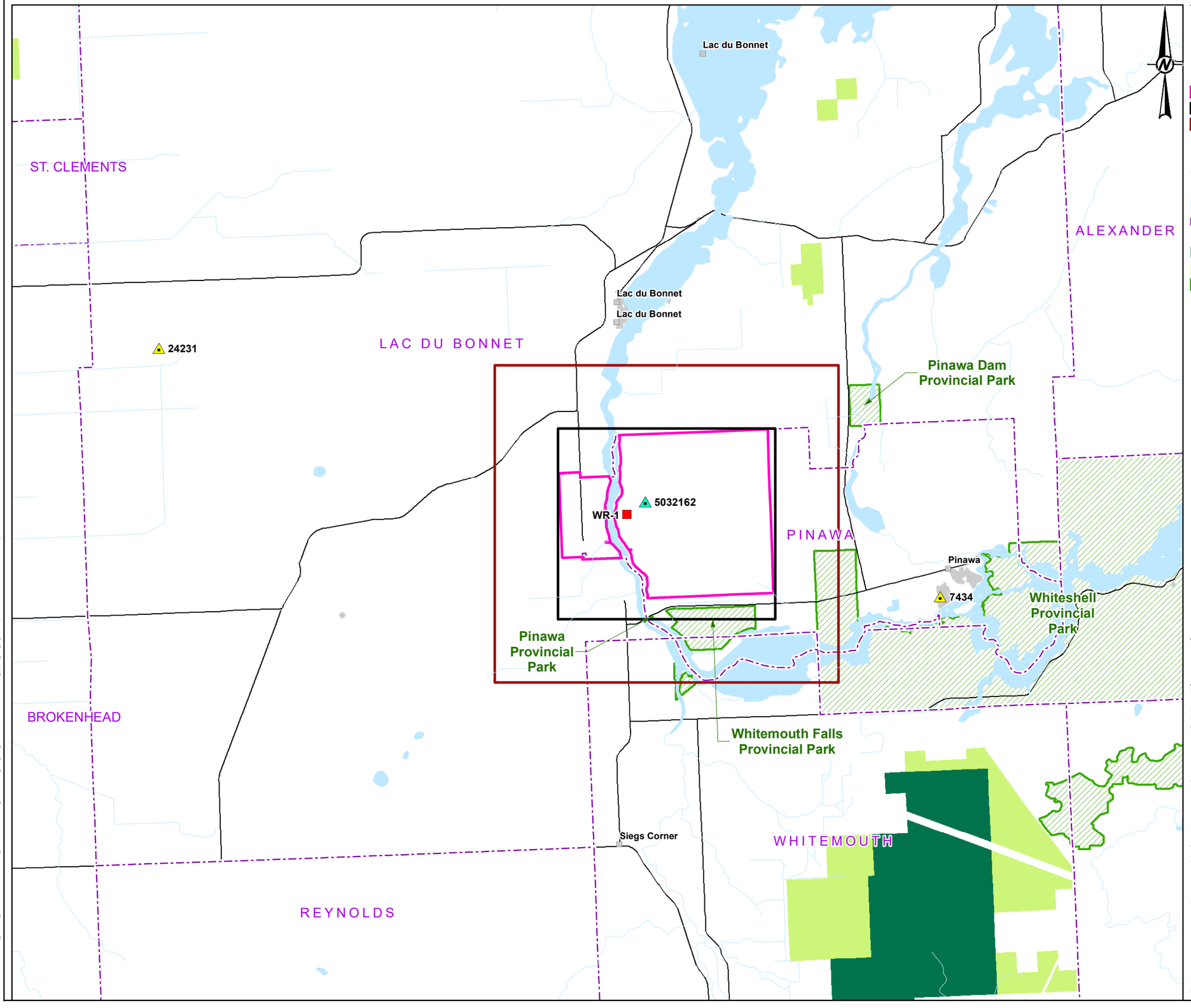

LEGEND

- WR-1 BUILDING (SITE STUDY AREA)
- METEOROLOGY STATION
- NAPS STATION
- NPRI FACILITY
- WHITESHELL LABORATORIES SITE
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

BASE FEATURES

- CITY/TOWN
- MAJOR ROAD
- WATERCOURSE
- WATERBODY
- MUNICIPAL BOUNDARY

PROTECTED AREAS

- ECOLOGICAL RESERVE
- WILDLIFE MANAGEMENT AREA
- PROVINCIAL PARK

0 5 10
1:150,000 KILOMETRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY PROVIDED BY CNL (2016-11-22)
3. TOPOGRAPHIC MAP -
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
SPATIAL BOUNDARIES FOR THE AIR QUALITY ASSESSMENT

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/RRD
REVIEWED	KL
APPROVED	SC

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0008	2	**2**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

Path: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0008_EIS_Sec_6.2\20145046-0008-RAA-0002_App 6_2-1_Figure 2 Spatial Boundaries for the Air Quality Assessment.mxd

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2.0 METEOROLOGY BASELINE ASSESSMENT

This section summarizes the current climate conditions at the WL site. Meteorological parameters analyzed include temperature, precipitation, wind speed and direction, relative humidity, atmospheric pressure, solar radiation and the occurrence of extreme and rare meteorological phenomena, as required by REGDOC-2.9.1, *Environmental Principles, Assessments and Protection Measures*, for the characterization of the atmospheric baseline environment (CNSC 2020).

2.1 Climate Normals Data Sources

Climate normals are used to summarize and describe the average climatic conditions of a particular location, using long-term averages (typically 30 years) of observed climate data that meet the data quality standards. Climate normals from Environment and Climate Change Canada (ECCC) climate stations located near the Project are used to describe the long-term record of climatic conditions in the region. Additional information on climate change and climate projection is available in the Golder (2017) report. The most recent climate normals available from ECCC are for the period from 1981 through 2010.

The Comprehensive Study Report (AECL 2001) completed the Climate and Meteorology Baseline assessment using climate normals from the climate station located at the WL site (closed in 1998) for periods ranging from 1964 to 1997. This station was considered for the Meteorology Baseline Assessment; however, this station was not retained for the current assessment due to insufficiency data availability for the most recent climate normals from 1981 through 2010.

For this study, the nearest climate station with published normals for the 1981 through 2010 period is the Pinawa WNRE station (Climate ID 5032162) located on the WL site, and is less than 1 km away from the WR-1 Building. The Pinawa WNRE station only has temperature and precipitation monitoring data and therefore for meteorological parameters required by CNSC REGDOC-2.9.1 without long-term data, the next closest station with the required parameters for climate normals, Winnipeg James Armstrong Richardson International Airport (Winnipeg Airport), was used for the assessment (Climate ID 5023222; ECCC 2016a). Table 1 presents the location of climate stations used in this assessment and Table 2 presents the available parameters at each station.

Table 1: Location of Climate Stations

Station Name	Climate ID	Distance and Direction from WR-1 [km]	Elevation [m]	Normal Period[b] [Years]
Pinawa WNRE[a]	5032162	0.25 NE	267	1981 – 2010
Winnipeg Airport[a]	5023222	104.45 SW	239	1981 – 2010

a) ECCC 2016a.
b) Normal period as defined by ECCC.

Table 2: Availability of Climate Normals for Meteorological Parameters at the Climate Stations

Station Name	Available Parameter						
	Wind Speed	Wind Direction	Temperature	Precipitation	Relative Humidity	Atmospheric Pressure	Solar Radiation
Pinawa WNRE	No[(a)]	No[(a)]	Yes	Yes	No	No[(a)]	No
Winnipeg Airport	Yes	Yes	Yes	Yes	Yes	Yes	Yes

a) Some data are available but there is insufficient data for a climate normal as per the ECCC data quality standards.

The purpose of the air quality baseline assessment in this Appendix is to present the local climate and meteorology conditions in the area surrounding the Project. This assessment was not used to assess the suitability of meteorological data for dispersion modelling, as the model used for the Project's air quality assessment does not require input of meteorological data. The Pinawa 503B1ER station has hourly meteorological data for all parameters, but the data are not available for the full 30-year period (only 6 years were available for the period considered [i.e., 1981 to 2010]); therefore, the Winnipeg Airport station was used for the unavailable parameters. As discussed below, the Winnipeg Airport station may be considered representative of conditions in the vicinity of the Project based on comparable temperature and precipitation data, as well as similar predominant wind direction.

2.2 Climate and Meteorology for the Project

This section presents the closest available climate normal. The expected values of weather parameters, including temperature, precipitation, wind speed and direction, relative humidity, atmospheric pressure and solar radiation, can be expressed in terms of normal values obtained from the long-term averages.

2.2.1 Temperature

A summary of the monthly temperature distribution for the climate normals from the Pinawa WNRE station is shown in Table 3. The daily average temperature in the winter season is approximately -14.3°C, while the daily average temperature in the summer season is approximately 18.0°C. The extreme minimum temperature during the 30-year period was -47.8°C while the extreme maximum temperature during the 30-year period was 37.5°C. Temperatures below -10°C have typically occurred between November and April, while temperatures above 30°C occur occasionally between May through August.

For comparison purposes, a summary of the monthly temperature distribution for the climate normals from the Winnipeg Airport station is shown in Table 4. The Winnipeg annual daily average, maximum and minimum temperatures are comparable to the Pinawa WNRE station.

Table 3: Monthly Temperature Distribution for the Pinawa WNRE Station

Climate Normals Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual[a]
Daily Average [°C]	-16.6	-13.2	-5.7	3.9	11.2	16.4	19.3	18.2	12.3	5.1	-4.5	-13.1	2.8
Standard Deviation [°C]	4	4.3	2.9	2.7	2	1.9	1.4	1.8	1.4	1.7	3.4	4.2	1.3
Daily Maximum [°C]	-11.1	-7.3	0.2	10.3	17.7	22.5	25.2	24.3	18	9.7	-0.7	-8.5	8.4
Daily Minimum [°C]	-22.1	-19	-11.6	-2.5	4.6	10.3	13.2	12	6.7	0.4	-8.3	-17.6	-2.8
Extreme Maximum [°C]	9.5	12	20	32.5	34.5	37.5	37	36	36	28.5	23.3	10	—
Extreme Minimum [°C]	-44	-47.8	-40.5	-28.9	-13.9	-3.9	-0.6	-1.5	-6.7	-15.5	-34.5	-40	—
Days with Maximum Temperatures Above 30°C	0	0	0	0	0.5	1.5	2.8	2.7	0.23	0	0	0	7.7
Days with Minimum Temperatures Below -10°C	26.9	21.6	15.1	2.7	0	0	0	0	0	0.56	10.4	22.6	99.9

a) The annual data average may not match the average of the presented monthly values due to rounding; however, the annual number days with maximum temperatures above 30°C and below -10°C would match the total of the monthly values.

Table 4: Monthly Temperature Distribution for the Winnipeg Airport Station

Climate Normals Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual[a]
Daily Average [°C]	-16.4	-13.2	-5.8	4.4	11.6	17	19.7	18.8	12.7	5	-4.9	-13.2	3
Standard Deviation [°C]	4.1	4.2	3.1	2.7	2.1	2	1.4	1.9	1.3	1.8	3.6	4.4	1.2
Daily Maximum [°C]	-11.3	-8.1	-0.8	10.9	18.6	23.2	25.9	25.4	19	10.5	-0.5	-8.5	8.7
Daily Minimum [°C]	-21.4	-18.3	-10.7	-2	4.5	10.7	13.5	12.1	6.4	-0.5	-9.2	-17.8	-2.7
Extreme Maximum [°C]	7.8	11.7	23.3	34.3	37	37.8	37.8	40.6	38.8	30.5	23.9	11.7	—
Extreme Minimum [°C]	-42.2	-45	-37.8	-26.3	-11.1	-3.3	1.1	—	-7.2	-17.2	-34	-37.8	—
Days with Maximum Temperatures Above 30°C	0.0	0.0	0.0	0.1	1.2	2.5	4.1	4.7	0.7	0.0	0.0	0.0	13.3
Days with Minimum Temperatures Below -10°C	27.4	21.9	14.6	2.2	0.04	0	0	0	0	0.93	11.8	23.5	102.2

a) The annual data average may not match the average of the presented monthly values due to rounding; however, the annual number days with maximum temperatures above 30°C and below -10°C would match the total of the monthly values.

2.2.2 Precipitation

A summary of the monthly and seasonal precipitation data for the climate normals from the Pinawa WNRE station are shown in Table 5 and Table 6, respectively. The 30-year climate normal from the Pinawa WNRE station calculates an average annual precipitation of approximately 578 millimetres equivalent (mm[eq]) for the region, with the highest precipitation occurring in the summer at 253.2 mm[eq]. The greatest extreme daily precipitation also occurs in summer at 168.4 mm[eq]. Approximately 94% of the precipitation in winter is attributed to snow. Winter extreme daily precipitation is 35 mm[eq].

Table 5: Monthly Precipitation Summary for the Pinawa WNRE Station

Month	Rainfall (mm)	Snowfall (cm)	Total Precipitation (mm[eq])[(a)]	Extreme Daily Precipitation (mm)	Days with Measurable Precipitation[(b)]
January	0.3	21.4	21.7	23.9	9.2
February	2.1	14.6	16.7	26	6.5
March	11	14.9	25.8	44.4	7.5
April	19.7	9.4	29.1	48	6.9
May	64.5	2.1	66.6	65	12.4
June	98.8	0	98.8	168.4	13.9
July	89.1	0	89.1	63.5	12.9
August	65.3	0	65.3	77.2	11.7
September	61.4	0.5	61.9	75.2	12.8
October	40.3	7.9	48.2	56.5	11.5
November	10.3	19.2	29.5	21.2	9.4
December	1.6	24	25.6	35	9.8
Annual	**464.3**	**113.9**	**578.3**	**—**	**124.5**

a) Total precipitation in mm [eq] is calculated by adding the snowfall in cm (a ratio of 10:1 to convert snow to rain) to the rainfall in mm.
b) Greater or equal to 0.2 mm.
mm[eq] = millimetres equivalent

Table 6: Seasonal Precipitation Summary for the Pinawa WNRE Station

Season	Total Precipitation (mm)
Winter (December – February)	64.0
Spring (March – May)	121.5
Summer (June – August)	253.2
Fall (September – November)	139.6
Total	**578.3**

For comparison purposes, a summary of monthly and seasonal precipitation for the climate normals from the Winnipeg Airport station are shown in Table 7 and Table 8, respectively. The Winnipeg Airport station annual total precipitation amount is slightly lower than the Pinawa WNRE station annual total precipitation amount, due to a lower amount of annual rainfall. The amount of annual snowfall at each station is comparable.

Table 7: Monthly Precipitation Summary for the Winnipeg Airport Station

Month	Rainfall (mm)	Snowfall (cm)	Total Precipitation[a] (mm[eq])	Extreme Daily Precipitation (mm)	Days with Measurable Precipitation[b]
January	0.2	23.7	19.9	22.5	12.2
February	2.7	12.5	13.8	23.6	8
March	9.7	16.5	24.5	35.6	9.2
April	19.2	10.6	30	44.1	7.2
May	54.1	2.6	56.7	60.2	11.5
June	90	0	90	69.8	13.3
July	79.5	0	79.5	83.6	11.4
August	77	0	77	83.8	10.7
September	45.5	0.3	45.8	65	10.4
October	32.7	4.8	37.5	74.4	9.4
November	6.9	19.9	25	27.7	10.3
December	1.5	23	21.5	21.8	11.8
Annual	**418.9**	**113.7**	**521.1**	**—**	**125.3**

a) Total precipitation in mm [eq] is calculated by adding the snowfall in cm (a ratio of 10:1 to convert snow to rain) to the rainfall in mm.
b) Greater or equal to 0.2 mm.
mm[eq] = millimetres equivalent.

Table 8: Seasonal Precipitation Summary for the Winnipeg Airport Station

Season	Total Precipitation (mm[eq])
Winter (December – February)	55.2
Spring (March – May)	111.2
Summer (June – August)	246.5
Fall (September - November	108.3
Total	**521.2**

mm[eq] = millimetres equivalent.

2.2.3 Wind Speed and Direction

Climate normals for wind were not available at the Pinawa WNRE station; therefore, wind climate normals from the Winnipeg Airport station were used to present the long-term wind data from the surrounding area. The long-term average of wind speed and most frequent direction from the Winnipeg Airport station is provided in Table 9. Winds were from the south at the Winnipeg Airport station, with an annual average wind speed of 17 km/hr.

Table 9: Monthly Wind Meteorology Data from the Winnipeg Airport Station

Month	Season	Average Wind Speed (km/hr)	Most Frequent Direction
January	Winter	17.4	S
February		16.9	S
March	Spring	18	S
April		18.5	S
May		18.4	S
June	Summer	16.3	S
July		14.6	S
August		15.4	S
September	Fall	16.9	S
October		18	S
November		17.9	S
December	Winter	17.4	S

S = south.

The Pinawa area is generally characterized by winds predominantly blowing from the south-southeast or north-northwest directions, which may be visualized by an annual wind-rose using hourly wind data obtained from ECCC for the most recent six-year period (January 2010 to December 2015; ECCC 2016b). As seen on Figure 3, there is variation in the annual wind speeds and direction in the area around the WR-1 Building, with winds predominantly from the south and south-southeast and slightly less predominantly from the north-northwest and northwest. Over the six-year period, there were no recorded wind speeds defined as “calms,” having a wind speed of less than 0.2 m/s. Some “model calms” were identified, these are defined as hours having a wind speed less than 3.6 km/hr or 1 m/s. Winds from the south were generally of lower wind speeds than winds from the northwest.

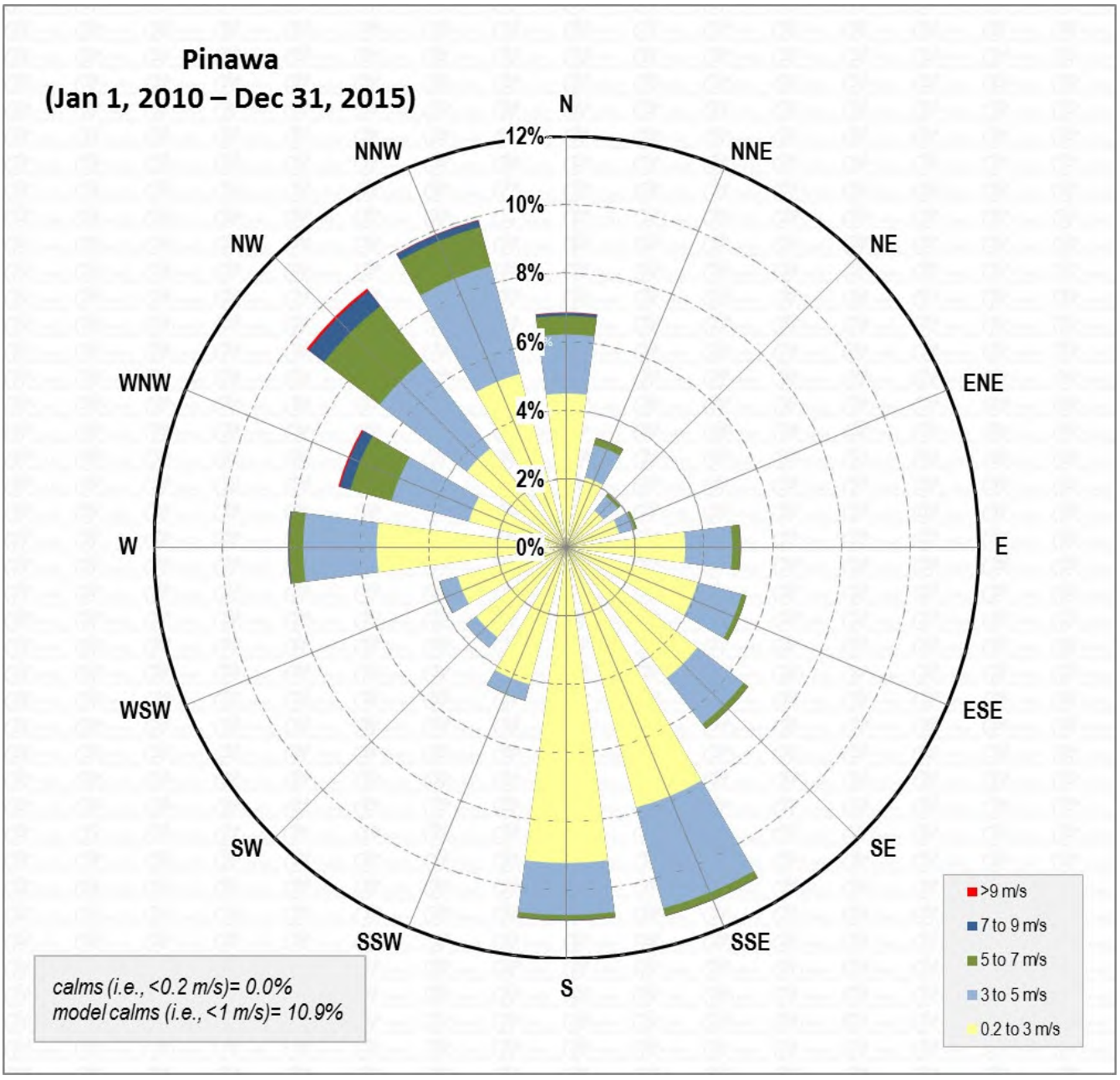

Figure 3: Annual Wind-Rose for the Pinawa WNRE Station (January 2010 to December 2015)

2.2.4 Relative Humidity

Relative humidity is the ratio of the actual water vapour in the air to the maximum amount the air can hold at a given temperature (ECCC 2016a). Table 10 presents the monthly average relative humidity climate normals from the Winnipeg Airport station recorded for 6:00 a.m. and 3:00 p.m. local time. Although the Winnipeg Airport station is located just over 100 km from the Project, it has been used as a regional comparison as there is no closer station reporting long-term relative humidity climate normals.

Table 10: Monthly and Annual Average Relative Humidity from the Winnipeg Airport Station

Month	Average Relative Humidity (%)	
	6:00 a.m.	3:00 p.m.
January	76.9	72.7
February	78.3	71.7
March	81.7	68.5
April	79.1	49.1
May	78.3	46.7
June	83.4	54.5
July	87.7	55.6
August	87.8	52.4
September	87.4	54.8
October	84.3	60.1
November	84.5	72
December	80	75.1
Annual	**82.4**	**61.1**

2.2.5 Atmospheric Pressure

Atmospheric pressure is the force per unit area exerted by the atmosphere on a surface. The higher the altitude, the lower the atmospheric pressure will be as less force will be applied on the surface. The monthly average atmospheric pressure from the Winnipeg Airport station is presented in Table 11. Although the Winnipeg Airport station is located just over 100 km from the Project, it has been used as a regional comparison, as there is no closer station reporting long-term (1981 to 2010) atmospheric pressure climate normals. The atmospheric pressure in Pinawa is comparable to Winnipeg as the stations are located at similar elevations.

Table 11: Monthly and Annual Average Atmospheric Pressure from the Winnipeg Airport Station

Month	Atmospheric Pressure (kPa)
January	98.9
February	98.9
March	98.9
April	98.7
May	98.5
June	98.3
July	98.4
August	98.5
September	98.5
October	98.6
November	98.7
December	98.8
Annual	**98.6**

kPa = kilopascal.

2.2.6 Solar Radiation

Solar radiation data from the Pinawa WNRE station is provided in Table 12. The solar radiation data are available through RETScreen (Natural Resources Canada 2013). RETScreen allows the user to select an ECCC station and provides the site reference conditions for the station selected, including daily solar radiation based on data from the National Aeronautics and Space Administration (NASA).

Table 12: Daily Solar Radiation for the Pinawa WNRE Station

Month	Daily Solar Radiation – Horizontal (kWh/m^2/day)
January	1.20
February	2.13
March	3.38
April	4.57
May	5.56
June	5.84
July	5.85
August	5.02
September	3.43
October	2.23
November	1.35
December	0.94
Annual	**3.47**

kWh/m^2/day = kilowatt-hour per square metre per day.

2.3 Extreme Weather Phenomena

Extreme weather conditions, including extreme temperature (either high or low), precipitation and winds, have been discussed in the previous sections. In addition, the CNSC REGDOC-2.9.1 indicates that extreme weather phenomena should also be included in the air quality assessment. The Comprehensive Study Report (AECL 2001) identified tornadoes as an extreme weather phenomenon and noted that there is a moderate probability of a tornado affecting the WL site. It was estimated that in a given 1 km^2 area within the southern area of Manitoba (approximately 190 km), there is a probability of a tornado strike of 0.00048 per year (AECL 2001).

2.4 Summary of Meteorology

The meteorological parameters discussed above characterize the meteorological climate for the baseline environment, as required by REGDOC-2.9.1. Of the parameters discussed in the sections above; temperature, precipitation, wind speed, wind direction, relative humidity, atmospheric pressure and solar radiation influence the atmospheric dispersion of the indicator compounds emitted in the study areas and from the Project. Results from the air quality assessment will incorporate meteorological effects.

3.0 AIR QUALITY BASELINE ASSESSMENT

This section summarizes the current air quality baseline for non-radiological indicator compounds at the WL site. The results presented in this section represent the Base Case air quality concentrations that are used in the EIS to assess changes to air quality from the Project.

3.1 Non-Radiological Criteria Air Contaminants

The assessment of air quality focused on predicting changes in the concentrations of selected non-radiological indicator compounds. These indicator compounds represent non-radiological compounds that are expected to be emitted from the Project, and include relevant compounds identified in the Comprehensive Study Report (AECL 2001). These compounds are generally accepted as indicators of changing air quality and for which relevant air quality criteria exist. The selected non-radiological indicator compounds fall into the following three categories:

- **particulate matter**: suspended particulate matter (SPM), particles nominally smaller than 10 µm in diameter (PM_{10}) and particles nominally smaller than 2.5 µm in diameter ($PM_{2.5}$); and
- **combustion gases**: nitrogen oxides (NO_X) represented by nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and carbon monoxide (CO).

These compounds are associated with various Project activities. Particulate matter is typically associated with airborne dust from demolition and decommissioning activities including the mobile concrete batching plant, vehicles travelling over on-site paved roads, as well as material loading and unloading activities. Products of combustion (NO_2, SO_2 and CO) are associated with the exhaust from on-site vehicles.

While ozone (O_3) is not directly emitted into the atmosphere from the Project, it is associated with the reaction of NO_X and volatile organic compounds (VOCs) to create NO_2 (MOE 2010). Ozone will be assessed as part of baseline conditions due to the availability of air quality monitoring data; however, emissions of ozone will not be quantified for the Project's air quality assessment Ozone baseline data will be used to calculate the NO_2 emissions from the Project. The VOCs, while a criteria air contaminant, are not considered indicator compounds for this Project. VOCs are not expected to be emitted from the decommissioning activities with the exception of some VOC emissions from fuel combustion; and therefore, were not retained for the air quality baseline assessment.

3.1.1 Applicable Guidelines

The relevant air quality criteria used for screening air quality effects in the region include the Manitoba Air Quality Criteria. The Province of Manitoba, Department of Sustainable Development, Climate Change and Air Quality Branch (Manitoba) has set guidelines related to ambient air concentrations and are summarized in *Objectives and Guidelines for Various Air Pollutants: Ambient Air Quality Criteria* (AAQC) (Government of Manitoba 2005). The Manitoba AAQCs are maximum concentration levels set for the protection and preservation of ambient air quality within Manitoba. The criteria are classified as objectives, guidelines or Canada-wide Standards. The Canada-wide Standards were updated in 2012 and are now known as Canadian Ambient Air Quality Standards (CAAQSs). The Manitoba AAQC are characterized as maximum tolerable, acceptable or desirable level concentrations in ambient air, and intend to serve as guidance for air quality assessment.

The Manitoba AAQC document states the following:

- Maximum Acceptable Levels are not to be exceeded in any urban centre including areas that are in the vicinity of industries with atmospheric emissions;
- within rural areas, it is in the goal to maintain pollutant concentrations at or below Maximum Desirable Levels; and
- Maximum Tolerable Levels are only for evaluation purposes to identify the severity of an anthropogenic or natural phenomenon in order to protect human health and institute appropriate corrective action.

As the Project is located in a rural area, the Maximum Desirable Levels were used to assess background air quality conditions if available; where the Maximum Desirable Levels were not available, the Maximum Acceptable Levels were used.

There are two sets of federal objectives and criteria: the National Ambient Air Quality Objectives (NAAQOs) and the Canadian Ambient Air Quality Standards (CAAQSs; formerly Canada Wide Standards or National Ambient Air Quality Standards [NAAQS]). Similar to the Manitoba AAQCs, the NAAQOs are benchmarks that can be used to facilitate air quality management on a regional scale, and provide goals for outdoor air quality that protect public health, the environment, or aesthetic properties of the environment (Canadian Council of Ministers of the Environment [CCME] 1999).

The NAAQO's are not regulatory criteria rather federal government has established the following levels of NAAQOs (Health Canada 1994):

- the Maximum Desirable Level defines the long-term goal for air quality and provides a basis for an anti-degradation policy for unpolluted parts of the country and for the continuing development of control technology; and
- the Maximum Acceptable Level is intended to provide adequate protection against adverse effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well-being.

The CAAQSs have been developed under the *Canadian Environmental Protection Act* (CEPA) and include standards for $PM_{2.5}$ and ozone that must be achieved by 2020. In 2015 the standard was phased in, with the final standard phase in date in 2020 (Government of Canada 2013). Similar to the NAAQO's the CAAQSs are not regulatory limits but, rather, are used as national targets for $PM_{2.5}$ and ozone, excluding Quebec (CCME 2014).

Monitoring data in Canada periodically exceeds these criteria, objectives, and standards at different locations for different periods of time. Measured concentrations above these values does not necessarily result in an immediate effects but serves as a guidance for areas where air quality could potentially be improved and to take actions to reduce or limit exposure.

A summary of the applicable Manitoba and federal objectives and criteria is listed in Table 13.

Table 13: Manitoba and Canadian Regulatory Air Quality Objectives and Criteria

Contaminant	Criteria Classification	Averaging Period	Manitoba AAQC[a] (µg/m³)			Canada-wide Standards[b]	Canadian Ambient Air Quality Standards[c] (µg/m³)	National Ambient Air Quality Standards and Objectives[d] (µg/m³)	
			Tolerable	Acceptable	Desirable			Desirable	Acceptable
SPM	Objective	24-hr	400	120	—	—	—	—	120
SPM	Objective	Annual	—	70	60	—	—	60	70
PM_{10}	Guideline	24-hr	—	50	—	—	—	—	—
$PM_{2.5}$	Guideline	24-hr	—	—	—	30	27[e]	—	—
$PM_{2.5}$	Guideline	Annual	—	—	—	—	8.8[e]	—	—
CO	Objective	1-hr	—	35,000	15,000	—	—	15,000	35,000
CO	Objective	8-hr	20,000	15,000	6,000	—	—	6,000	15,000
NO_2	Objective	1-hr	1000	400	—	—	—	—	400
NO_2	Objective	24-hr	—	200	—	—	—	—	200
NO_2	Objective	Annual	—	100	30	—	—	60	100
SO_2	Objective	1-hr		900	450	—	—	450	900
SO_2	Objective	24-hr	800	300	150	—	—	150	300
SO_2	Objective	Annual	—	60	30	—	—	30	60

a) Manitoba AAQC (Government of Manitoba 2005).

b) Canada-wide Standard as published in the Manitoba AAQC (2005) (updated in 2012 to CAAQS).

c) CAAQS published in the Canada Gazette Volume 147, No. 21 - May 25, 2013. Final standard phase in date of 2020 used.

d) CCME (1999).

e) The 24-hour CAAQS for $PM_{2.5}$ is based on the three-year average of the annual 98th percentile of the daily averaged monitored data. The annual CAAQS for $PM_{2.5}$ is based on the three-year average of annual averaged monitored data.

f) The 8-hour CAAQS for O_3 is based on the fourth highest 8-hour value annually, averaged over a 3-year period.

µg/m^3 = micrograms per cubic metre; SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; CO = carbon monoxide; NO_2 = nitrogen dioxide; O_3 = ozone; SO_2 = sulphur dioxide; — = No guideline available.

3.1.2 Existing Emissions Sources

There are three industrial facilities that report indicator compounds releases, disposals and transfers for recycling under Part 1A to the National Pollutant Release Inventory (NPRI) within 55 km of the Project (ECCC 2016c). These emissions contribute to the local air quality and the consideration of cumulative effects. Reporting facilities and emission totals are summarized in Table 14. These sources are minor contributors to the Projects indicator compounds provincial totals, as their total emissions for the six indicator compounds contribute from less than 1% to 3% to their respective provincial total emissions.

Table 14: 2014 Air Emission Totals for Industry Reported to National Pollutant Release Inventory within 55 km of the Project

Company Name	Distance to the Project (km)[a]	Direction from the Project	Emissions (tonnes)					
			NO_X	SO_2	CO	SPM	PM_{10}	$PM_{2.5}$
			11104-93-1	7446-09-5	630-08-0	NA-M08	NA-M09	NA-M10
Canadian Nuclear Laboratories	13	SE	—[b]	—[b]	—[b]	19.5	5.0	0.5
Lehigh Hanson Materials Ltd.	20	NW	1.6	0.2	6.7	82.1	35.2	5.0
Tantalum Mining Corporation of Canada	52	NE	—	—	—	32.4	9.6	0.9
Facilities Total			1.6	0.2	6.7	134.0	49.8	6.4
Manitoba Total			3,053	156,733	2,429	4,511	2,463	1,272
Percent Facilities Total of Manitoba Total			<1%	<1%	<1%	3.0%	2.0%	<1%

a) Approximate distance from WR-1 as reported to NPRI

b) NO_X, SO_2 and CO emissions for WL are reported as part of the Annual Safety Review Report.

SE = southeast; NW = northwest; NE = northeast; NO_X = nitrogen oxides; SO_2 = sulphur dioxide; CO = carbon monoxide; SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; — = Below NPRI reporting threshold.

3.2 Data Sources

In Manitoba, regional air quality is monitored through a network of air quality monitoring stations operated by the ECCC NAPS. These stations are operated under strict quality assurance and quality control procedures. Existing air quality was characterized using background air concentrations from monitoring data sources near the Project. The Comprehensive Study Report (AECL 2001) included an air quality baseline assessment that used monitoring stations that are no longer in operation or have been relocated (i.e., Winnipeg's station ID 9119); therefore, the data from these stations was not considered in this assessment.

There are no air quality monitoring stations within the RSA; however, three air quality monitoring stations are located within 300 km of the Project: Winnipeg (65 Ellen Street), Experimental Lakes and Brandon Assiniboine Community College (Assiniboine). The 65 Ellen Street station was the only air quality monitoring station located within 100 km of the Project[1]. The 65 Ellen Street station includes all indicator compounds with the exception of SPM. The 65 Ellen Street station is located approximately 84 km from the Project, in an urban area and approximately 60 km to 70 km away from two large bodies of water.

The second closest station, Experimental Lakes is located approximately 180 km away from the Project and is situated in one of the largest research areas for freshwater lakes that is managed by the International Institute for Sustainable Development (IISD 2016). The data from this station is heavily influenced by the more than 50 surrounding freshwater lakes and the station only monitors ozone which makes it difficult to compare with the other data sets. The limited data from this station are not considered representative of the air quality within the LSA and RSA, and therefore, were not used in the air quality assessment.

The next closest air quality monitoring station is located in Brandon Assiniboine Community College (Assiniboine) and includes all indicator compounds with the exception of CO, SO_2 and SPM. The Assiniboine station is located approximately 280 km from the Project.

Ideally, an air quality monitoring station would be within close proximity of the Project with a similar geographical siting and similar influences; however, the NAPS program focuses on areas that are affected by local sources and not on remote un-affected areas like the WL site. Therefore, for the Project, the 65 Ellen Street station is considered to be the most representative station of the RSA due to proximity, although there are differences in the geographical siting.

While the Assiniboine station is farther away and has less indicator compounds compared to the 65 Ellen Street station, it was selected to be included in the background air quality assessment for comparison to the 65 Ellen Street station. Its geographical siting is not as remote as the Project, has little influence from waterbodies, is located within an industrial setting and is not considered to be as representative as the 65 Ellen Street station for the WL site.

The relative locations of the two air monitoring stations selected to describe the background air quality for the LSA and RSA (i.e., 65 Ellen Street and Assiniboine) are provided in Table 15 and the station locations are shown on Figure 1. Any other stations are located more than 400 km away from the Project, and therefore, were not retained for the assessment given the long distance. For this assessment, data from 2009 to 2013 was used,

[1] The second monitoring station in Winnipeg was not selected for this assessment as it monitors less

which is the most recent five-year period at the time of this assessment for which all data are available and quality assured by ECCC.

Table 15: Location of Air Monitoring Stations in Close Proximity to the Project

City	NAPS Station ID	Location	Latitude and Longitude	Distance to the Project[(a)] (km)	Direction
Winnipeg	70119	Outside Regional Study Area	49.89809, -97.14652	84	Southwest
Brandon	70203	Outside Regional Study Area	49.83918, -99.9206	280	Southwest

a) Approximate distance from WR-1.
NAPS = National Air Pollution Surveillance

The air flow into the WL site varies in direction but is predominantly blowing from the south and south-southeast and slightly less predominantly from the north-northwest and northwest. The Project is located in a fairly remote area, with very few industrial emission sources that influence the airshed surrounding the Project. The air flow into the Winnipeg area is from the south, thereby including local and transboundary industrial influences. As the selected monitoring stations are located in more industrial and urban areas, the air quality data from the selected stations can be considered to provide conservative air quality estimates and are likely to be greater than the existing conditions in the RSA.

Table 16 provides a summary of the monitoring data available from each of the two selected stations for the period from 2000 through 2013. At the time of this assessment, complete datasets were available up until 2013, with only partial information available for 2014 and 2015. Not all compounds have the same data availability period for a given station, as additional compounds are added to the station at different dates as required by the ECCC (e.g., SO_2 was only monitored starting in 2008).

Table 16: Availability of Ambient Air Quality Data (Years)

Compound	65 Ellen Street Station	Assiniboine Station
SPM	—	—
PM_{10}	2006 - 2013	2006 - 2013
$PM_{2.5}$	2000 - 2002, 2013	2001 - 2002, 2013
NO_2	2000 - 2013	2000 - 2010, 2012 - 2013
NO	2000 - 2013	2000 - 2013
SO_2	2008 - 2013	—
CO	2006 - 2013	—
O_3	2000 - 2013	2000 - 2013

SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; CO = carbon monoxide; NO_2 = nitrogen dioxide; NO = nitrogen oxide; O_3 = ozone; SO_2 = sulphur dioxide; — = data for the parameter were not available at that station.

3.3 Assessment of Background Air Quality

The continuous monitoring stations listed in Table 15 were used to reflect the existing conditions in the RSA. The existing air quality levels based on background air concentrations from available monitoring stations are summarized in the following sections. The available air monitoring data represents the combined effect of emissions from sources near to each of the monitoring stations, as well as the effect of the emissions transported into the region.

Although gaseous monitoring equipment records concentrations in units of parts per million parts (ppm) or parts per billion parts (ppb), regulatory criteria are established on the basis of micrograms per cubic metre (µg/m³). In this section, monitoring results for gaseous compounds are presented in the units of µg/m³, to facilitate the comparison of monitoring to criteria. The conversion from ppm to µg/m³ is unique to each compound, based on the molecular weight of the compound and standard atmospheric conditions (1 atmosphere of pressure and 25°C). In contrast, particulate monitoring equipment records concentrations in units of µg/m³, allowing for direct comparison to the regulatory criteria.

3.3.1 Comparison of Monitored Data by Indicator Compound

The graphs in the following sections present simplified box-and-whisker plots showing the available concentration data. The box on the figures represents the bounds of the middle 50% of the data points. The top of the box represents the 75th percentile concentration, while the bottom of the box represented the 25th percentile concentration. The line through the middle of the box represents the median, or 50th percentile concentration. The orange diamond represents the average concentration, and the green circle represents the 90th percentile. On these figures, the whiskers extend up to the maximum and down to the minimum concentration.

The 90th percentile of the 1-hour, 8-hour and 24-hour measurements are typically used to represent the background air quality value when conducting an effects assessment as this value is exceeded only 10% of the time. The annual average concentration is used for annual background levels (AESRD 2013) and based on the measurement data. The average concentration for the shorter time periods provides an indication of what air quality would typically be at the location. The 75th percentile provides an indication of the concentration below which most of the existing air quality readings occurred. Significant differences between the average and 75th percentile readings provide an indication that the background air quality is dominated by infrequent, increases in measured concentration.

Particulate Matter (SPM, PM_{10} and $PM_{2.5}$)

Particulate emissions occur due to anthropogenic activities (e.g., industrial, transportation and residential sources), as well as natural sources. Suspended particulate matter is classified based on its aerodynamic particle size, primarily due to the different health effects that can be associated with the particles of different diameters.

There is no monitoring data available for SPM at the 65 Ellen Street and Assiniboine stations, however, an estimate of the background SPM concentrations can be estimated from the available PM_{10} monitoring results. Because PM_{10} is a subset of SPM, it is reasonable to assume that the ambient concentrations of SPM will be greater than corresponding PM_{10} levels. The mean levels of PM_{10} in Canadian locations are found to be approximately 50% of the SPM concentrations (Brook et al. 2011). By applying this ratio, it is possible to estimate the background SPM concentrations for the RSA. The average and 90th percentile 24-hour SPM estimated from PM_{10} monitoring results did not exceed the Manitoba AAQC (Acceptable Level) at either monitoring stations.

Monitoring data for PM_{10} was available at both monitoring stations. There were no PM_{10} values that are above the Manitoba AAQC (Acceptable Level) at the 65 Ellen Street station; however, the maximum monitored PM_{10} data are above the AAQC at the Assiniboine station, as shown on Figure 4. As discussed above, the Assiniboine station is located 280 km away from the WL site and data from this station is provided for comparison purposes only. Given its location and geographic siting, it is not considered to be as representative of the WL site as the 65 Ellen Street station.

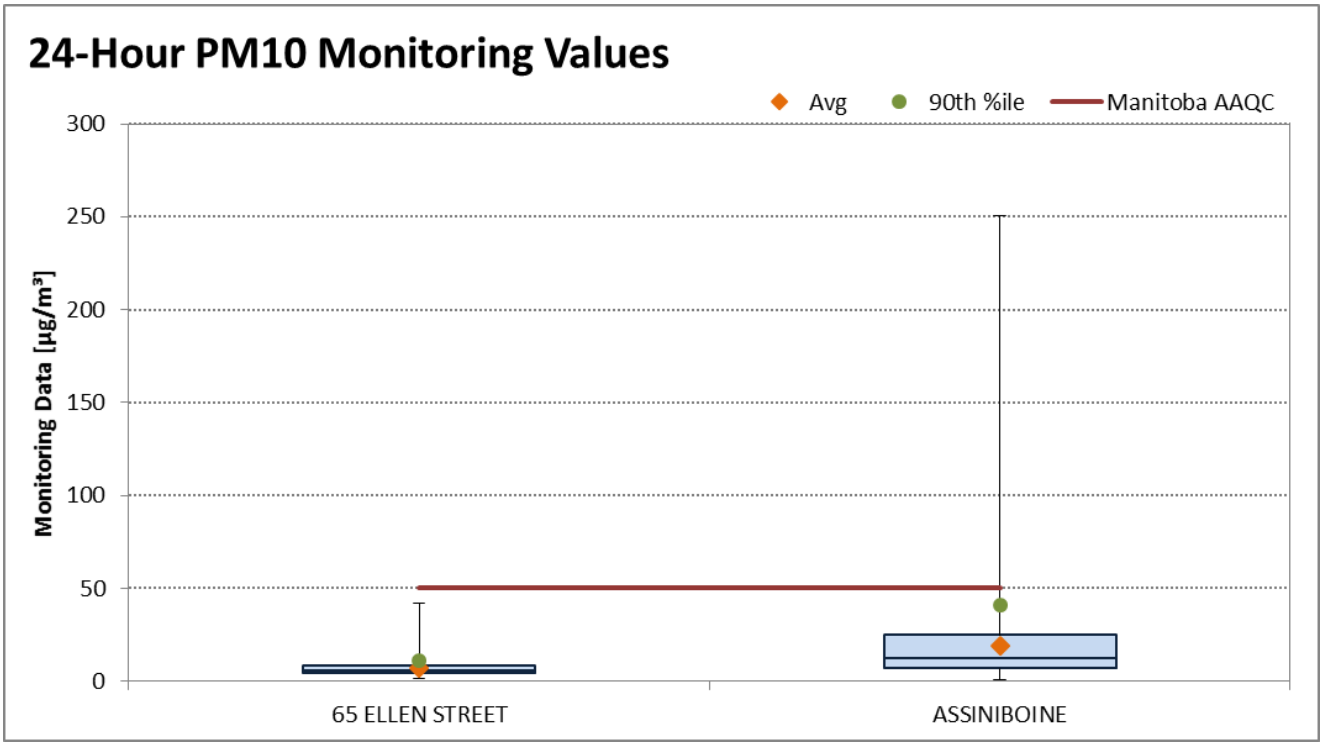

Figure 4: PM_{10} Monitoring Data for 2009 through 2013

In Manitoba, fine particulate matter ($PM_{2.5}$) emissions have been demonstrating a steady decline since 1990 (ECCC 2016d). While the maximum 24-hour value of $PM_{2.5}$ at 65 Ellen Street may be above the CAAQS (to be phased-in in 2020; as shown on Figure 5), the standards are calculated as the 98th percentile of the annual monitored data averaged over three years of measurements. At the 65 Ellen Street station, there were no periods of three consecutive years with monitored data after 2008. The Assiniboine station also did not have any periods with three consecutive years of monitored data. Therefore, there is insufficient data quantity for an assessment against the 24-hour CAAQS. Similarly, an assessment of the annual of the CAAQS could not be completed due to insufficient data quantity; however, a background value based on the annual average of the 2013 monitoring data were calculated to be 6.64 µg/m³.

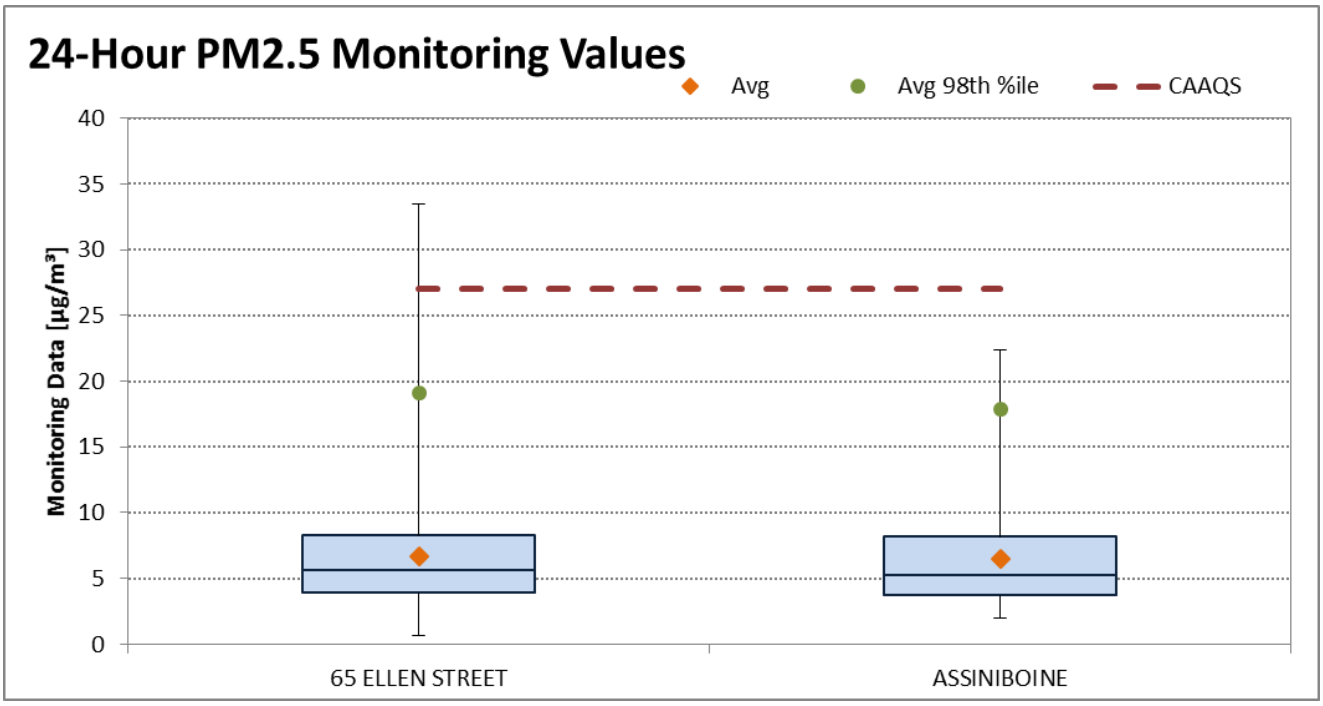

Figure 5: $PM_{2.5}$ Monitoring Data for 2013

Nitrogen Oxides and Nitrogen Dioxide (NO_x and NO_2)

The oxides of nitrogen (NO_x) are emitted in two primary forms: nitric oxide (NO) and nitrogen dioxide (NO_2 The NO reacts with ozone in the atmosphere to create NO_2. The air quality assessment was complete for NO_2, which has a Manitoba AAQCs. The primary source of NO_x and NO_2 in the region is the combustion of fossil fuels. Emissions of NO_X and NO_2 result from the operation of stationary sources such as, boilers and generators, as well as the operation of mobile sources such as vehicles, haul trucks and other equipment.

The annual mean concentrations of NO_2 in Manitoba have been decreasing slowly since 1990 (ECCC 2016e). There was NO_2 monitoring available both monitoring stations and there were data above the 1-hour or 24-hour Manitoba AAQC (Acceptable Level) for NO_2 recorded between 2009 and 2013 (Figure 6).

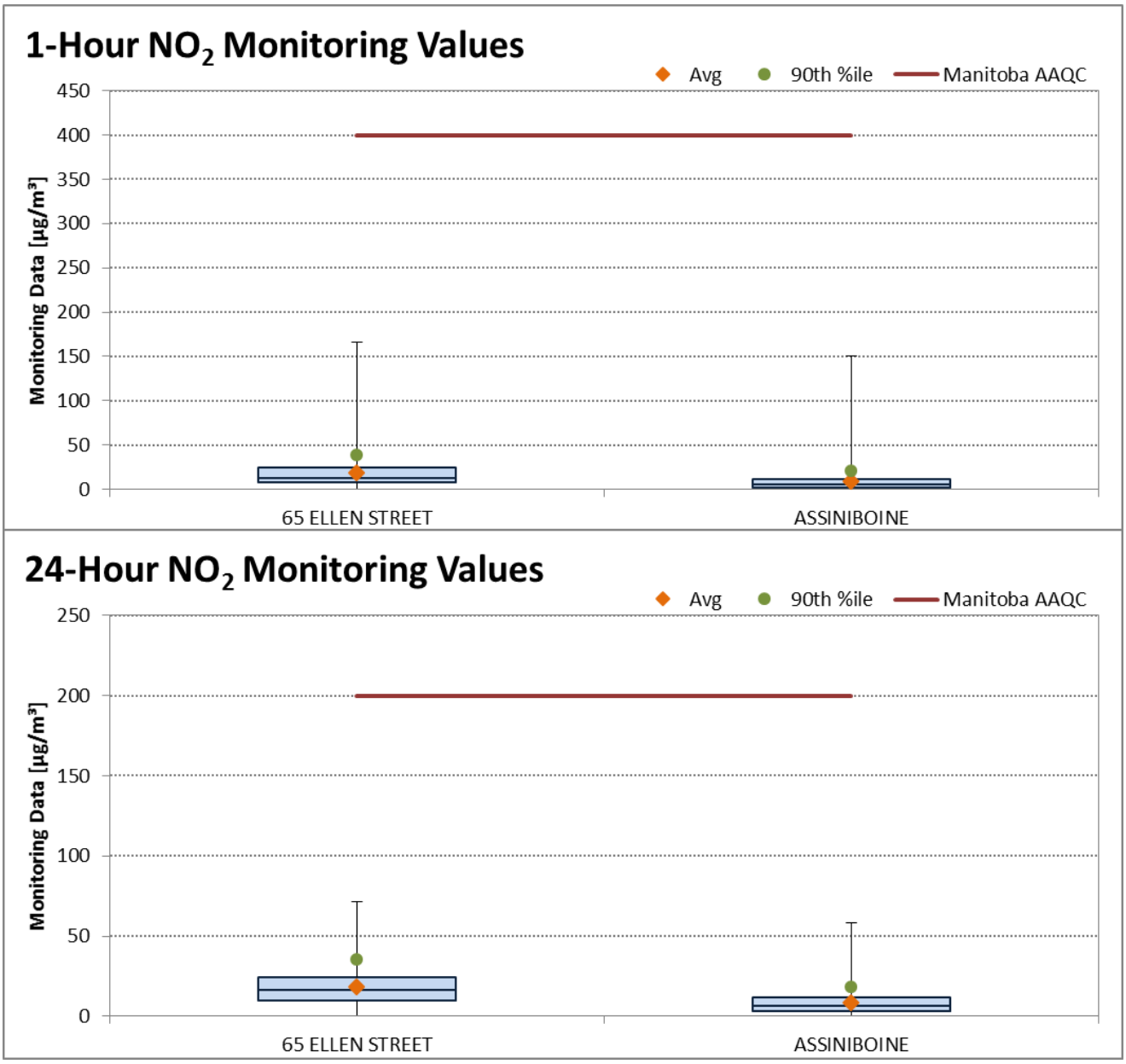

Figure 6: NO_2 Monitoring Data for 2009 through 2013

Sulphur Dioxide (SO_2)

The primary source of sulphur dioxide (SO_2) is the combustion of fossil fuels in a variety of sectors such as the electricity and smelter sectors. In Manitoba, emissions have decreased significantly due to the phase out of coal-fired generating stations in the province. A summary of the monitored SO_2 concentrations are summarized on Figure 7. While SO_2 monitoring was not available at the Assiniboine station, no SO_2 values above the 1-hour or 24-hour AAQC (Desirable Level) for SO_2 were recorded at the 65 Ellen Street station between 2009 and 2013.

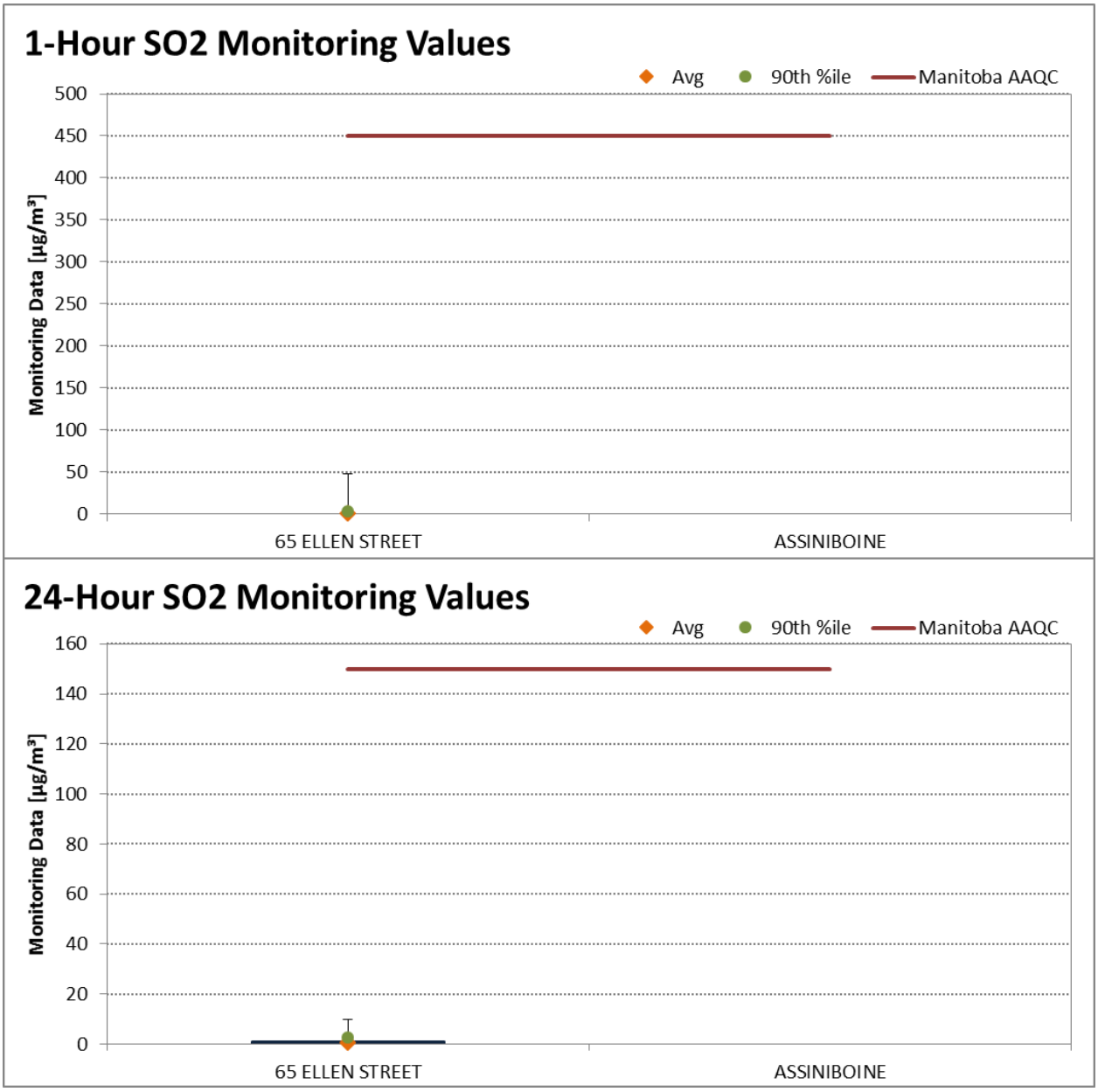

Figure 7: SO_2 Monitoring Data for 2009 through 2013

Carbon Monoxide (CO)

Carbon monoxide (CO) is a colourless, odourless, tasteless and, at high concentrations, toxic gas. It is produced primarily from the incomplete combustion of fossil fuels, as well as natural sources. Emissions of CO have been decreasing since 1990, mainly due to transportation emission reductions (ECCC 2016f). While CO monitoring was not available at the Assiniboine station, there were no values above the 1-hour or 8-hour AAQC (Desirable Level) for CO recorded at the 65 Ellen Street station between 2009 and 2013 (Figure 8).

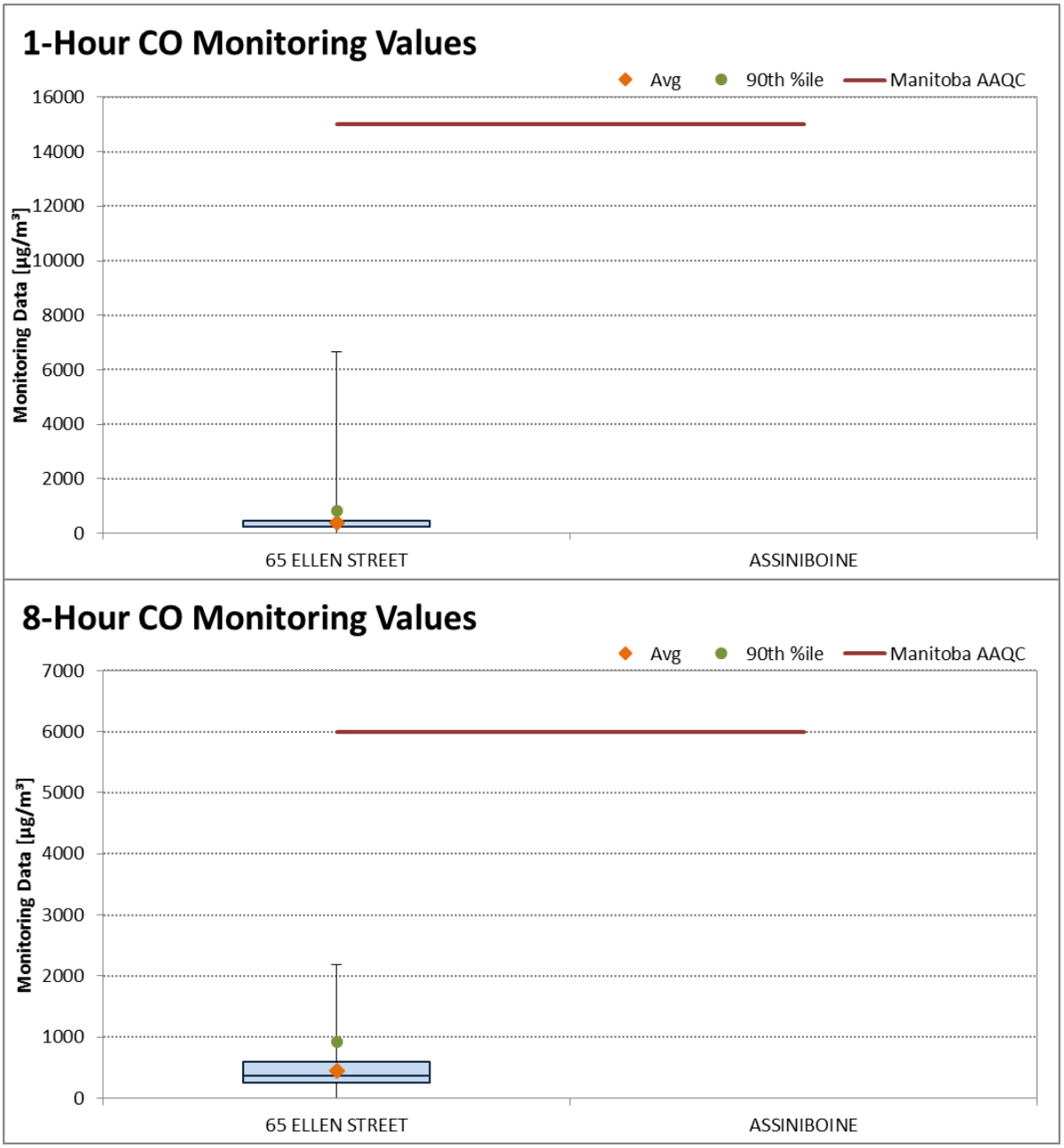

Figure 8: CO Monitoring Data for 2009 through 2013

Ozone (O_3)

Ground-level ozone (O_3) is formed when NO_x and VOCs react in the presence of sunlight. A summary of the monitored O_3 concentrations is provided on Figure 9. Although the maximum 1-hour concentrations of O_3 were above the Manitoba AAQC (Desirable Level), the average and 90th percentile concentrations were below this Manitoba AAQC. Overall, O_3 values above the 1-hour Manitoba AAQC were measured at the 65 Ellen Street station and Assiniboine station 5% and 6% of the time (equivalent to 100 and 109 days in 5 years), respectively, throughout the period of 2009 to 2013 and, at most, 8% of the time in one of the years at both stations (equivalent to approximately 29 days per year).

Currently there is no 8-hour Manitoba AAQC for O_3, but there is a CAAQS, which has been used for comparison to the data. The maximum 8-hour concentration of O_3 was above the standard at the 65 Ellen Street station but was just below this standard at the Assiniboine station. However, compliance with the CAAQS is based on the fourth highest 8-hour value annually, averaged over a 3-year period. At both stations, the most recent (2011–2013) average 4th highest concentrations were below the CAAQS. Table 17 presents a summary of the 3-year averaging method using 8-hour O_3 ambient monitoring results.

Although the maximum and 90th percentile O_3 monitored data were above the Manitoba AAQC at both stations, as these stations are located 84 km and 280 km from the WL site in urban settings with higher NO_X and VOCs; consequently, and therefore this results in higher O_3 data. These stations will provide conservative background ozone concentration estimates for the Project located in a rural setting and with low population density. However, Assiniboine station it is not considered to be as representative of the WL site as the 65 Ellen Street station, as previously described, and was not retained for the baseline assessment.

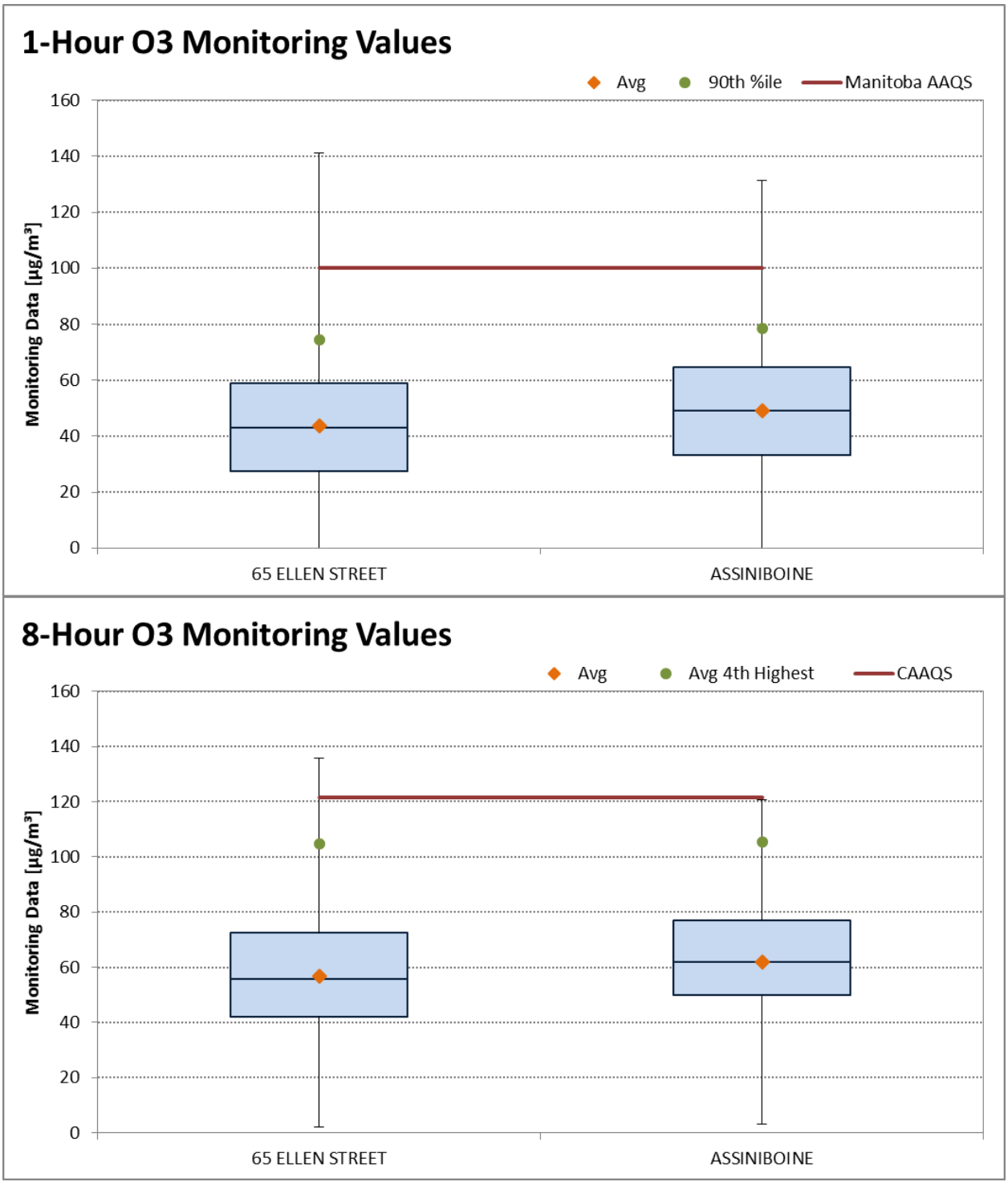

Figure 9: O_3 Monitoring Data for 2009 through 2013

Table 17: Summary of 3-year average 8-Hour O_3 Monitoring Results for Comparison to the CAAQS

Years	8-Hour Ozone [µg/m³]	
	65 Ellen Street	Assiniboine
2007–2009	96.65	104.99
2008–2010	105.81	105.48
2009–2011	107.20	103.60
2010–2012	112.27	105.73
2011–2013	104.83	105.48

3.4 Summary of Monitored Data by Station

For each of the 65 Ellen Street and Assiniboine stations, monitoring data for the years 2009 through 2013 were summarized by indicator compound for the averaging period relevant to the AAQC. As discussed above, to provide an understanding of the variability of the monitoring data, the average, 75th percentile, 90th percentile and maximum values for both stations are summarized in Table 18 and Table 19.

Table 18: Summary of Background Air Quality at the 65 Ellen Street Station (2009 – 2013)

CAC	Averaging Period	Average (µg/m³)[a]	75th (µg/m³)[a]	90th (µg/m³)[a]	Max (µg/m³)[a]
SPM[b]	24-hour	13.63	16.23	22.46	83.25
	Annual	13.72	—	—	19.45
PM_{10}	24-hour	6.81	8.11	11.23	41.63
$PM_{2.5}$[c]	24-hour	6.65	8.29	11.58	33.46
	Annual	6.64	—	—	6.64
NO_2	1-Hour	18.45	24.45	39.50	165.53
	24-Hour	18.48	24.62	35.41	71.23
	Annual	18.48	—	—	21.86
SO_2	1-Hour	0.74	0.00	2.62	47.15
	24-Hour	0.75	1.09	2.62	9.79
	Annual	0.75	—	—	1.30
CO	1-Hour	373.75	458.10	801.67	6642.40
	8-Hour	453.79	588.98	916.19	2192.32

a) Data measured in parts per billion (ppb) or parts per million (ppm), were converted to µg/m³ assuming standard temperature and pressure (25°C and one atmosphere of pressure).

b) SPM concentrations were calculated using PM_{10} concentrations.

c) The 24-hour CAAQS for $PM_{2.5}$ is based on the three-year average of the annual 98th percentile of the daily averaged monitored data. The annual CAAQS for $PM_{2.5}$ is based on the three-year average of annual averaged monitored data. Please note, the table does not present the values to compare to the relevant CAAQS due to insufficient data.

CAC = criteria air contaminant; µg/m³ = microgram per cubic metre; SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; NO_2 = nitrogen dioxide; SO_2 = sulphur dioxide; CO = carbon monoxide; O_3 = ozone.

Table 19: Summary of Background Air Quality at the Assiniboine Station (2009 – 2013)

Indicator	Averaging Period	Average[a] (µg/m³)	75th[a] (µg/m³)	90th[a] (µg/m³)	Max[a] (µg/m³)
SPM[b]	24-hour	37.73	49.38	81.61	501.50
	Annual	38.26	—	—	45.56
PM_{10}	24-hour	18.87	24.69	40.80	250.75
$PM_{2.5}$[c]	24-hour	6.47	8.16	11.79	22.42
	Annual	6.47	—	—	6.47
NO_2	1-Hour	8.77	11.29	20.69	150.48
	24-Hour	8.74	12.15	18.49	58.64
	Annual	7.14	—	—	10.58
SO_2	1-Hour	—	—	—	—
	24-Hour	—	—	—	—
	Annual	—	—	—	—
CO	1-Hour	—	—	—	—
	8-Hour	—	—	—	—
O_3[d]	1-Hour	49.15	64.76	78.50	131.49
	8-Hour	62.07	77.03	88.07	120.69

a) Data measured in parts per billion (ppb) or parts per million (ppm), were converted to µg/m³ assuming standard temperature and pressure (25°C and one atmosphere of pressure).

b) SPM concentrations were calculated using PM_{10} concentrations.

c) The 24-hour CAAQS for $PM_{2.5}$ is based on the three-year average of the annual 98th percentile of the daily averaged monitored data. The annual CAAQS for $PM_{2.5}$ is based on the three-year average of annual averaged monitored data. Please note, the table does not present the values to compare to the relevant CAAQS due to insufficient data.

d) The 8-hour CAAQS for O_3 is based on the fourth highest 8-hour value annually, averaged over a 3-year period. Please note, the table does not present the values to compare to the relevant CAAQS; however, this value may be found in section 3.3.1.

µg/m³ = microgram per cubic metre; SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; NO_2 = nitrogen dioxide; SO_2 = sulphur dioxide; CO = carbon monoxide; O_3 = ozone.

3.5 Summary of Background Air Quality

This section summarizes the existing air quality for the RSA, which is considered as background air quality. The 65 Ellen Street station is the only air quality monitoring station located within 100 km of the Project. As discussed above, due to proximity to the Project and to two large bodies of water, the 65 Ellen Street station is considered to be the most representative station of the RSA; and therefore, represents the background for non-radiological indicator compounds monitored at that station. As previously discussed, given its distance from the WL site and geographic siting (no large bodies of water, industrialize setting), the Assiniboine station was not retained for the background value as it is not considered to be as representative of the WL site as the 65 Ellen Street station. The background air quality values retained for the assessment are presented below in Table 20 and are based on the 65 Ellen Street station. The existing concentrations are below the respective provincial and federal criteria for each indicator compound, suggesting that the region has generally good air quality.

Table 20: Background Air Quality Values (90th Percentile, Average for Annual Only)[a]

Indicator	Averaging Period	65 Ellen Street (84 km SW)	Background (Base Case)
SPM	24-hour	22.46	**22.46**
	Annual	13.72	**13.72**
PM_{10}	24-hour	11.23	**11.23**
$PM_{2.5}$[b]	24-hour	11.58	**11.58**
	Annual	6.64	**6.64**
NO_2	1-Hour	39.50	**39.50**
	24-Hour	35.41	**35.41**
	Annual	18.48	**18.48**
SO_2	1-Hour	2.62	**2.62**
	24-Hour	2.62	**2.62**
	Annual	0.75	**0.75**
CO	1-Hour	801.67	**801.67**
	8-Hour	916.19	**916.19**
O_3[c]	1-Hour	74.57	**74.57**
	8-Hour	86.35	**86.35**

a) Data measured in parts per billion (ppb) or parts per million (ppm), were converted to µg/m³ assuming standard temperature and pressure (25°C and one atmosphere of pressure).

b) The 24-hour CAAQS for $PM_{2.5}$ is based on the three-year average of the annual 98th percentile of the daily averaged monitored data. The annual CAAQS for $PM_{2.5}$ is based on the three-year average of annual averaged monitored data. Please note, the table does not present the values to compare to the relevant CAAQS due to insufficient data.

c) The 8-hour CAAQS for O_3 is based on the fourth highest 8-hour value annually, averaged over a 3-year period. Please note, the table does not present the values to compare to the relevant CAAQS; however, this value may be found in section 3.3.1.

Bolded values represent the Base Case air quality.

µg/m³ = microgram per cubic metre; SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; NO_2 = nitrogen dioxide; SO_2 = sulphur dioxide; CO = carbon monoxide; O_3 = ozone.

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APPENDIX 6.2-2

Emissions Estimates

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1.0 INTRODUCTION

This Appendix was prepared to support the Environmental Impact Statement (EIS) for the Canadian Nuclear Laboratories (CNL) In Situ Decommissioning of WR-1 at the Whiteshell Laboratories Site (the Project). The following sections summarize the emission calculation methods followed to quantify the air quality emissions for use in the non-radiological dispersion modelling for indicator compounds as well as greenhouse gas (GHG) emissions. The emission estimation methods described within this Appendix follow generally accepted practices for conducting Environmental Assessments and, where appropriate, guidance in Appendix C of REGDOC-2.9.1, *Environmental Principles, Assessments and Protection Measures* (CNSC 2020). Scientifically accepted by Manitoba Sustainable Development (Draft Guidelines) and well-documented emission factors, such as AP-42 from the United States Environmental Protection Agency (US EPA) were used to estimate maximum and average emission rates.

2.0 ASSESSMENT OF COMPOUNDS AND ACTIVITIES

The assessment of air quality focused on predicting changes in the concentrations of selected non-radiological indicator compounds. The GHG assessment focused on predicting the emissions of GHGs and comparing them to provincial and federal emissions.

2.1 Air Quality Assessment

2.1.1 Air Quality – Indicator Compounds

The selected non-radiological indicator compounds fall into two categories:

- **particulate matter**: suspended particulate matter (SPM), particles nominally smaller than 10 micrometres (µm) in diameter (PM_{10}) and particles nominally smaller than 2.5 µm in diameter ($PM_{2.5}$); and
- **combustion gases**: nitrogen oxides (NO_X) represented by nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and carbon monoxide (CO).

These compounds are associated with various Project activities. Particulate matter is typically associated with airborne dust from demolition and decommissioning activities including the mobile concrete batching plant, non-road equipment (such as construction vehicles) and vehicles travelling over on-site paved roads, as well as material handling activities. Products of combustion (NO_2, SO_2 and CO) are associated with the exhaust from on-site vehicles. Ozone was assessed as part of baseline conditions, to calculate the NO_2 emissions from the Project. Emissions of ozone are not quantified for the Project's activities as it is not directly emitted into the atmosphere from the Project.

Emissions were assessed for the Project activities during the various stages of the closure phase. Scientifically accepted and well-documented emission factors, such as AP-42 from the US EPA were used to estimate maximum and average emission rates. Compounds that will be emitted from the Project in negligible amounts and/or activities that discharge a compound in a negligible amount were excluded from further analysis.

The rationale for these exclusions is provided in Section 2.2.2. Table 1 provides a summary of the activities for which emissions were calculated in the air quality assessment (i.e., considered in the Application Case), as well as a summary of the compounds expected to be released from the Project. The Application Case includes Project Stages 1 to 3, and therefore, the emissions and associated effects during these stages of the Project represent the bounding cases.

Table 1: Activities and Non-Radiological Indicator Compounds Released/Expected During the Closure Phase

Project Stage	Duration	Project Component		Application Case? [Y/N]	Emission Source Type	Non-Radiological Indicator Compounds					
						SPM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO
1 Preparation for In Situ Disposal	2022 - 2025	1.1	Create pathways between rooms	Y	Non-road Equipment Exhaust	✓	✓	✓	✓	✓	✓
		1.2	Batch mixing plant (temporary)	Y	Process	✓	✓	✓	—	—	—
					Non-road Equipment Exhaust	✓	✓	✓	✓	✓	✓
					Raw Material Handling	✓	✓	✓	—	—	—
					Road Exhaust	✓	✓	✓	✓	✓	✓
					Paved Roads	✓	✓	✓	—	—	—
					Propane Combustion	✓	✓	✓	✓	✓	✓
2 Grouting of below-grade structures and systems	2025	2.1	Fill below-grade areas with grout according to engineered fill schedule (multiple lifts of grouting pours)	Y	Non-road Equipment Exhaust	✓	✓	✓	✓	✓	✓
					Material Handling	✓	✓	✓	—	—	—

Table 1: Activities and Non-Radiological Indicator Compounds Released/Expected During the Closure Phase

Project Stage	Duration	Project Component		Application Case? [Y/N]	Emission Source Type	Non-Radiological Indicator Compounds					
						SPM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO
3 Removal of above-grade WR-1 structures and systems	2024-2025	3.1	Demolition of main reactor hall, the above-grade portion of the Primary Heat transport System, the 50T reactor hall bridge crane and the Ventilation Stack	Y	Non-road Equipment Exhaust	✓	✓	✓	✓	✓	✓
					Demolition	✓	✓	✓	—	—	—
		3.2	Removal of hazardous waste	Y	Road Exhaust	✓	✓	✓	✓	✓	✓
					Paved Roads	✓	✓	✓	—	—	—
		3.3	Recycling of materials	Y	Road Exhaust	✓	✓	✓	✓	✓	✓
					Paved Roads	✓	✓	✓	—	—	—
		3.4	Disposal of asbestos at the WL landfill[3]	Y	Road Exhaust	✓	✓	✓	✓	✓	✓
					Paved Roads	✓	✓	✓	—	—	—
4 Installation of concrete cap and engineered cover over grouted WR-1 Building	2026	4.1	Installation of concrete cap and engineered cover and barrier	N[2]	—	—	—	—	—	—	—
					—	—	—	—	—	—	—
		4.2	Grading of area	N[2]	—	—	—	—	—	—	—
					—	—	—	—	—	—	—
		4.3	Installation of drainage measures	N[2]	—	—	—	—	—	—	—
					—	—	—	—	—	—	—
5 Final site restoration	2026	5.1	Grading of disturbed area	N[2]	—	—	—	—	—	—	—
					—	—	—	—	—	—	—

Table 1: Activities and Non-Radiological Indicator Compounds Released/Expected During the Closure Phase

Project Stage	Duration	Project Component		Application Case? [Y/N]	Emission Source Type	Non-Radiological Indicator Compounds					
						SPM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO
6 Preparation for Institutional Control	2026	6.1	Fencing of grouted area	N(2)	—	—	—	—	—	—	—
					—	—	—	—	—	—	—
		6.2	Installation of monitoring wells	N(2)	—	—	—	—	—	—	—
					—	—	—	—	—	—	—
Miscellaneous			Emergency Power Generators	Y	Combustion	—(1)	—(1)	—(1)	✓	✓	✓

1) Compounds from this activity were considered to be negligible in comparison to the other activities occurring on-site.

2) Activities not included in the Application Case air quality assessment as worst-case conditions occur during the overlapping years of Stages 1 to 3.

3) For the emissions estimate, it was assumed that clean asbestos would be disposed of at the WL Landfill; however, some clean asbestos may be disposed of offsite.

SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; NO_2 = nitrogen dioxide; SO_2 = sulphur dioxide; CO = carbon monoxide; Y = yes; N = No.

2.1.2 Activities Not Considered in the Air Quality Assessment

There are many activities associated with the Project that produce emissions; however, not all activities produce emissions for any or all compounds that are relevant to the overall emissions assessment. All activities that potentially produce emissions were evaluated to assess their relevance; however, only activities that were considered to be relevant were included in the assessment. The following lists rationale as to why certain activities and/or emissions of certain compounds can be excluded from the assessment:

- the emission rates of certain compounds are very small relative to the overall emissions at the Project;
- the emissions of certain sources are known to not be relevant due to the type of operations in the assessment; and
- the location of the source relative to the rest of the sources on-site (i.e., the source is located far away from any potential receptors).

Table 2 lists the activities that were not assessed and the accompanying rationale.

Table 2: Emissions Not Included in the Air Quality Assessment

Activity/Compound	Rationale for Excluding from the Air Quality Assessment
Emergency power equipment	Emissions from the emergency power equipment were only included for contaminants with averaging period of 1 hour (NO_2, CO, SO_2). Other averaging periods for NO_2, CO, SO_2 exclude the generators emissions. Other contaminants with longer averaging periods (particulates) are excluded from the emergency power equipment assessment. The generators only operate periodically during monthly routine maintenance testing and a duration of one hour per month, rather than continuously. Additionally, the emergency power generators will only be used to supply electricity during power outage when other equipment is not in operation. Therefore, only routine maintenance of one hour per month is included in the representative scenario.
Snow removal equipment	Emissions from this equipment occur seasonally and are infrequent (i.e., only during the winter following a snowfall), and therefore, are not included in the representative scenario.
Operations support activities, such as maintenance activities	Emissions from these sources are infrequent, relatively small and do not occur at all times compared to the other activities that are occurring regularly and/or continuously. For example, these activities may include minor vehicles maintenance.
Combustion from Propane Space Heating	At the time of the assessment, it is unknown when the electric building heating systems will be taken offline for the WR-1 Building and replacement heating using propane has not been confirmed. The possible emissions from the combustion of propane used to replace the electric space heating would account for less than 5% of the total emissions from the Project and were not included in the representative scenario.
Removal of the Primary Heat Transport system	Releases from dust or gaseous emissions from removal of the PHT system are expected to be negligible because these particulates are anticipated to be captured in the remnant organics (oil), within the system. In addition, the structure is made of steel not concrete, which also inhibits the collection of dust and particulates on the PHT system. Regardless of the decontamination and dismantling techniques used for the WR-1, best practices will be implemented and will follow the Environmental Protection Plan. Releases of radiological emissions from the removal of the PHT system are evaluated in Section 6.7 Human and Ecological Health.
Non-road nuisance dust	Potential sources of dust not already included in the assessment will be managed through the *Management and Monitoring of Emissions* (CNL 2018a).

Table 2: Emissions Not Included in the Air Quality Assessment

Activity/Compound	Rationale for Excluding from the Air Quality Assessment
Non-dust fugitive emissions	■ Materials such as insulating material and asbestos are handled through existing strict procedures outlined in the Management Control Procedure, Controlling Asbestos Hazards (CNL 2017b) and are therefore not included in the assessment. ■ The bulk of the residual organic coolant that is in piping in tanks has been drained out, with the remainder to be filled as practical in place. This coolant, OS-84, has a negligible evaporation rate and its vapour pressure is lower than 0.001 hPa. Therefore, the coolant's components are not volatile and are not expected to be released to the atmosphere in measurable amounts.

NO_2 = nitrogen dioxide; SO_2 = sulphur dioxide; CO = carbon monoxide; PHT = primary heat transport; hPa = hectopascal pressure unit

2.2 Greenhouse Gas Assessment

2.2.1 Greenhouse Gas Compounds

There is no GHG regulatory program specific to Manitoba currently in place; however, Manitoba is in the process of developing a mandatory reporting of GHG emissions regulation (IISD 2015). While is the regulation is under development, Manitoba continues to rely on the federal GHG Reporting Program (GHGRP) to collection GHG data for the large emitters and other GHG sources Manitoba covered through the National Inventory Report for Canada (ECCC 2014).

Only direct GHG emissions from the Project have been considered in this assessment. Direct emissions include emissions that are owned or controlled by CNL, such as fuel use. Indirect GHG emissions, such as electricity, are emissions that are a consequence of the CNL activities but occur at sources owned or controlled by another entity, and therefore, are excluded from the assessment. The Project is not expected to require a large amount of electricity, as the Project activities are mainly powered by fuel.

The GHG emissions included the following:

- carbon dioxide (CO_2);
- methane (CH_4); and
- nitrous oxide (N_2O).

There are no Project activities which are expected to emit sulphur hexafluoride (SF_6), perfluorocarbons (PFCs) or hydrofluorocarbons (HFCs); therefore, these compounds are not included in the GHG assessment.

The GHG emissions were calculated from the stationary combustion sources, including the boiler's propane combustion and emergency power equipment diesel combustion, and mobile equipment based on the equipment/vehicle information provided by CNL for the closure phase. The GHG emission estimation assumptions are documented in Section 3.0. The GHG emissions were calculated using methods described in the guidance documents for the Environment and Climate Change Canada (ECCC) GHGRP.

2.2.2 Activities Not Considered in the Greenhouse Gas Assessment

There are many activities associated with the Project that produce GHG emissions; however, not all activities produce emissions for any or all compounds that are relevant to the overall emissions assessment. All activities that potentially produce emissions were evaluated to assess their relevance; however, only activities that were considered to be relevant were included in the assessment. Table 3 lists the activities that were not considered to be relevant (e.g., not included in the assessment) and the accompanying rationale.

Table 3: Emissions Not Included in the Greenhouse Gas Emissions Assessment

Activity/Compound	Rationale for Excluding from the GHG Assessment
Emissions from electricity consumption	Emissions from the electricity consumption from the Project are excluded from the greenhouse gas (GHG) assessment. This is consistent with the Greenhouse Gas Reporting Program (GHGRP) as only direct GHG emissions from sources operating at the facility are reported. Emissions from electricity consumption are considered as indirect emissions.
Emissions from transportation that occurred outside the Whiteshell Laboratories (WL) Site boundary	The transportation emissions to and from the site are excluded and should not be reported in accordance to the GHGRP. Only emissions from machinery used for the on-site transportation of materials or products used in the Project activities are included in the GHG assessment.
Snow removal equipment	Emissions from this equipment occur seasonally and are infrequent (i.e., only during the winter following a snowfall), and therefore, are not included in the representative scenario.
Upstream GHG emissions	A March 19, 2016 Notice in the Canada Gazette presented ECCC's proposed method for estimating the upstream GHG emissions associated with projects undergoing federal environmental assessments. Upstream GHG emissions are those resulting from all industrial activities from the point of resource extraction to the Project. The specific processes will vary by resource but generally include extraction, processing, handling and transportation. The final block volume of 15,000m^3 of grout is not planned to enable new soil or clay extraction or cement production facilities. Rather, the Project will be a customer for existing soil or clay supply and cement facilities and is unlikely to affect the Provincial supply and demand for these materials. Therefore, these indirect and upstream emissions have been excluded from the assessment. An upstream GHG assessment has been conducted and the resulting GHG emissions estimates are considerably lower than the ECCC's Strategic Assessment of Climate Change (ECCC 2020) threshold for requiring an upstream GHG assessment, therefore, the upstream GHG assessment has not been included in this report but is available as a standalone document.
Land Clearing (Carbon Sinks)	There is no land clearing associated with the Project and therefore no negative impact on carbon sinks. During the Final Site Restoration stage, the reclaimed WL site will have a vegetative grass cover producing an overall positive impact on carbon sinks for the Project. The area of the reclaimed land will not result in a significant change in GHG emissions, and therefore, an assessment has not been conducted
Emissions from Accidents or Malfunctions	There are no potentially large sources of GHG emissions from accidents or malfunctions associated with the Project, and therefore, are not included in the assessment.
Emissions Intensity	There are no products manufactured as part of the Project to estimate an emissions intensity, and therefore, an intensity estimate is not included in the assessment.
Net-Zero Plan	A Net-Zero Plan is not required as the Project is not planning to operate beyond 2050.

m^3 = cubic metres

3.0 ASSUMPTIONS

Table 4 documents the assumptions made as part of the estimation of non-radiological indicator compounds and GHG emission rates.

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Table 4: Air Quality and Greenhouse Gas Emissions Assessment Assumptions List

Activity	Data Sources / Assumptions			
	Parameter	Value	Unit	Source / Assumption
General				
Operating Schedule	Weekly Schedule	5	days/week	CNL
	Annual Schedule	50	weeks/year	CNL
	Monthly Schedule	12	months/year	CNL
	Grouting Daily Schedule	9	hr/day	Grout Formulation Package
	General Daily Schedule	10	hr/day (maximum)	CNL
		7.5	hr/day (average)	CNL
	Batch Mixing Plant Annual Schedule	109	days/year	Grout Formulation Package
Project Stages				See Project Stages table below
Batch Mixing Plant				
Grout	Grout Throughput	110	m³/hr (maximum)	Grout Formulation Package
		30	m³/minimum (average)	Grout Formulation Package
	Grout Density	2,190.03	kg/m³	Grout Formulation Package
	Grout Composition			See Grout Composition table below
Control Efficiency	Batch Mixing Process and Raw material Handling Control Efficiency	70%	Enclosure	Australia's NPI Emission Estimation Technique for Mining, January 2012 (Section 5.3 Control Technologies, Table 4) http://www.npi.gov.au/system/files/resources/7e04163a-12ba-6864-d19a-f57d960aae58/files/mining.pdf CNL proposes a complete enclosure, however tor conservatism, it is assumed the enclosure is 3-sided and will house the process as well as raw material handling. (http://www.diamondshelters.net/index.php?view=detail&id=547&option=com_joomgallery&Itemid=24).

Project Stages

Project Stages		Duration	# of Years
1	Preparation for In Situ Disposal	2022 - 2025	3
2	Grouting of below-grade structures and systems	2023	1
3	Removal of above-grade WR-1 structures and systems	2024 - 2025	2
4	Installation of engineered cover over grouted WR-1 Building	2026	1
5	Final site restoration	2026	1
6	Preparation for Institutional Control	2026	1
Project Description (WLDP-03700-ENA-001) pg. 3-12			

Percent Composition from the Grout Formulation Package:

Raw Material	Material [kg/m³]	% Composition
Portland Cement Type GU	89	4%
Fly Ash	297	14%
Sand	1570	72%
Water	232	11%
SIKA Visco Crete 2100	1.77	<1%
Diutan Gum based VMA	0.26	<1%

Table 4: Air Quality and Greenhouse Gas Emissions Assessment Assumptions List

Activity	Data Sources / Assumptions			
	Parameter	Value	Unit	Source / Assumption
Batch Mixing Plant				
Raw Material	Silt Content	Varies	Based on raw material	See nested table below
Boiler	Purpose	Hot water heaters used for grout production		
	Fuel	Propane		CNL
	Number	1		Assumed
	Thermal Input	1,500,000	Btu/hr	Assumed based on similar process
	Propane Fuel Sulfur Content	15	gr/100 ft³	http://www.sbcapcd.org/eng/tech/sulfur01.htm
	Hours of Operation	5	hr/day	Half of general daily maximum operating schedule
	Years of Operation	1	yr	Assumed boiler not needed for 3 years
Demolition				
Volumes for Removal or ISD Relocation	WR-1 Equipment	563	Mg	Detailed Decommissioning Plan
		345	m³	
	WR-1 Building	32,600	Mg	
		14,700	m³	
	SDR	13	Mg	
		178	m³	
	Decontamination/ Protection Wastes	50	Mg	
		50	m³	
	Total	33,226	Mg	
		15,273	m³	
Duration	Assume total removed in	2	years	
Material	Daily Material Movement	66	tonne/day	Based on Volumes for Removal and 2-year duration
	Material Moisture Content	2.1	%	US EPA AP-42 Section 13.2.4, mean silt loading for Municipal solid waste landfills - various limestone products
Grout Filling				
Material	Volume of Required Grout	10,000	m³/year	Grout Formulation Package
		110	m³/day	Grout Formulation Package
		2168	tonne/day (maximum)	Grout Formulation Package
		1150	tonne/day (average)	Grout Formulation Package
	Grout Moisture Content	11	%	US EPA AP-42 Section 13.2.4, mean silt loading for Municipal solid waste landfills - misc. fill materials

Component	Mean Moisture Content [%]	US EPA AP-42
Cement	2.1	Table 13.2.4-1 - Various Limestone Products
Fly Ash	27	Table 13.2.4-1 - Fly Ash
Sand	7.4	Table 13.2.4-1 - Sand
Gravel	0.7	Table 13.2.4-1 - Crushed Limestone

Table 4: Air Quality and Greenhouse Gas Emissions Assessment Assumptions List

Activity	Data Sources / Assumptions			
	Parameter	Value	Unit	Source / Assumption
Roads				
Parameters	Silt Loading	12	g/m²	US EPA AP-42 Section 13.2.1 - concrete batching
	Maximum Speed	20	km/hr	
	PM_{10} Control Efficiency	75%		WRAP AIR (2006) - WRAP Fugitive Dust Handbook (Table - Fugitive Dust Control Measures Applicable for the WRAP Region) Assumed control efficiency based on the following controls: minimization of track out (40%-80%), removal of deposits on roads asap (>90%), limit of on-site vehicle speed to 15 mph (57%)
	Road Width	3	m	Estimated based on typical Canadian road between 2.5 m and 3.25 m.
	Road width (2 lanes)	6	m	NSSGA
	Adjusted Road Width	12	m	NSSGA guidance (5.1.6.1)
Road Segments				Quantity transported was based on information provided by CNL Distance travelled was estimated using Google Earth, assumed 2 passes per road

Project Component		Activity	Description	Quantity Transported		Distance Travelled (One-Way) [km]
1.2	Temporary batch mixing plant	Raw Material Movement	Raw material from property boundary to storage area	884.21	m³/day (max)	3.7
				468.90	m³/day (average)	3.7
3.2	Removal of hazardous waste	Haulage	Waste materials from WR-1 Building to WMA	4,842	Mg	3.1
				2,249	m³	
3.3	Recycling of materials where possible (sent for recycling)	Haulage		28,354	Mg	
				12,994	m³	
3.4	Disposal of asbestos at the WL landfill or an off-site landfill(1)	Haulage	Asbestos material from WR-1 Building to WL Asbestos Disposal Site (WL landfill)	30.36	m³	4.5

Equipment	Truck Capacity	9.2	m³/truck	Tandem Axle Dump Truck http://www.donmann.com/equipment.php?subPage=trucks&equip=tandem
		13.5	tonnes/truck	
	Truck Weight	35600	kg	Tandem Steer/Tridem Drive Straight Truck, Maximum Gross Vehicle Weight Limits RTAC) https://www.gov.mb.ca/mit/mcd/mce/pdf/mb_vehicle_weights_and_dimensions_guide.pdf
		35.6	tonne	
	Horsepower	365 – 475	hp	Cat® CT13 Engine http://www.cat.com/en_US/products/new/equipment/on-highway-trucks/on-highway-trucks/18463770.html
	Truck Load Factor	0.9		Conservative assumption, assumed operating 90% of time

Table 4: Air Quality and Greenhouse Gas Emissions Assessment Assumptions List

Activity	Data Sources / Assumptions			
	Parameter	Value	Unit	Source / Assumption
Non-road Equipment				
Equipment	Vehicle Tier	Tier 3		CNL

Load factors were obtained from US EPA (US EPA 2010). Table F4 was used to obtain load factors for common cycle types and Table F6 was used to obtain the representative cycle types if not available in Table F4. The highest potential load factor was used for equipment that did not explicitly have a load factor defined in the Crank case document.
US EPA (2010). Crank case emission factors for non-road Engine Modelling (Compression Ignition) - 009d
https://www3.epa.gov/otaq/models/nonrdmdl/nonrdmdl2010/420r10018.pdf

Project Component		Equipment	Number of Units per Day	Horsepower Range [hp]	Load Factor	Basis for Equipment Type Load Factor
1.1	Create pathways between rooms	Tractor (Site Prep)	2	300 - 600	0.21	Backhoe/Loader
1.2	Temporary batch mixing plant	Pump Truck (Truck-Mounted Concrete Pump)	1	50 - 75	1.00	None (Cement & Mortar Mixers)
2.1	Fill below-grade areas with grout according to engineered fill schedule (multiple lifts of grouting pours)	Wheel Loader - Small	2	175 - 300	0.21	Backhoe/Loader
2.1		Wheel Loader - Large	2	300 - 600	0.21	Backhoe/Loader
3.1	Demolition of main reactor hall, the above-grade portion of the Primary Heat transport System, the 50T reactor hall bridge crane and the Ventilation Stack	Crane	1	300 - 600	1.00	None (Crane)
3.1		Excavator - Large	5	300 - 600	0.53	Excavator
3.1		Material Handler (Wheel)	4	175 - 300	0.21	Backhoe/Loader
3.1		Wheel Loader - Small	2	175 - 300	0.21	Backhoe/Loader
3.1		Wheel Loader - Large	2	300 - 600	0.21	Backhoe/Loader
3.1		Wheel Dozer	2	300 - 600	0.58	Crawler Dozer
4.1	Installation of concrete cap and engineered cover and barrier	Compactor (Roller)	2	300 - 600	0.58	Crawler Dozer
4.1		Dozer - Small	2	100 - 175	0.58	Crawler Dozer
4.1		Dozer - Large	2	300 - 600	0.58	Crawler Dozer
4.2	Grading of area	Motor Grader	2	175 - 300	0.58	Crawler Dozer
4.3	Installation of drainage measures	Material Handler (Wheel)	2	175 - 300	0.21	Backhoe/Loader
5.1	Grading of disturbed area	Motor Grader	2	175 - 300	0.58	Crawler
6.1	Fencing of grouted area	Material Handler (Wheel)	2	175 - 300	0.21	Backhoe/Loader
6.2	Installation of monitoring wells	Material Handler (Wheel)	2	175 - 300	0.21	Backhoe/Loader

Emergency Power Generators				
Equipment	Number of Generators	4		CNL
	Fuel	Diesel		CNL
	Number of Generators Tested Simultaneously	1		Assumed
	Generator Rating	250	kW	CNL
Miscellaneous				
Wind Speed		5.04	m/s	This is the average daily wind speed between 2010 and 2015, based on the hourly wind data obtained from the Pinawa Meteorological Station.

Note: For the purposes of this assessment, it is conservatively assumed that a batch mixing plant will be used.
1) For the emissions estimate, it was assumed that clean asbestos would be disposed of at the WL Landfill; however, some clean asbestos may be disposed of offsite.
hr = hour; m^3 = cubic metre; kg = kilogram; Btu = British thermal units; gr/100 ft^3 = grains per 100 feet; yr = year; Mg = megragram; g/m^2 = grams per square metre; km/hr = kilometres per hour; m = metre; kW = kilowatt; m/s = metres per second; hp = horsepower.

4.0 CALCULATIONS

The emission calculations expected during the closure phase were estimated as per REGDOC-2.9.1 (CNSC 2020), including average and maximum emission rates from the planned sources associated with the Project. Sample calculations are provided to demonstrate how the emission estimates were developed.

The emission rates for the non-radiological indicator compounds are expressed in units of grams per seconds (g/s), which are required for the dispersion models. The dispersion model assumes the emission rate is constant over an hourly period, which is the smallest time-step within the models used for predictions. Non-radiological indicator compounds were assessed against their respective criteria and averaging periods (e.g., SO_2 has criteria with 1-hour, 24-hour and annual averaging periods).

Prior to air dispersion modelling, 1-hour (hourly) emission rates were calculated for NOx, SO_2 and CO and 24-hour (daily) emission rates were calculated for SPM, PM_{10}, $PM_{2.5}$, NOx, SO_2 and CO. Hourly emission rates represent emissions averaged over a period of one hour while daily emission rates represent emissions averaged over a day, based on the activities operating schedule as described in Table 4. The 8-hour CO emission rate was conservatively assumed to equal its 1-hour emission rate. Annual emission rates were used following the completion of the modelling and were estimated using the Project's annual operating schedule.

The emission rates for GHG emissions are expressed in tonnes of carbon dioxide equivalent (CO_2eq) per year, as required under the assessment frameworks discussed in EIS Section 6.2.2.4.1 Methods.

4.1 Indicator Compounds – Emission Calculations

Non-radiological indicator compound emissions for particulates (SPM, PM_{10}, $PM_{2.5}$), NOx, SO_2 and CO were calculated for activities described in the Project description (Section 3.0) for the closure phase. These included the following:

- fugitive emissions from material handling activities related to demolition and grouting;
- vehicles exhaust from non-road equipment and on-road vehicles;
- fugitive dust from paved roads;
- emissions released from activities associated with the temporary batch mixing plant, including grout production, raw material handling and propane combustion; and
- products of combustion from emergency power generators.

The assessment follows scientifically accepted and well-documented calculation methods and emission factors, such as AP-42 from the US EPA.

4.1.1 Material Handling

Material handling activities associated with the demolition and grouting activities are expected to occur during two of the Project stages, including the grouting of below-grade structures and systems and removal of above-grade WR-1 structures and systems. These are characterized during the Project by the potential of fugitive dust during the grouting process and by the movement of material during demolition.

4.1.1.1 Grouting

The second stage of the Project, namely the grouting process, will involve the filling of below-grade areas with grout according to engineered fill schedule, which is proposed to involve multiple lifts of grouting pours. The grout-filling is expected to be completed through manually installed pipes (slick lines) within the building to direct grout where needed, eliminating the need to relocate lines and pumps during the grout pouring process and distributing the grout from the batch mixing plant directly to the WR-1. Material handling emissions from the grouting process were estimated based on the planned daily volume of grout to be used. These estimates are considered very conservative, as the process should have minimal lifts of materials, and therefore, limited exposure of material to the environment.

Predictive emission factors for particulate emissions were developed using equations from the US EPA document entitled *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources* (AP-42) (US EPA 1995). Equations documented in AP-42 Section 13.2.4 – Aggregate Handling and Storage Piles (US EPA 2006). The following predictive emissions equation was used in determining the emission factors for material handling:

$$\text{Emission Factor } [\frac{\text{kg}}{\text{Mg}}] = \text{k} \times 0.0016 \times \frac{\left(\frac{\text{U}}{2.2}\right)^{1.3}}{\left(\frac{\text{M}}{2}\right)^{1.4}}$$

Where:

k = particle size multiplier for particle size range (Table 5)
U = mean wind speed (metres per second [m/s])
M = moisture content of material (percent [%])

Table 5: Particle Size Multiplier for Particle Size Range Used for Material Transfer Assumptions

SPM	PM_{10}	$PM_{2.5}$
0.74	0.35	0.053

SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter

The following is a sample calculation for the SPM emission factor from the material handling of grout at the Project. A mean wind speed of 5.0 m/s calculated using the hourly wind speed data obtained from the ECCC meteorological station at Pinawa WNRE (2010 to 2015) was used for the calculation. This wind speed is the average daily mean wind speed. A moisture content of 11% for miscellaneous fill material was used, which was obtained from Table 13.2.4.1 of the US EPA AP-42.

$$\text{Emission Factor} = 0.74 \times 0.0016 \times \frac{\left(\frac{5.0}{2.2}\right)^{1.3}}{\left(\frac{11}{2}\right)^{1.4}}$$

$$\text{Emission Factor} = 3.19\text{E} - 04 \frac{\text{kg}}{\text{Mg}}$$

The following is a sample calculation for the daily SPM emission rate under the maximum scenario for a grout movement rate of 42 tonnes/day.

$$\text{Emission Rate} = 3.19\text{E} - 04 \frac{\text{kg}}{\text{Mg}} \times \frac{2168\ \text{Mg}}{\text{day}} \times \frac{1\ \text{day}}{24\ \text{hr}} \times \frac{1\ \text{hr}}{3{,}600\ \text{s}} \times \frac{1{,}000\ \text{g}}{1\ \text{kg}}$$

$$\text{ER} = 8.02\text{E} - 03\ \frac{\text{g}}{\text{s}}$$

The emission rates of PM_{10} and $PM_{2.5}$ were calculated as presented above with their corresponding calculated emission factors.

4.1.1.2 Demolition

The demolition activities as part of the third stage of the Project will involve the removal of the following components: main reactor hall, above-grade portion of the Primary Heat transport System, 50T reactor hall bridge crane and Ventilation Stack. Some of the removed components will be emplaced below-grade (i.e., Primary Heat transport System) while some will be hauled away for disposal. The third stage of the Project will involve the removal of hazardous waste, recycling of materials and disposal of asbestos at the WL landfill (it should be noted that some clean asbestos may be disposed of offsite). Demolition activities, as well as material removal, will be completed using non-road equipment. Emissions released from demolition activities are estimated based on the area of the proposed demolition.

Predictive emissions for particulate emissions were estimated using the demolition emission factors for PM_{10} obtained from the WRAP Air document titled WRAP Fugitive Dust Handbook, Chapter 3 - Construction and Demolition (Western Governors' Association 2006). The following equation was used to calculate particulate emissions from demolition:

$$\text{Emission Rate}\ \left[\frac{\text{g}}{\text{s}}\right] = \text{Emission Factor}\ \left[\frac{\text{ton}}{\text{acre} - \text{month}}\right] \text{x Area Demolished [acre] x Activity Period [month] x Conversion Factors}$$

The following is a sample calculation for the daily PM_{10} emission rate from the demolition activities under the maximum scenario:

$$\text{Emission Rate} = 0.42\frac{\text{ton}}{\text{acre} - \text{month}} \text{ x } 907{,}185\frac{\text{g}}{\text{ton}} \text{x } \frac{1 \text{ acre}}{0.004 \text{ km}^2} \text{ x } 0.0034 \text{ km}^2 \text{x } \frac{1 \text{ month}}{20 \text{ days}} \text{ x } \frac{1 \text{ day}}{24 \text{ hr}} \text{ x } \frac{1 \text{ hr}}{3{,}600 \text{ s}}$$

$$\text{Emission Rate} = 0.18 \frac{\text{g}}{\text{s}}$$

As the available emission factor is for PM_{10}, the emission factors for SPM and $PM_{2.5}$ were calculated using the particle size distribution for fugitive sources as per US EPA's AP-42 Chapter 13.2.4.

4.1.2 Non-Road Vehicles – Exhaust Emissions

Crank case emission factors and load factors for non-road Engine Modelling (Compression Ignition) – US EPA 009d (July 2010); Crank case document) were used to calculate the exhaust (tailpipe) emissions from on-site vehicles. A load factor of 1.0 was assumed for equipment that did not have an explicitly defined a load factor or a representative load factor to use in the pieces of equipment identified in the Crank case document. For conservatism, it was assumed that all on-site vehicles comply with Tier 3 emission standards.

The following predictive emissions equation was used to calculate the daily emission rates for on-site vehicles:

$$\begin{aligned}&\text{Daily Emission Rate}\\ &= \text{Emission Factor}\left[\frac{\text{g}}{\text{hp} - \text{hr}}\right] \times \text{Engine Horsepower Rating[hp]} \times \text{Load Factor}\\ &\times \text{Numberof Units per Day} \times \text{Daily Operating Hours} \times \text{Conversion Factors}\end{aligned}$$

The following is a sample calculation for the daily PM_{10} emissions for the tractors to be used for the Project:

$$\text{Daily Emission Rate} = 0.15 \frac{\text{g}}{\text{hp} - \text{hr}} \times 600 \text{ hp} \times 0.21 \times 2 \text{ Tractors} \times \frac{10 \text{ operating hr/day}}{24 \text{ hr/day}} \times \frac{1 \text{ hr}}{3{,}600 \text{ s}}$$

$$\text{Daily Emission Rate} = 4.38\text{E} - 03 \text{ g/s}$$

The emissions rates for PM_{10}, NOx and CO were calculated using the same equation. The emission rate for SPM was assumed to equal the emission rate of PM_{10}. The emission rate for $PM_{2.5}$ was calculated by multiplying the PM_{10} emission rate by 97%, as per the guidance document (US EPA 2010). The emission rate calculation for SO_2 included a conversion calculation for the emission factor prior to using the above equation. The emission rates for non-road equipment were calculated for all equipment associated with the Project based on the type and number of equipment present (e.g., dozers, excavators). Emission calculations for non-road equipment assume all equipment is operating at the same time and all are located at the Project.

4.1.3 On-Road Vehicles – Exhaust Emissions

Emission factors for the vehicle exhaust for on-road vehicles for the Project were obtained using the US EPA's mobile source emission factor model MOBILE6.2. The Canadian version of MOBILE6.2, which integrates the Canadian climate and fuel compositions emission model, was used for this assessment (MOBILE6.2C, Version 6.2.3).

The following inputs to MOBILE6.2C were created by following the Ministry of Transportation's Environmental Guide for Assessing and Mitigating the *Air Quality Impacts and Greenhouse Gas Emissions of Provincial Transportation Projects* (MTO 2012).

- The month of evaluation was July which is the preferred month by the MTO.
- The diurnal patterns in temperature were derived using the average ECCC meteorological station located on-site (Pinawa WNRE) hourly data from July 2013 (Refer to Appendix 6.2-1 – Baseline Air Quality and Meteorology for more details).
- The diurnal patterns in relative humidity the average ECCC meteorological station located on-site (Pinawa WNRE) hourly data from July 2013 (Refer to Appendix 6.2-1 – Baseline Air Quality and Meteorology for more details).
- The vehicle characteristics parameters including the vehicle miles travel (VMT) fraction, age distribution, annual mileage accumulation rates and diesel fractions for the 16 vehicle classes, were based on the default input data built into the MOBILE6.2C.
- The Canadian Sulfur in Diesel Fuel Regulation requires the diesel sulphur content of 15 parts per million (ppm), which was used.
- The emission reductions due to Inspection and Maintenance (I/M) Programs have not been considered as a conservative approach.
- Local was used as the road type and the speed of 20 kilometres per hour (km/hr) were used as the average speed on-site.
- Fuel composition and properties was representative of Manitoba.

The main inputs to the MOBILE 6.2C for this assessment are summarized in Table 6.

Table 6: MOBILE 6.2C Inputs

External Conditions	Input
Calendar year of evaluation	2019
Month	July
Altitude	Low, appropriate for use for the altitude of approximately 280 m at the WL Site.
Temperature	Average hourly temperature at the CNL on-site station
Humidity	Average hourly relative humidity at the CNL on-site station
Pressure	29.11 in Hg (Refer to Appendix 6.2-1 – Baseline Air Quality and Meteorology Appendix for more details)
Fuel Options	
RVP (PSI)	8.9 psi
Diesel sulphur content	15 ppm (Canadian legal requirement since 2010)[1]
Gasoline sulphur content	25 ppm
Air Toxics	
Gasoline aromatics (%)	28.4
Gasoline olefin (%)	10.3
Gasoline benzene (%)	0.8
Vapor percentage of gasoline at 200 F (%)	47.3
Vapor percentage of gasoline at 300 F (%)	83.3
Oxygenate volume% of Ethanol or Ethyl Alcohol (Ethanol)	10% volume and 20% market share
Vehicle Fleet Characteristic	
Distribution of Vehicle Registrations	default
Diesel fractions	default
Annual mileage accumulation rates	default
Vehicle Miles Travelled (VMT) fraction	default
Natural gas vehicles (NGVs) fraction	default
Alternate emission factors for NGVs	default
Activity Commands	
Fractions of Vehicle Miles Traveled (VMT)	default
VMT by facility, hour and speed	default
Starts per day	default
Distribution of vehicle starts during the day	default
Soak distribution	default
hot soak activity	default
Diurnal soak activity	default
Weekday trip length distribution	default
Weekend trip length distribution	default
Use weekend vehicle activity	default
Facility type	Local

[1] Federal Sulfur in Diesel Fuel Regulations and the Fuels Information Regulations.

The emission factors developed for the trucks are provided in Table 7. These emission factors were converted from VMT to vehicle kilometres travelled (VKT) and used for estimating emissions from on-road vehicles in both the construction and operations phases.

Table 7: Emission Factors for Fleet Trucks Calculated Using MOBILE6

Compound	Emission Factor (g/VKT)
SPM	4.46×10^{-2}
PM_{10}	4.46×10^{-2}
$PM_{2.5}$	2.65×10^{-2}
NO_X	1.23×10^{0}
SO_2	8.14×10^{-3}
CO	6.46×10^{-1}

SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; NO_X = oxides of nitrogen; SO_2 = sulphur dioxide; CO = carbon monoxide; g/VKT = grams per vehicle kilometres travelled.

The following equation was used to calculate the vehicle kilometres travelled per day (VKT/day):

$$\text{Daily Vehicle Kilometers Travelled } \left[\frac{\text{VKT}}{\text{day}}\right] = \frac{\text{\# of Trucks}}{\text{day}} \times \text{Number of Passes per Road} \times \text{Road Length Travelled [km]}$$

The following is a sample calculation for daily vehicle kilometres travelled on one segment (P1) of the paved roads:

$$\text{Daily Vehicle Kilometers Travelled} = \frac{97 \text{ Trucks}}{\text{Day}} \times 2\frac{\text{passes}}{\text{road}} \times 3.7 \text{ km}$$

$$\text{Daily Vehicle Kilometers Travelled} = 718\frac{\text{VKT}}{\text{day}}$$

Each of the road segments P1 to P4 and were calculated using the equation above. The road segments are presented on Figure 1 Site Layout and Dispersion Modelling Plan, and the length of the segments were estimated based on the site imagery. The following predictive emissions equation was used to calculate the vehicles exhaust emission rates for on-site vehicles travelling on paved road P1:

$$\text{Emission Rate } \left[\frac{\text{g}}{\text{s}}\right] = \text{Emission Factor } \left[\frac{\text{g}}{\text{VKT}}\right] \times \text{Daily Vehicle Kilometer Travelled} \frac{\text{VKT}}{\text{day}} \times ConversionFactors$$

The following is a sample calculation for daily SPM emissions for on-site vehicles exhaust emissions on paved road segment P1.

$$\text{Emission Rate} = 4.46\text{E}-02\ \frac{\text{g}}{\text{VKT}} \times 718 \frac{\text{VKT}}{\text{day}} \times \frac{1\ \text{day}}{24\ \text{hr}} \times \frac{1\ \text{hr}}{3{,}600\ \text{s}}$$

$$\text{Emission Rate} = 3.70\text{E}-04 \frac{\text{g}}{\text{s}}$$

The PM_{10}, $PM_{2.5}$, SO_2, NOx and CO rates were calculated using the same equation.

4.1.4 On-Road Vehicles – Paved Road Dust

The US EPA AP-42 emission factors from Chapter 13.2.1 – Paved Roads (January 2011) were used to calculate the fugitive dust emissions from paved roadways. The following predictive emissions equation was used to calculate the fugitive dust emission factor for paved roads:

$$\text{Emission Factor } [\frac{\text{g}}{\text{VKT}}] = (\text{k}(\text{sL})^{0.91} \times (\text{W})^{1.02})$$

Where:

k = particle size multiplier for particle size range and units of interest (Table 8)
sL = road surface silt loading (grams per square metre [g/m^2]) assumed to be 12 (as per US EPA AP-42 Section 13.2.1-3, silt loading for concrete batching)
W = average weight (tons) of the vehicles travelling the road

Table 8: Particle Size Assumptions for Paved Road Dust

Size Range	SPM	PM_{10}	$PM_{2.5}$
k(g/VKT)	3.23	0.62	0.15

SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; k(g/VKT) = the constant for the particle size multipliers used on the Road Dust emission calculations, in units of g/VKT (or grams per vehicle kilometre travelled).

The following is a sample calculation for SPM for the predictive emission factor for vehicles that will travel along paved segment 1 (P1) on the main site access. It was estimated that the fleet vehicles will have an average weight of 45.7 tons.

$$\text{Emission Factor} = (3.23\ \times (12)^{0.91} \times (45.7)^{1.02})$$

$$\text{Emission Factor} = 1{,}687.61 \frac{\text{g}}{\text{VKT}}$$

The emission rate of particulates was calculated according to the following equation.

$$\text{Daily Emission Rate } \left[\frac{\text{g}}{\text{s}}\right] = \text{Emission Factor } \left[\frac{\text{g}}{\text{VKT}}\right] \times \text{Daily Vehicle Kilometers Travelled } \left[\frac{\text{VKT}}{\text{day}}\right] \times (100\% - \text{Control Efficiency}) \times \text{Conversion Factors}$$

A control efficiency of 75% was selected to represent the implementation of limiting on-site vehicle speed to 15 mph. The following is a sample calculation for the SPM emission rate for vehicles travelling along the same paved road segment:

$$\text{Emission Rate} = 1{,}687.61\frac{\text{g}}{\text{VKT}} \times 718\frac{\text{VKT}}{\text{day}} \times (100\% - 75\%) \times \frac{1\text{ day}}{24\text{ hr}} \times \frac{1\text{ hr}}{3600\text{ s}}$$

$$\text{Emission Rate} = 3.51\text{ g/s}$$

The emission rates of PM_{10} and $PM_{2.5}$ were calculated as presented above.

4.1.5 Batch Mixing Plant

The temporary batch mixing plant is proposed to produce grout material for the filling of below-grade areas. The batch mixing plant will involve raw material handling activities, which will be sheltered, as well as supporting propane combustion activities to heat water required for grout production.

4.1.5.1 Grout Production

It is expected that the batch mixing plant will produce between 30 to 110 cubic metres (m^3) of grout per hour. Production time is estimated to be eight to nine hours per day on a shift duration of 12 hours per day, five days per week. The maximum scenario is therefore considered to have a throughout of 990 m^3/day and the average scenario is considered to have a throughput of 630 cubic metres per day (m^3/day). Based on a material density of 2190 kilograms per cubic metre (kg/m^3), these throughputs are 2168 tonne/day and 1150 tonne/day, respectively.

Emission factors for SPM and PM_{10} were obtained from US EPA AP-42 Chapter 11.12 – Concrete Batching, Table 1 (US EPA 2006). Controlled emission factors were used if available; if no controlled emission factors were available, a control efficiency was applied, if possible. The emission factor for $PM_{2.5}$ was calculated using the particle size distribution for fugitive sources as per US EPA AP-42 Chapter 13.2.4 (US EPA 2006).

The following equation was used to calculate the daily emission rates for particulates:

$$\text{Daily Emission Rate } \left[\frac{\text{g}}{\text{s}}\right] = \text{Emission Factor } \left[\frac{\text{kg}}{\text{Mg}}\right] \times \text{Daily Throughput } \left[\frac{\text{tonne}}{\text{day}}\right] \times \text{ Conversion Factors}$$

The following is a sample calculation for the maximum daily SPM emission rate for the aggregate transfer activity:

$$\text{Daily SPM Emission Rate} = 1.05\text{E}-03\frac{\text{kg}}{\text{Mg}} \times 294\frac{\text{tonne}}{\text{day}} \times \frac{1000\text{ g}}{1\text{ kg}} \times \frac{1\text{ day}}{24\text{ hr}} \times \frac{1\text{ hr}}{3{,}600\text{ s}}$$

4.1.5.2 Raw Material Handling

Although the calculation of emissions related to the production of grout includes fugitive emissions related to material transfer and truck loading, raw material handling was assessed to include all fugitive emissions related to the process. The amount of raw material required to produce the abovementioned daily throughput was estimated based results from the grout formulation package. The mean moisture content for the raw material was based on US EPA AP-42 Chapter 13.2.4 (Table 1; US EPA 2006). The raw material percent composition and mean moisture content is summarized in Table 9.

Table 9: Composition and Mean Moisture Content of Grout Raw Material

Component	Material Concentration (kg/m^3)(1)	Percent Composition(2)	Mean Moisture Content (%)	AP-42 Table 13.2.4-1 Material
Portland Cement Type I/II	89	4%	2.1	Various Limestone Products
Fly Ash Class F	297	13%	27	Fly Ash
Sand	1570	50%	7.4	Sand
Water	232	11%	—	—

1) Based on Table 1 – Use of Cementitious Materials for SRS reactor Facility In Situ Decommissioning (Langton et al. 2010) retrieved from http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/44/122/44122428.pdf

2) Percent Composition was selected for structural fill grout PR-ZB-FF-8-D based on the following: grout mix PR-UZB-FF-8 is for underwater placements, the grout mix with higher percent compositions (PR-ZB-FF) does not include gravel and has a high water content (15%), and the selected grout mix has the highest percent composition of non-water components.

kg/m^3 = kilogram per cubic metre; % = percent; - = not applicable.

Although it is expected the Project will install a complete enclosure for the raw material handling, a three sided enclosure was assumed for conservatism. The daily amount of raw material handling was calculated by multiplying the maximum and average throughputs by the percent composition of the raw material.

Emissions from raw material handling were calculated with the same equation as described in Section 4.1.1. Similarly, a mean wind speed of 5.0 m/s was used in the calculation. The following is a sample equation for the emission factor and emission rate of SPM from the material handling of cement under the maximum scenario.

$$\text{Emission Factor} = 0.74 \times 0.0016 \times \frac{\left(\frac{5.0}{2.2}\right)^{1.3}}{\left(\frac{2.1}{2}\right)^{1.4}}$$

$$\text{Emission Factor} = 3.25\text{E}-03\,\frac{\text{kg}}{\text{Mg}}$$

$$\text{Emission Rate} = 3.25\text{E}-03\,\frac{\text{kg}}{\text{Mg}} \times 88.1\,\frac{\text{Mg}}{\text{day}} \times \frac{1\text{ day}}{24\text{ hr}} \times \frac{1\text{ hr}}{3{,}600\text{ s}} \times \frac{1{,}000\text{ g}}{1\text{ kg}}$$

$$\text{ER} = 9.93\text{E}-04\,\frac{\text{g}}{\text{s}}$$

4.1.5.3 Propane Combustion

The process of grout production in the batch mixing plant will require the heating of water using a propane-fired boiler. It is assumed there will be one boiler with a maximum thermal input of 1,500,000 British thermal unit per hour (Btu/hr). Based on the propane heat content of 91,500,000 Btu/10³ gal, this boiler is expected to require 16.4 gallons per hour (gal/hr) input of propane.

Emission factors were obtained from US EPA AP-42 Section 1.5 - Liquefied Petroleum Gas Combustion. The emission factor for propane is provided in lb/10³ gal. The calculated hourly emission rate is conservatively assumed to equal the daily emission rate.

The following is the equation and sample calculation for the emission rate of NO_x from propane combustion:

$$\text{Emission Rate } [\frac{\text{g}}{\text{s}}] = \text{Maximum Gas Input } \frac{\text{gal}}{\text{hr}} \times \text{ Emission Factor } \frac{\text{lb}}{10^3\text{gal}} \times \text{Conversion Factors}$$

$$\text{NOx Emission Rate } = 16.4\frac{\text{gal}}{\text{hr}} \times 13\frac{\text{lb}}{10^3\text{gal}} \times \frac{1\text{ hr}}{3600\text{ s}} \times \frac{454\text{ g}}{1\text{ lb}}$$

$$\text{Emission Rate } = 2.69\text{E} - 02\frac{\text{g}}{\text{s}}$$

4.1.6 Emergency Power Generators

The Project proposes four diesel-fired emergency power generators to be installed at the WL site for provision of power in the event of electrical power loss. Only the testing of the generators was included in this assessment. It is assumed that only one generator will be tested at a time, for one hour per month. The generators will have a rated capacity of 250 kilowatts (kW).

Emission factors were obtained from US EPA AP-42 Chapter 3.3 – Gasoline and Diesel Industrial Engines (US EPA 1996). The emission factors are provided in pound per horsepower-hour (lb/hp-hr). These were converted to kilograms per kilowatt-hour (kg/kW-hr) by multiplying them by 0.608 as per Note (a) in Table 3.3-1 of the US EPA Chapter 3.3. To assess the worst-case scenario for daily emissions, it was assumed there is one hour testing per day. Emissions were estimated for contaminants that have limits with averaging periods less than 1-hour (i.e., NOx, CO and SO_2). The following is the equation and sample calculation for the emission rate of NO_x from emergency power generators testing:

$$\text{Emission Rate } \left[\frac{\text{g}}{\text{s}}\right] = \text{Rated Capacity [kW]} \times \text{ Emission Factor } [\frac{\text{kg}}{\text{kW} - \text{hr}}] \times \text{Number of Generators} \times \text{Conversion Factors}$$

$$\text{NOx Emission Rate} = 250\text{ kW} \times 0.019\ \frac{\text{kg}}{\text{kW} - \text{hr}} \times 4\text{ Generators} \times \frac{1\text{ hr testing}}{24\text{ hr per day}} \times \frac{1\text{ hr}}{3{,}600\text{ s}} \times \frac{1000\text{ g}}{1\text{ kg}}$$

$$\text{Emission Rate} = 0.22\frac{\text{g}}{\text{s}}$$

4.2 Greenhouse Gas – Emission Calculations

The GHG emissions, including CO_2, CH_4 and N_2O, were calculated for on-road and non-road equipment (mobile equipment) as well as stationary general combustion sources. Emissions for the Project stages were calculated using the equipment/vehicle information available for the closure phase. The assessment generally followed the calculation methods in the ECCC GHG Emissions Reporting Program, as well as other guidance was used as deemed appropriate.

4.2.1 On-Road and Non-Road Equipment (Mobile Equipment)

The GHG emissions from mobile equipment from the Project were calculated based on fuel consumption and fuel-specific emission factors as presented in Table A6-11 in Part 2 of ECCC's National Inventory Report 1990-2013 for calculating CO_2, CH_4 and N_2O emissions (ECCC 2015a). The method to calculate GHG emissions from mobile equipment is based on equipment rating, load factor and the default fuel specific emission factor (grams per litre [g/L]).

The equations below present the methods for calculating CO_2, CH_4 and N_2O emissions from mobile equipment:

$$\text{Emissions}\left[\frac{\text{tonnes}}{\text{yr}}\right] = \text{BSFC}_{i,k}\left[\frac{\text{lb}}{\text{hp}-\text{hr}}\right] \times h_{pi,k}\,[\text{hp}] \times h_{i,k}\left[\frac{\text{hr}}{\text{yr}}\right] \times \text{LF}_{i,k} \times \text{Daily \# of Units} \div \text{Diesel Density}\left[\frac{\text{kg}}{\text{L}}\right] \times \text{EF}_{i,CO2}\left[\frac{\text{g}}{\text{L}}\right] \times \text{Conversion Factors}$$

Where:

$h_{i,k}$ = total annual hours of operation for the mobile equipment sources
$h_{pi,k}$ = rated equipment horsepower for mobile equipment
$LF_{i,k}$ = load factor for mobile equipment, between 0 and 1
$BSFC_{i,k}$ = brake-specific fuel consumption for mobile equipment
EF = fuel-specific default emission factor

It was assumed that all mobile equipment is fueled by diesel. The annual fuel consumption for each vehicle type was calculated based on an assumed vehicle horsepower, brake specific fuel consumption and load factors from the Crank case document (US EPA 2010).

The following is a sample calculation for the emission rate of CO_2 from the non-road tractors:

$$\text{Emissions}_{CO2} = 0.367\frac{\text{lb}}{\text{hp}-\text{hr}} \times 600\ \text{hp} \times 10\frac{\text{hr}}{\text{day}} \times 250\frac{\text{days}}{\text{yr}} \times 0.21 \times 2\ \text{units} \times \frac{1\ \text{L}}{0.845\ \text{kg}} \times 2690\frac{\text{g}}{\text{L}} \times \frac{0.454\ \text{kg}}{1\ \text{lb}} \times \frac{1\ \text{tonne}}{1{,}000{,}000\ \text{g}}$$

$$\text{Emissions}_{CO2} = 334\frac{\text{tonne}}{\text{yr}}$$

4.2.2 General Stationary Combustion

Stationary combustion sources for the Project includes propane combustion for the hot water boiler as part of the batch mixing plant, propane combustion for the heating of the building once it is disconnected from the grid, as well as diesel combustion by the emergency power generators. For the purposes of this assessment, ECCC's Technical Guidance on Reporting GHG Emissions (2015b) was used to calculate emissions of CO_2, CH_4 and N_2O.

4.2.2.1 Propane Combustion

ECCC's Technical Guidance on Reporting GHG Emissions (ECCC 2015b) references Volume 2, Chapter 2 of the 2006 IPCC Guidelines (IPCC 2006), which presents energy-based emission factors for liquefied petroleum gas (in kilograms per terajoule [kg/TJ]). The equation below presents the methods for calculating CO_2, CH_4 and N_2O emissions from general stationary combustion:

$$\text{Emissions}\left[\frac{\text{tonnes}}{\text{yr}}\right] = \text{MaximumThermal heat Inpupt}\left[\frac{\text{GJ}}{\text{hr}}\right] \times \text{Daily Operating Hours [hr]} \times \text{EmissionFactor}\left[\frac{\text{kg}}{\text{TJ}}\right] \times \text{Conversion Factors}$$

Maximum Thermal Heat Input for the propane-fired boiler was estimated based on the assumed boiler rating of 1,500,000 Btu/hr. The following is a sample calculation for the emission rate of CO_2 from the combustion of propane as part of the batch mixing plant:

$$\text{Emissions}_{CO_2} = 1.58\frac{\text{GJ}}{\text{hr}} \times 9\frac{\text{hr}}{\text{day}} \times 109\frac{\text{days}}{\text{yr}} \times 63{,}100\ \frac{\text{kg}}{\text{TJ}} \times \frac{1\ \text{tonne}}{1{,}000\ \text{kg}} \times \frac{1\ \text{TJ}}{1{,}000\ \text{GJ}}$$

$$\text{Emissions}_{CO_2} = 97.6\ \frac{\text{tonnes}\ CO_2}{\text{yr}}$$

Maximum Thermal Heat Input for the building heat supplied via propane was estimated based on the combined kW rating of the individual units, converted to GJ and assumed to operate over an eight month heating period. The following is a sample calculation for the emission rate of CO_2 from the combustion of propane to provide building heat:

$$\text{Emissions}_{CO_2} = 24{,}261.12\frac{\text{GJ}}{\text{yr}} \times 63{,}100\ \frac{\text{kg}}{\text{TJ}} \times \frac{1\ \text{tonne}}{1{,}000\ \text{kg}} \times \frac{1\ \text{TJ}}{1{,}000\ \text{GJ}}$$

$$\text{Emissions}_{CO_2} = 1{,}530.9\ \frac{\text{tonnes}\ CO_2}{\text{yr}}$$

4.2.2.2 Diesel Combustion

Emission factors for CO_2, CH_4 and N_2O were obtained from Table 20-2 of ON.20 (General Stationary Combustion) of the Ontario Guideline for Greenhouse Gas Emissions Reporting (as set out under Ontario Regulation 452/09 under the *Environmental Protection Act;* MOECC 2015). Emissions of GHGs from the diesel generators were conservatively calculated using the number of hours that the generators will operate, the horsepower of each generator and emission factors for diesel provided in Table 20-2 of ON.20 (General Stationary Combustion). The following describes the equation used to calculate the GHG emissions from the diesel generators.

$$\text{Emission}\left[\frac{\text{tonne}}{\text{yr}}\right] = \text{Emission Factor}\left[\frac{\text{g}}{\text{GJ}}\right] \times \text{Rated Capacity [hp]} \times \text{Number of Generators} \times \text{Hours of Operation [hr]} \times \text{Conversion Factors}$$

The following is a sample calculation for the emission rate of CO_2 from the combustion of diesel:

$$\text{Emissions}_{CO_2} = 69{,}530\,\frac{\text{g}}{\text{GJ}} \times 250\ \text{kW} \times \frac{1.341\ \text{hp}}{1\ \text{kW}} \times 0.00268\,\frac{\text{GJ}}{\text{hp}-\text{hr}} \times 4\ \text{Generators} \times \frac{1\ \text{hr}}{1\ \text{month}} \times \frac{12\ \text{months}}{1\ \text{year}} \times \frac{1\ \text{tonne}}{1{,}000{,}000\ \text{g}}$$

$$\text{Emissions}_{CO_2} = 3.00\,\frac{\text{tonne}}{\text{yr}}$$

4.2.3 Global Warming Potentials

Emissions from CO_2, CH_4 and N_2O were converted to CO_2e. The GHG emissions are expressed as tonnes of equivalent CO_2, by multiplying the annual emissions of each GHG by its 100-year global warming potential (GWP). The GWP of each gas represents the gas's ability to trap heat in the atmosphere in comparison to CO_2. The federal GWPs that are used to calculate the GHG emissions from the Project are listed in Table 10 (ECCC 2015b). Federal GWPs were used to compare against the Canada-wide GHG emissions.

Table 10: Federal Global Warming Potentials

GHG Compound	GHGRP GWP
CO_2	1
CH_4	25
N_2O	298

Note: GHG = greenhouse gas; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; GHGRP GWP = Greenhouse Gas Reporting Program global warming potential.

5.0 EMISSION RATES

This section outlines the emission rates to be used in the Air Quality Assessment (in g/s) and GHG Assessment (in tonne CO2e/year), which were calculated for the Application Case as described in Section 4.0.

5.1 Air Quality Assessment

Table 11 and Table 12 summarize the maximum and average scenario daily emission rates, respectively, for each activity at the Project. Tables 13 and 14 summarize the maximum and average scenario percentages, respectively, that each source contributes to the overall emissions from the Project stages during the closure phase based on the daily emission rates.

Table 11: Maximum Scenario Summary of Daily Emissions Rates During the Closure Phase

Project Stage	Duration	Project Component		Emission Source Type	Daily Emission Rates (g/s)					
					SPM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO
1 Preparation for In Situ Disposal	2022 - 2025	1.1	Create pathways between rooms	Non-road Equipment Exhaust	4.38×10^{-3}	4.38×10^{-3}	4.24×10^{-3}	7.29×10^{-2}	1.46×10^{-4}	2.46×10^{-2}
		1.2	Batch mixing plant (temporary)	Process	7.62×10^{-2}	2.62×10^{-2}	5.46×10^{-3}	—	—	—
				Non-road Equipment Exhaust	2.08×10^{-3}	2.08×10^{-3}	2.02×10^{-3}	4.08×10^{-2}	4.81×10^{-5}	2.05×10^{-2}
				Raw Material Handling	4.09×10^{-3}	1.93×10^{-3}	2.93×10^{-4}	—	—	—
				Road Exhaust	3.70×10^{-4}	3.70×10^{-4}	2.20×10^{-4}	1.02×10^{-2}	6.76×10^{-5}	5.37×10^{-3}
				Paved Roads	3.51×10^{0}	6.73×10^{-1}	1.63×10^{-1}	—	—	—
				Propane Combustion	4.13×10^{-4}	4.13×10^{-4}	4.13×10^{-4}	2.69×10^{-2}	3.10×10^{-3}	1.55×10^{-2}
2 Grouting of below-grade structures and systems	2025	2.1	Fill below-grade areas with grout according to engineered fill schedule (multiple lifts of grouting pours)	Non-road Equipment Exhaust	5.91×10^{-3}	5.91×10^{-3}	5.73×10^{-3}	9.84×10^{-2}	1.96×10^{-4}	3.19×10^{-2}
				Material Handling	8.02×10^{-3}	3.79×10^{-3}	5.74×10^{-4}	—	—	—

Table 11: Maximum Scenario Summary of Daily Emissions Rates During the Closure Phase

Project Stage	Duration	Project Component		Emission Source Type	Daily Emission Rates (g/s)					
					SPM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO
3 Removal of above-grade WR-1 structures and systems	2024-2025	3.1	Demolition of main reactor hall, the above-grade portion of the Primary Heat transport System, the 50T reactor hall bridge crane and the Ventilation Stack	Non-road Equipment Exhaust	6.10×10^{-2}	6.10×10^{-2}	5.92×10^{-2}	1.02×10^{0}	2.03×10^{-3}	3.39×10^{-1}
				Demolition	1.83×10^{-1}	1.83×10^{-1}	1.83×10^{-2}	—	—	—
		3.2	Removal of hazardous waste	Road Exhaust	3.20×10^{-6}	3.20×10^{-6}	1.90×10^{-6}	8.82×10^{-5}	5.84×10^{-7}	4.64×10^{-5}
				Paved Roads	3.03×10^{-2}	5.81×10^{-3}	1.41×10^{-3}	—	—	—
		3.3	Recycling of materials	Road Exhaust	9.59×10^{-6}	9.59×10^{-6}	5.70×10^{-6}	2.65×10^{-4}	1.75×10^{-6}	1.39×10^{-4}
				Paved Roads	9.08×10^{-2}	1.74×10^{-2}	4.22×10^{-3}	—	—	—
		3.4	Disposal of asbestos at the WL landfill(1)	Road Exhaust	4.64×10^{-6}	4.64×10^{-6}	2.76×10^{-6}	1.28×10^{-4}	8.48×10^{-7}	6.73×10^{-5}
				Paved Roads	4.39×10^{-2}	8.44×10^{-3}	2.04×10^{-3}	—	—	—
Miscellaneous			Emergency Power Generators	Combustion	—	—	—	—	—	—
				Total	**4.02×10^{0}**	**9.94×10^{-1}**	**2.67×10^{-1}**	**1.49×10^{0}**	**2.00×10^{-2}**	**4.84×10^{-1}**

1) For the emissions estimate, it was assumed that clean asbestos would be disposed of at the WL Landfill; however, some clean asbestos may be disposed of offsite.

SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; NO_X = oxides of nitrogen; SO_2 = sulphur dioxide; CO = carbon monoxide; g/s = grams per second.

Table 12: Average Scenario Summary of Emissions Rates During the Closure Phase

Project Stage		Duration	Project Component		Emission Source Type	Daily Emission Rates (g/s)					
						SPM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO
1	Preparation for In Situ Disposal	2022 - 2025	1.1	Create pathways between rooms	Non-road Equipment Exhaust	3.28×10^{-3}	3.28×10^{-3}	3.18×10^{-3}	5.47×10^{-2}	1.09×10^{-4}	1.84×10^{-2}
			1.2	Batch mixing plant (temporary)	Process	4.04×10^{-2}	1.39×10^{-2}	2.89×10^{-3}	—	—	—
					Non-road Equipment Exhaust	1.56×10^{-3}	1.56×10^{-3}	1.52×10^{-3}	3.06×10^{-2}	3.61×10^{-5}	1.54×10^{-2}
					Raw Material Handling	2.17×10^{-3}	1.03×10^{-3}	1.55×10^{-4}	—	—	—
					Road Exhaust	1.95×10^{-4}	1.95×10^{-4}	1.16×10^{-4}	5.37×10^{-3}	3.56×10^{-5}	2.82×10^{-3}
					Paved Roads	1.84×10^{0}	3.54×10^{-1}	8.56×10^{-2}	—	—	—
					Propane Combustion	4.13×10^{-4}	4.13×10^{-4}	4.13×10^{-4}	2.69×10^{-2}	3.10×10^{-3}	1.55×10^{-2}
2	Grouting of below-grade structures and systems	2025	2.1	Fill below-grade areas with grout according to engineered fill schedule (multiple lifts of grouting pours)	Non-road Equipment Exhaust	5.91×10^{-3}	5.91×10^{-3}	5.73×10^{-3}	9.84×10^{-2}	1.96×10^{-4}	3.19×10^{-2}
					Material Handling	4.25×10^{-3}	2.01×10^{-3}	3.04×10^{-4}	—	—	—

Table 12: Average Scenario Summary of Emissions Rates During the Closure Phase

Project Stage		Duration	Project Component		Emission Source Type	Daily Emission Rates (g/s)					
						SPM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO
3	Removal of above-grade WR-1 structures and systems	2024-2025	3.1	Demolition of main reactor hall, the above-grade portion of the Primary Heat transport System, the 50T reactor hall bridge crane and the Ventilation Stack	Non-road Equipment Exhaust	4.58×10^{-2}	4.58×10^{-2}	4.44×10^{-2}	7.63×10^{-1}	1.52×10^{-3}	2.54×10^{-1}
					Demolition	4.81×10^{-2}	4.81×10^{-2}	4.81×10^{-3}	—	—	—
			3.2	Removal of hazardous waste	Road Exhaust	3.20×10^{-6}	3.20×10^{-6}	1.90×10^{-6}	8.82×10^{-5}	5.84×10^{-7}	4.64×10^{-5}
					Paved Roads	3.03×10^{-2}	5.81×10^{-3}	1.41×10^{-3}	—	—	—
			3.3	Recycling of materials	Road Exhaust	9.59×10^{-6}	9.59×10^{-6}	5.70×10^{-6}	2.65×10^{-4}	1.75×10^{-6}	1.39×10^{-4}
					Paved Roads	9.08×10^{-2}	1.74×10^{-2}	4.22×10^{-3}	—	—	—
			3.4	Disposal of asbestos at the WL landfill (1)	Road Exhaust	4.64×10^{-6}	4.64×10^{-6}	2.76×10^{-6}	1.28×10^{-4}	8.48×10^{-7}	6.73×10^{-5}
					Paved Roads	4.39×10^{-2}	8.44×10^{-3}	2.04×10^{-3}	—	—	—
Miscellaneous				Emergency Power Generators	Combustion	—	—	—	—	—	—
					Total	**2.16×10^{0}**	**5.08×10^{-1}**	**1.57×10^{-1}**	**1.20×10^{0}**	**1.94×10^{-2}**	**3.85×10^{-1}**

1) For the emissions estimate, it was assumed that clean asbestos would be disposed of at the WL Landfill; however, some clean asbestos may be disposed of offsite.

Average scenario emissions from the emergency power generators are assumed to equal emissions from the maximum scenario.
SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; NO_X = oxides of nitrogen; SO_2 = sulphur dioxide; CO = carbon monoxide; g/s = grams per second.

Table 13: Maximum Scenario Summary of Percentage Contributions of Emissions Rates During the Closure Phase

Project Stage		Duration	Project Component		Emission Source Type	Compound Percent of Overall Compound Emissions					
						SPM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO
1	Preparation for In Situ Disposal	2022 - 2025	1.1	Create pathways between rooms	Non-road Equipment Exhaust	<1%	<1%	2%	5%	<1%	5%
			1.2	Batch mixing plant (temporary)	Process	2%	3%	2%	—	—	—
					Non-road Equipment Exhaust	<1%	<1%	<1%	3%	<1%	4%
					Raw Material Handling	<1%	<1%	<1%	—	—	—
					Road Exhaust	<1%	<1%	<1%	<1%	<1%	1%
					Paved Roads	87%	68%	61%	—	—	—
					Propane Combustion	<1%	<1%	<1%	2%	15%	3%
2	Grouting of below-grade structures and systems	2025	2.1	Fill below-grade areas with grout according to engineered fill schedule (multiple lifts of grouting pours)	Non-road Equipment Exhaust	<1%	<1%	2%	7%	<1%	7%
					Material Handling	<1%	<1%	<1%	—	—	—

Table 13: Maximum Scenario Summary of Percentage Contributions of Emissions Rates During the Closure Phase

Project Stage	Duration	Project Component		Emission Source Type	Compound Percent of Overall Compound Emissions					
					SPM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO
3 Removal of above-grade WR-1 structures and systems	2024-2025	3.1	Demolition of main reactor hall, the above-grade portion of the Primary Heat transport System, the 50T reactor hall bridge crane and the Ventilation Stack	Non-road Equipment Exhaust	2%	6%	22%	68%	10%	70%
				Demolition	5%	18%	7%	—	—	—
		3.2	Removal of hazardous waste	Road Exhaust	<1%	<1%	<1%	<1%	<1%	<1%
				Paved Roads	<1%	<1%	<1%	—	—	—
		3.3	Recycling of materials	Road Exhaust	<1%	<1%	<1%	<1%	<1%	<1%
				Paved Roads	2%	2%	2%	—	—	—
		3.4	Disposal of asbestos at the WL landfill(1)	Road Exhaust	<1%	<1%	<1%	<1%	<1%	<1%
				Paved Roads	1%	<1%	<1%	—	—	—
Miscellaneous			Emergency Power Generators	Combustion	—	—	—	15%	72%	10%

1) For the emissions estimate, it was assumed that clean asbestos would be disposed of at the WL Landfill; however, some clean asbestos may be disposed of offsite.
SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; NO_X = oxides of nitrogen; SO_2 = sulphur dioxide; CO = carbon monoxide; < = less than; % = percent; - = not applicable.

Table 14: Average Scenario Summary of Percentage Contributions of Emissions Rates During the Closure Phase

Project Stage	Duration	Project Component		Emission Source Type	Compound Percent of Overall Compound Emissions					
					SPM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO
1 Preparation for In Situ Disposal	2022 - 2025	1.1	Create pathways between rooms	Non-road Equipment Exhaust	<1%	<1%	2%	5%	<1%	5%
		1.2	Batch mixing plant (temporary)	Process	2%	3%	2%	—	—	—
				Non-road Equipment Exhaust	<1%	<1%	<1%	3%	<1%	4%
				Raw Material Handling	<1%	<1%	<1%	—	—	—
				Road Exhaust	<1%	<1%	<1%	<1%	<1%	<1%
				Paved Roads	85%	70%	55%	—	—	—
				Propane Combustion	<1%	<1%	<1%	2%	16%	4%
2 Grouting of below-grade structures and systems	2025	2.1	Fill below-grade areas with grout according to engineered fill schedule (multiple lifts of grouting pours)	Non-road Equipment Exhaust	<1%	1%	4%	8%	1%	8%
				Material Handling	<1%	<1%	<1%	—	—	—

Table 14: Average Scenario Summary of Percentage Contributions of Emissions Rates During the Closure Phase

Project Stage	Duration	Project Component		Emission Source Type	Compound Percent of Overall Compound Emissions					
					SPM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO
3 Removal of above-grade WR-1 structures and systems	2024-2025	3.1	Demolition of main reactor hall, the above-grade portion of the Primary Heat transport System, the 50T reactor hall bridge crane and the Ventilation Stack	Non-road Equipment Exhaust	2%	9%	28%	64%	8%	66%
				Demolition	2%	9%	3%	—	—	—
		3.2	Removal of hazardous waste	Road Exhaust	<1%	<1%	<1%	<1%	<1%	<1%
				Paved Roads	1%	1%	<1%	—	—	—
		3.3	Recycling of materials	Road Exhaust	<1%	<1%	<1%	<1%	<1%	<1%
				Paved Roads	4%	3%	3%	—	—	—
		3.4	Disposal of asbestos at the WL landfill(1)	Road Exhaust	<1%	<1%	<1%	<1%	<1%	<1%
				Paved Roads	2%	2%	1%	—	—	—
Miscellaneous		Emergency Power Generators		Combustion	—	—	—	18%	74%	12%

1) For the emissions estimate, it was assumed that clean asbestos would be disposed of at the WL Landfill; however, some clean asbestos may be disposed of offsite.

SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; NO_X = oxides of nitrogen; SO_2 = sulphur dioxide; CO = carbon monoxide; < = less than; % = percent; — = not applicable.

For simplicity, emission rates may also be summarized based on the type of source considered in the Air Quality Assessment, specifically road (including dust from paved roads, exhaust emissions from paved roads) and non-road emissions (including exhaust emissions from non-road equipment, batch mixing plant, in situ disposal and demolition and emergency power generators). These emissions for the Maximum Scenario are summarized in Table 15.

Table 15: Summary of Maximum Scenario Project Emissions for Road and Non-Road Emissions

Contaminant	CAS No.	Averaging Period (hours)	Maximum Scenario Emission Rate (g/s)
Roads Emissions			
SPM	N/A-1	24-hour	3.671
PM_{10}	N/A-2	24-hour	0.705
$PM_{2.5}$	N/A-3	24-hour	0.171
NO_x	10102-44-0	1-hour	0.026
NO_x	10102-44-0	24-hour	0.011
CO	630-08-0	1-hour	0.013
CO	630-08-0	8-hour	0.013
SO_2	7446-09-5	1-hour	0.00017
SO_2	7446-09-5	24-hour	0.00007
Non-Roads Emissions			
SPM	N/A-1	24-hour	0.346
PM_{10}	N/A-2	24-hour	0.289
$PM_{2.5}$	N/A-3	24-hour	0.096
NO_x	10102-44-0	1-hour	8.239
NO_x	10102-44-0	24-hour	1.475
CO	630-08-0	1-hour	2.150
CO	630-08-0	8-hour	2.150
SO_2	7446-09-5	1-hour	0.355
SO_2	7446-09-5	24-hour	0.020

SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; NO_X = oxides of nitrogen; SO_2 = sulphur dioxide; CO = carbon monoxide; g/s = grams per second.

Following dispersion modelling, annual emission rates were calculated to account for the annual days of operations since the Project will not operate every day of the year.

5.2 Greenhouse Gas Assessment

The GHG emissions were estimated for the project phases including emissions from mobile and stationary fuel combustion sources. Table 16 presents the Application Case annual emissions from the Project. Tonnes of CO_2e were calculated using the federal GWPs.

Table 16: Summary of GHG Emission Rates

Source	Annual Emissions (tonnes CO_2e)			Total Annual Emissions (tonnes CO_2eq)
	CO_2	CH_4	N_2O	
	124-38-9	74-82-8	10024-97-2	
Mobile Equipment (Road & Non-Road)	11,886	17	693	12,595
Propane Combustion	1,629	0.65	0.77	1,630
Emergency Power Generators	3	0.004	0.13	3
Total	**13,517**	**17**	**694**	**14,228**

CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; CO_2eq = carbon dioxide equivalent.

6.0 CONSERVATISM IN EMISSION CALCULATIONS

Table 17 outlines the areas where conservatism was assumed in the emission rate calculations for air quality and GHG emissions, which results in an assessment that is not likely to under-predict the emissions associated with the Project.

Table 17: Areas of Conservatism in the Emission Rate Calculations

Project Activity	Conservatism
Non-road Equipment	It is conservatively assumed that all non-road equipment is operating simultaneously during the daily operating hours for Project Stages 1 to 3 and for the entire duration. In reality, it is unlikely that all equipment would operate simultaneously and that the same type of equipment will operate simultaneously for different components of these phases (e.g., it is assumed that two small wheel loaders are operated during both Stages 2 and 3).
Vehicles Emissions (on-road and non-road)	Assumed that all equipment will comply with US EPA Tier 3 emissions standards. Tier 3 standards have begun being phased-out in Canada (variable depending on the engine sizes) and new equipment will be required to comply with interim Tier 4 or Tier 4 emissions standards starting in 2014 (ECCC 2012).
Propane combustion	Based on assumed maximum equipment firing rate.
Fugitive Dust from Paved Roads	Roadway segments at the Project were assessed based on the type of roadway and anticipated traffic. Emission estimation equations from Chapters 13.2.1 of the AP-42 Emission Factor (US EPA 2011) were used for fugitive road dust from paved roads. These emission estimates are conservative and will overestimate emissions from facility roadways for the following reasons. ■ The US EPA AP-42 equations were developed from measured emissions from public roadways and as a result will tend to over-estimate low speed vehicle traffic from construction and industrial sites. ■ All roadways at the Project were modelled assuming simultaneous and continuous use; however, it is unlikely that this situation will occur in reality. ■ As the dust best management practices are revised through continuous improvements, the emissions from the on-site roadways are likely to decrease. ■ Seasonal variability for fugitive dust emissions was not considered in the assessment.

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APPENDIX 6.2-3

Dispersion Modelling

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1.0 INTRODUCTION

This Appendix was prepared to support the Environmental Impact Statement (EIS) for the Canadian Nuclear Laboratories (CNL) In Situ Decommissioning of WR-1 at the Whiteshell Laboratories Site (the Project). This Appendix describes the dispersion models and modelling approach used to conduct the non-radiological air dispersion modelling as part of the effects assessment. More specifically, this Appendix documents the methods, inputs and assumptions that were used to prepare and complete the dispersion modelling to predict ground-level concentrations of non-radiological indicator compounds resulting from the Project.

The modelling approach described within this Appendix follows generally accepted practices for conducting environmental assessments and modelling guidance. It should be noted that the Manitoba Sustainable Development (now Manitoba Environment, Climate and Parks), Climate Change and Air Quality Branch, has limited dispersion modelling guidance included in the *Draft Guidelines for Air Dispersion Modelling in Manitoba* from the Manitoba Conservation (2006) – Air Quality Section. Therefore, the Draft Guidelines and the following guidance documents were followed as appropriate: the Ontario Ministry of the Environment and Climate Change (MOECC) document titled *Air Dispersion Modelling Guideline for Ontario* (2009), the Saskatchewan Ministry of the Environment (MOE) document titled *Saskatchewan Air Quality Modelling Guideline* (2012) and in the National Stone, Sand and Gravel Association (NSSGA) document titled *Modeling Fugitive Dust Sources* (2004). The air dispersion modelling for the Project included the following approach:

- SCREEN3 dispersion modelling for emissions sources other than paved roads; and
- CAL3HQC dispersion modelling for paved roads.

2.0 AIR DISPERSION MODELLING

The likely environmental effects for the air quality indicators were evaluated with the aid of the SCREEN3 and CAL3QHC dispersion models developed by the United States Environmental Protection Agency (US EPA).

The selection of the SCREEN3 and CAL3HQC models were based on the following capabilities:

- has a technical basis that is scientifically sound and is in keeping with the current understanding of dispersion in the atmosphere;
- applies formulations that are clearly delineated and are subjected to rigorous independent scrutiny;
- makes predictions that are consistent with observations;
- is recognized by federal and provincial regulators as one suitable for use;
- evaluates the source configurations and indicator compounds associated with the Project;
- the terrain surrounding the Project is relatively simple;
- allows for the use of worst-case meteorological data; and
- long-range transport of compounds is not anticipated.

2.1 Dispersion Modelling

2.1.1 Model Development

The US EPA SCREEN3 dispersion model (version 13043) is a single-source dispersion model that can be used to predict worst-case 1-hour concentration without the need for dispersion modelling meteorological data. As noted in the Saskatchewan Air Quality Modelling Guideline (MOE 2012), if the air quality meets the appropriate standards using this screening approach and model, there is no need for additional modelling using a more refined model. SCREEN3 was selected to model the activities associated with the in situ disposal of the WR-1 Building since all the activities will occur either at the WR-1 Building or next to it. Emissions from the vehicles travelling on paved roads to and from the WR-1 Building were modeled using CAL3HQC (a dispersion model for roads). The SCREEN3 model was developed by the US EPA and calculates 1-hour concentration estimates which are based on the US EPA document titled *Screening Procedures for Estimating the Air Quality Impact of Stationary Sources* (US EPA 1992). This model has been adopted in Manitoba (Manitoba Conservation 2006) and in Ontario and Saskatchewan as a regulatory model recommended for permitting and regulatory applications (MOECC 2009; MOE 2012). The SCREEN3 model uses a Gaussian plume model, which includes emission source parameters and worst-case meteorological data (US EPA 1995a).

In 1980, after careful validation with field data, the US EPA endorsed CALINE3 as the official model for estimating concentrations of non-reactive criteria air contaminants near highways (and roadways). The US EPA developed the CAL3HQC and CAL3HQCR dispersion models in 1995, which incorporate the CALINE3 model but are more versatile and user-friendly. The CAL3HQC model is most suited to predict concentrations for a single set of meteorological conditions and is the preferred model for the credible worst-case analysis method as identified in Ontario Ministry of Transportation's *Environmental Guide for Assessing and Mitigating the Air Quality Impacts and Greenhouse Gas Emissions of Provincial Transportation Projects* (MTO Guide, MTO 2012). The CAL3QHC model was selected for air dispersion modelling analysis for the paved road emissions for the Project, given that the majority of vehicular air emissions are traffic related.

The Project is located in Manitoba. The selected models are approved regulatory dispersion models in several Canadian provinces including Ontario (MOECC 2009; MTO 2012) and Saskatchewan (MOE 2012), which border Manitoba; therefore, the SCREEN3 and CAL3HQC models are considered suitable models for the Project.

2.1.2 Model Calibration and Validation

Regulatory dispersion models do not readily lend themselves to modification to incorporate site-specific characteristics in the equations themselves; however, the models do require site-specific input data to operate. The SCREEN3 and CAL3HQC model both require minimal site-specific input data. The inputs used for each model are described in detail in Sections 2.2 and 2.3. Part of the rigorous process used by the US EPA prior to adopting SCREEN3 and CAL3HQC as screening and regulatory models (US EPA 2004) was a peer review process to confirm that the model could accurately predict ground-level concentrations when compared to monitoring data (US EPA 2004).

2.1.3 Model Uncertainty and Sensitivity

Dispersion models employ assumptions that simplify the random processes associated with atmospheric motions and turbulence. While this simplification limits the model's ability to replicate individual events, the strength of the model lies in the ability to predict overall values for a given set of input parameters. The process undertaken by the US EPA in the development and promulgation of the dispersion models reaffirms that the model predictions can be relied on as reasonable estimate of the likely concentrations. SCREEN3 and CAL3HQC are based on known theory and proven to reliably produce repeatable results. To limit the uncertainty associated with emissions input to the model, conservative assumptions were made where practical. Finally, meteorological data which provides the highest concentration was used by both models.

2.2 Dispersion Modelling Inputs

This section summarizes the dispersion modelling inputs for the SCREEN3 and CAL3QHC models.

2.2.1 SCREEN3 Inputs

To predict ambient air concentrations with the aid of SCREEN3, source configuration inputs are required that parameterize the sources of emissions, as well as their transport. The SCREEN3 dispersion model includes meteorological data that are not required to be input. Meteorological data includes the following information: wind speed and direction, stability class, mixing height and temperature. The SCREEN3 dispersion uses simple terrain, with options to select flat or elevated terrain.

2.2.1.1 Emissions Source

Air emission rates were estimated for the Project for which a measurable change from existing conditions is anticipated and may occur. These emission rates were then used as inputs for the dispersion modelling that provided estimates of maximum ground-level concentrations resulting from the Project emissions. Appendix 6.2-2 Emission Estimates provides a detailed description of the methods, inputs and assumption used to estimate emission rates.

2.2.1.2 Source Configuration

The model source type used in this assessment was a volume source. Figure 1 Site Layout and Dispersion Modelling Plan illustrates the model source location used in this assessment for the Project. Volume sources are used to model releases from a variety of industrial sources that cannot be classified as a point or area source.

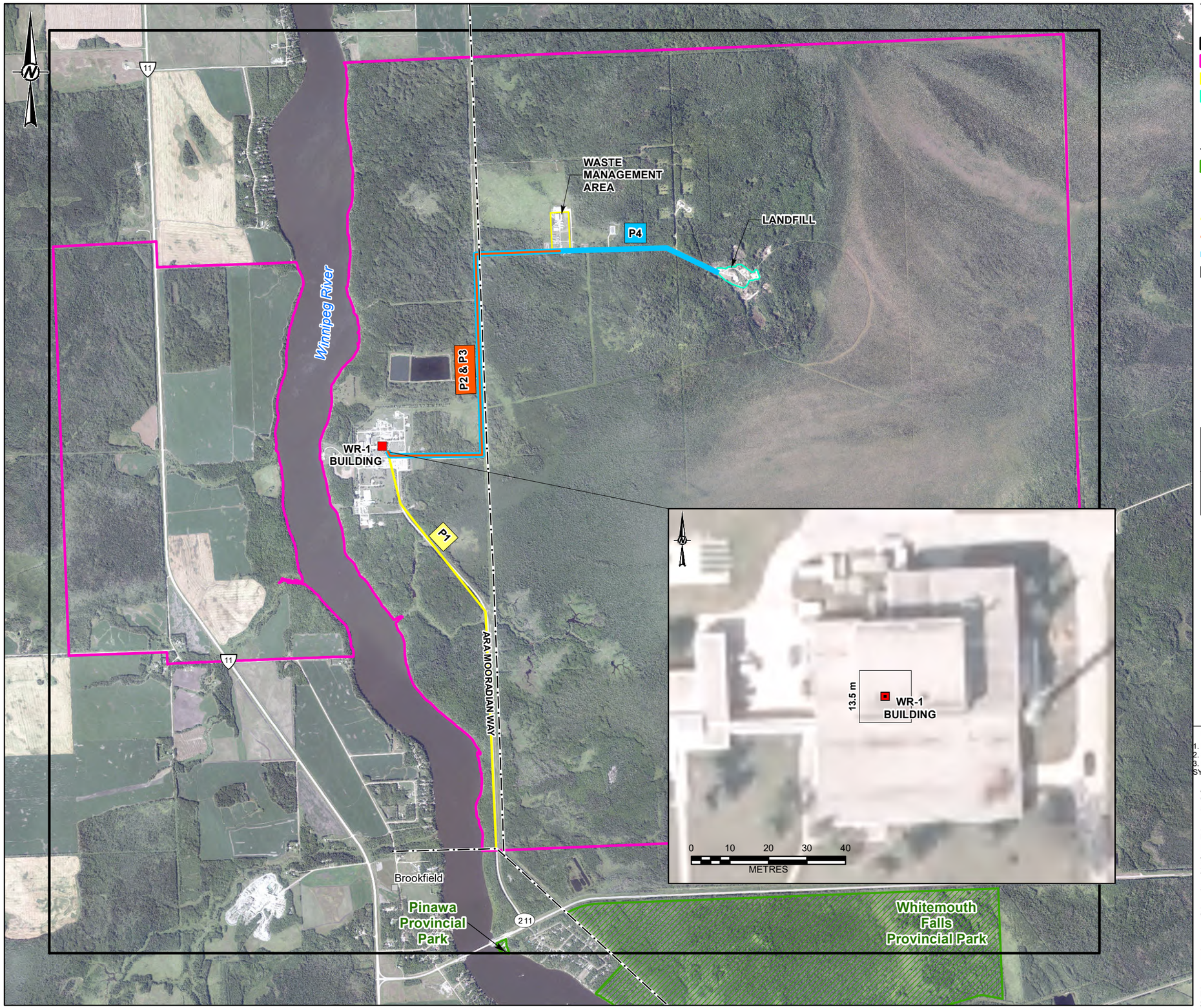
The in situ disposal of the WR-1 Building was modelled as a single volume source. The activities associated with the Project will occur either at the WR-1 Building or immediately next to it. As the WR-1 Complex has a larger footprint that will be decommissioned and/or demolished, its dimensions were used to develop the modelling inputs (Table 1).

Table 1: Summary of Project Source Parameters

Project Structure	Length (m)	Width (m)	Height (m)	Centroid Coordinates (X, Y) (m)
WR-1 Building	27.4	23.1	17.8	709870, 5562664
WR-1 Complex	63.9	52.7	Multi-Tier	—

m = metre.

Volume sources are square and are determined by calculating the shortest side length of the area which the source's dimensions result in. The WR-1 Complex footprint was used to calculate this area and is estimated to be 3,367.5 square metres (m²); the shortest possible side length is 58 metres (m).



LEGEND

- WR-1 BUILDING (SITE STUDY AREA)
- LOCAL STUDY AREA
- WHITESHELL LABORATORIES SITE
- WASTE MANAGEMENT AREA
- LANDFILL

BASE FEATURES

- CITY/TOWN
- TRANSMISSION LINE
- Provincial Park

DISPERSION MODELLING PLAN

- Whiteshell Reactor #1
- P1
- P2 & P3
- P4
- VOLUME SOURCE SQUARE

ROAD SEGMENT NAME	DESCRIPTION
P1	Raw material from property boundary to storage area
P2	Waste materials from B100 to WMA
P3	Waste materials from B100 to WMA
P4	Asbestos material from B100 to WL Asbestos Disposal Site (WL landfill)

0 1,000 2,000
METRES
1:31,486

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY PROVIDED BY CNL (2016-11-22)
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT
CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT
EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE
SITE LAYOUT AND DISPERSION MODELLING PLAN

CONSULTANT
WSP GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/RRD
REVIEWED	KL
APPROVED	SC

PROJECT NO.	CONTROL	REV.	FIGURE
20145046	0008	2	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm 0

Path: S:\Clients\Canadian_Nuclear_Laboratories\Manitoba\99_PROJ\20145046\40_PROD\0008_EIS_Sec_6\20145046-0008-RA-0003_App_6_2-3_Figure 1 Site Layout and Dispersion Modelling Plan.mxd

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The volume source parameters developed for the dispersion model based on the source dimensions and the calculation of the shortest side length, following guidance in *Modelling Fugitive Dust Sources* (NSSGA 2004). The type of volume source that was modelled is considered to be a single, surface-based volume source. The volume source parameters are summarized in Table 2.

Table 2: Summary of Dispersion Modelling Inputs

Modelling ID	Release Height Above-grade[1] (m)	Initial Lateral Dimension of Volume[2] (m)	Initial Vertical Dimension of Volume[3] (m)
WR-1 Building	8.9	13.50	8.28

1) Release Height = WR-1 Height ÷ 2.
2) Initial Lateral Dimension = Shortest Side Length ÷ 4.3.
3) Initial Vertical Dimension = WR-1 Height ÷ 2.15.

2.2.1.3 Model Options

Table 3 presents the modelling parameters used in the dispersion modelling assessment.

Table 3: SCREEN3 Modelling Inputs

Source Type	Volume
Dispersion Coefficient	Rural
Receptor Height	0
Simple Terrain	Flat
Meteorology	Full
Automated Distances	
Minimum	2,721 m
Maximum	6,000 m
Spacing Distances	100 m
Discrete Distance from source activities (WR-1) to LSA	2,721 m

LSA = Local Study Area.

The minimum and maximum automated distances are based on the shortest distance to the Local Study Area (LSA) and the Regional Study Area (RSA), respectively. The discrete distance is based on the actual shortest distance from WR-1 to the LSA.

2.2.2 CAL3QHC Inputs

To predict ambient air concentrations from roads with the aid of CAL3QHC model, site geometry inputs are required to parameterize the sources of emissions as well as their transport. The CAL3QHC dispersion model also requires input data for vehicle emission rates, receptor locations and meteorological conditions.

2.2.2.1 Site Geometry

The CAL3QHC can process up to 120 links. A link is defined as a straight-line segment and can be specified as either a free flow or a queue link. For this Project, all links used in the dispersion modelling are free flow links. A free flow link is defined as a straight segment of roadway with a constant width, height, traffic volume, travel speed and vehicle emission factor. The location of the link is specified by its start and end point coordinates, X1, Y1 and X2, Y2.

Link width or mixing zone width (W) is defined as the width of the travelled roadway (lanes of moving traffic only), plus 3 m on each side of the roadway to account for the dispersion of the plume generated by the wake of moving vehicles. For the Project, a link width of 12 m for all links has been used. Link height (H) can be elevated or depressed but is limited within 10 m for elevated and -10 m for depressed. For the Project, all the links are assumed at grade (i.e., a link height of 0 m has been assumed). A total of eight links have been defined for the Project to represent the emissions from different activities (Table 4).

All the modelling objects have been defined using Universal Transverse Mercator (UTM) projection (NAD83, Zone 14N). In order for easy tracking in the modelling input and output files, the UTM coordinated have been subtracted by 707149 m (easting) and 5558522 m (northing). All the links are geographically presented on Figure 1 and a simplified schematic diagram below on Figure 2.

Table 4: List of Links Modelled

Road ID	Link ID	X1 (m)	Y1 (m)	X2 (m)	Y2 (m)	Length (m)	H (m)	W (m)
P1	P1A	3908.1	230.3	3659.1	681.3	515	0	12
	P1B	3659.1	681.3	3566.1	2790.3	2111	0	12
	P1C	3566.1	2790.3	2870.1	3671.3	1123	0	12
	P1D	2870.1	3671.3	2763.1	4104.3	446	0	12
Common Section of P2, P3 & P4	P2&3&4A	2784.1	4064.3	3538.1	4071.3	754	0	12
	P2&3&4B	3538.1	4071.3	3484.1	5711.3	1641	0	12
	P2&3&4C	3484.1	5711.3	4179.1	5737.3	695	0	12
P4	P4A	4179.1	5737.3	5045.1	5762.3	866	0	12
	P4B	5045.1	5762.3	5471.1	5556.3	473	0	12

LEGEND

- WR-1 BUILDING (SITE STUDY AREA)
- WHITESHELL LABORATORIES SITE
- WASTE MANAGEMENT AREA
- LANDFILL
- TRANSMISSION LINE

Road Segment

- P1
- P2 & P3
- P4

0 1,000 2,000

1:25,000 METRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. WL SITE PROPERTY BOUNDARY PROVIDED BY CNL (2016-11-22)
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE14N

CLIENT

CANADIAN NUCLEAR LABORATORIES LTD.

PROJECT

EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE

TITLE

ROAD SEGMENTS MODELLED FOR CAL3QHC DISPERSION MODELLING

CONSULTANT

wsp GOLDER

MM-YYYY	DECEMBER 2022
DESIGNED	CGE
PREPARED	CGE/RRD
REVIEWED	KL
APPROVED	SC

PROJECT NO.	CONTROL	REV.	FIGURE
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2.2.2.2 Emission Source

Emission sources for the Project have been defined using free flow links, as discussed about. In addition to the link information, the emission factor (grams per mile [g/mile]) and traffic volume (vehicles/hour) have to be defined. For the analysis, emissions for particulate matter include typical mobile emissions (exhaust, break, tires) and re-entrained road dust. The total emissions on individual roads have been normalized using the lengths and a traffic volume of 3,600 vehicle per hour (for converting grams per second [g/s] to grams per hour [g/hour]). Table 5 shows the total emissions for four road segments and the emission factors input to CAL3QHC. Please note that the emission factors have been inflated by a factor (inflation factors presented in Table 5) to get the readable concentration numbers from the model outputs. Accordingly, the predicted maximum concentrations outputs from the CAL3QHC model runs have to be divided by the relevant inflation factors to derive the actual predicted maximum concentrations.

Table 5: Emission Inputs to CAL3QHC

Emission Inventory

Road ID	SPM (g/s)	PM_{10} (g/s)	$PM_{2.5}$ (g/s)	Nitrogen Oxides (g/s)	Sulphur Dioxide (g/s)	Carbon Monoxide (g/s)	Total Length (miles)
P1	3.51×10^{0}	6.73×10^{-1}	1.63×10^{-1}	1.02×10^{-2}	6.76×10^{-5}	5.37×10^{-3}	2.61
P2	3.03×10^{-2}	5.81×10^{-3}	1.41×10^{-3}	8.82×10^{-5}	5.84×10^{-7}	4.64×10^{-5}	1.92
P3	9.08×10^{-2}	1.74×10^{-2}	4.22×10^{-3}	2.65×10^{-4}	1.75×10^{-6}	1.39×10^{-4}	1.92
P4	4.40×10^{-2}	8.44×10^{-3}	2.04×10^{-3}	1.28×10^{-4}	8.48×10^{-7}	6.73×10^{-5}	2.75

Input to CAL3QHC

Link	SPM (g/VMT)	PM_{10} (g/VMT)	$PM_{2.5}$ (g/VMT)	Nitrogen Oxides (g/VMT)	Sulphur Dioxide (g/VMT)	Carbon Monoxide (g/VMT)	Total Length (miles)
P1A, P1B, P1C and P1D	1.34	2.58	6.25	0.94	6.23	4.94	1.34
P2&3&4A, P2&3&4B and P2&3&4C	0.08	0.15	0.37	0.06	0.37	0.29	0.08
P4A and P4B	0.02	0.03	0.07	0.01	0.07	0.06	0.02
Inflation Factor	1	10	100	100	100,000	1,000	1

Note: SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 micrometres (µm) in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; NO_X = nitrogen oxides; SO_2 = sulphur dioxide; CO = carbon monoxide; g/s = grams per second; g/VMT = grams per vehicle mile travelled.

2.2.2.3 Receptors

Receptor locations are specified in terms of X, Y and Z coordinates. As the Project sources are about 2 km from the LSA boundary, a total of 162 receptors were spaced evenly on the LSA at an interval of 200 m, as per MOECC guideline (MOECC 2009). All receptors are assumed to be ground-level receptors (i.e., Z = 0 m). CAL3QHC can only process 60 receptor locations for all 360 degree wind angles. For each contaminant, the model is run three times for three subsets (60, 60 and 42) of receptors.

2.2.2.4 Meteorological Conditions

CAL3QHC takes one set of meteorological conditions including wind speed, stability class, mixing height and surface roughness length, with an option to search the wind direction for predicting the maximum concentrations at each receptor. As the emissions are ground based, the maximum downwind concentrations typically occur under low wind speeds and stable conditions. Accordingly, the following meteorological conditions were set:

- wind speed – 1 m/s;
- stability class – 6 (very stable);
- surface roughness length – 200 centimetres (cm; the site is located within the wooded area);
- mixing height – 1000 m (per US EPA guide [US EPA 1995b]); and
- wind direction – 0° ~ 360° with an interval of 10° for search the maximum concentration for each receptor.

Additionally, for the dispersion of particulate matter, the settling and deposition velocities have to be set. Following MTO Guide (MTO 2012), the settling velocities for $PM_{2.5}$ and PM_{10} are set to be at 0.02 and 0.3 centimetres per second (cm/s), respectively. The deposition velocities for $PM_{2.5}$ and PM_{10} are set to be at 0.1 and 0.5 cm/s, respectively. The MTO Guide does not have recommended values for SPM. For this analysis, the settling and deposition velocities for SPM are conservatively set to be the same as those of PM_{10}.

2.3 Dispersion Modelling Results

This section summarizes the dispersion modelling results from the SCREEN3 and CAL3QHC models.

2.3.1 SCREEN3 Results

The 1-hour dispersion factor obtained from the SCREEN3 model is 119.3 micrograms per cubic metre (µg/m³) per g/s. This dispersion factor occurs at the LSA, approximately 2,721 m away from WR-1.

2.3.2 CAL3QHC Results

CAL3QHC predicts the maximum 1-hour concentration under the specified meteorological conditions. The predicted 1-hour maximum concentrations with the inflated emissions (i.e., the outputs from CAL3QHC model runs) are tabulated in Table 6. The actual predicted maximum concentrations at ground level are those from the CAL3QHC model outputs divided by the relevant inflation factors (Table 6).

Table 6: Summary of CAL3QHC Predicted Maximum 1-Hour Concentrations

Contaminant	CAL3QHC Output	CAL3QHC Output Unit	Inflation Factor	Predicted Concentration (µg/m³)
SPM	136	µg/m³	1	136.0
PM_{10}	260	µg/m³	10	26.0
$PM_{2.5}$	748	µg/m³	100	7.48
NOx	120	µg/m³	100	1.2
SO_2	792	µg/m³	100,000	0.00792
CO	629	µg/m³	1,000	0.629

SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; NO_X = nitrogen oxides; SO_2 = sulphur dioxide; CO = carbon monoxide; µg/m³ = micrograms per cubic metre.

2.4 Post-Processing

Most air quality concentration results are output directly from the model; however, there are certain parameters that require post-processing, including averaging periods greater than 1-hour and conversion of NO_2 using existing regional ozone concentrations. These post-processing methods are described in the following sections.

2.4.1 Time Average Conversions

The time scale that SCREEN3 predicts concentrations is a 1-hour average value. There are instances when criteria are based on different averaging times, and in these cases the following conversion factor (F), recommended by the MOECC for conversion from a 1-hour averaging period to the applicable averaging period greater than 1-hour could be used (MOECC 2009). The MOECC conversation factors were used as the factors are slightly more conservative than those listed in the Draft Guidance. An example is given below for converting from a 1-hour averaging period to a 24-hour averaging period:

$$F = \left(\frac{t_1}{t_0}\right)^n$$

$$F = \left(\frac{1}{24}\right)^{0.28}$$

$$F = 0.41$$

Where:

F =.... the factor to convert from the averaging period t_1 output from the model (1-hour averaging period) to the desired averaging period t_0 (assumed to be 24-hour in the example above)

N = the exponent variable; in this case the MOECC value of n = 0.28 is used for conversion

Time average conversions were completed for the outputs from the SCREEN3 and CAL3QHC dispersion modelling. The output concentrations from SCREEN3 (considered as the dispersion factors in µg/m³) are summarized in Table 7 and the output concentrations from CAL3QHC are summarized in Table 8.

Table 7: SCREEN3 Dispersion Modelling Results and Time Average Conversions

Averaging Period	Dispersion Factor (µg/m³ per g/s)
1-hour(1)	119.3
24-hour	49.0
8-hour	66.6
Annual	9.4

1) 1-hour dispersion factor was obtained from the SCREEN3 dispersion model.
µg/m³ = microgram per cubic metre; g/s = gram per second

Table 8: CAL3QHC Dispersion Modelling Results and Time Average Conversions

Contaminant	CAS	Predicted Concentration (µg/m³)			
		1-hour(1)	8-hour	24-hour	Annual
SPM	N/A-1	136.0	—	55.86	10.71
PM_{10}	N/A-2	26.0	—	10.68	2.05
$PM_{2.5}$	N/A-3	7.48	—	3.07	0.59
NOx	10102-44-0	1.2	—	0.49	0.09
CO	630-08-0	0.6	0.35	0.26	0.05
SO_2	7446-09-5	0.00792	—	3.25×10^{-3}	6.23×10^{-4}

1) 1-hour concentrations were obtained from the CAL3QHC dispersion model.
SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; NO_X = nitrogen oxides; SO_2 = sulphur dioxide; CO = carbon monoxide; µg/m³ = microgram per cubic metre.

2.4.2 Conversions of NOx to NO_2

Emissions of oxides of nitrogen (NO_X) were used as inputs to the SCREEN3 model. Ambient predictions of nitrogen dioxide (NO_2), one of the criteria air contaminants, can be calculated from modelled NO_X values using the Ozone Limiting Method (OLM). The OLM consists of comparing the maximum modelled NOx concentration to the background ozone (O_3) concentration to assess the limiting factor to NO_2 (Cole and Summerhays 1979). The following equations present the method:

If background $[O_3] > 0.90\ [NO_x]$, total conversion: $[NO_2] = [NO_x]$

If background $[O_3] < 0.90\ [NO_x]$, NO_2 is limited by O_3: $[NO_2] = [O_3] + 0.10\ [NO_x]$

For the air quality assessment, the 24-hour and annual NO_2 concentrations were calculated assuming total conversion of NOx since background ozone values at these averaging periods were above 0.90 [NOx]. The 1-hour NO_2 concentrations were calculated using the 90th percentile of the ground-level ozone concentration from the Pinawa WNRE, Manitoba station for the years 2009 to 2013. A sample calculation is presented below for 1-hour NO_2:

1-hour Background $[O_3] = 74.57$ µg/m^3 *(Winnipeg Richardson Airport Station, 2009-2013)*

Modelled 1-hour maximum [NO_x] = 984.17 µg/m^3

0.90 [NO_x] = 885.75 µg/m^3

[O_3] <0.90 [NO_x], therefore [NO_2] = [O_3] + 0.10 [NO_x] applies:

[NO_2] = 74.57 µg/m^3 + 0.10 (984.17 µg/m^3)

[NO_2] = 172.99 µg/m^3

Additional information on the background air quality assessment is presented in Appendix 6.2-1.

Table 9 provides a summary of the NO_2 calculation for the three averaging periods under the Maximum Scenario.

Table 9: Summary of Maximum Scenario NOx Conversion to NO_2

Averaging Period	O_3 Background Concentration (µg/m^3)	NOx Estimated Concentration (µg/m^3)	0.9 (NOx)	Required Approach	NO_2 Estimated Concentration (µg/m^3)
1-hour	74.57	984.17	885.75	OLM	172.99
24-hour	67.85	72.74	65.47	Full Conversion	72.74
Annual	43.63	9.58	8.62	Full Conversion	9.58

O_3 = ozone; NO_X = nitrogen oxides; NO_2 = nitrogen dioxide.

2.5 Application Case Dispersion Modelling Results

The dispersion modelling results for the Application Case (Maximum Scenario) may be summarized based on the type of source considered in the Air Quality Assessment, specifically road (including dust from paved roads, exhaust emissions from paved roads) and non-road emissions (including exhaust emissions from non-road equipment, batch mixing plant or other similar equipment, in situ disposal and demolition and emergency power generators). Emission rates (in g/s) for all sources assessed as part of the Application Case are presented in Appendix 6.2-2.

Maximum concentrations for the Application Case Maximum Scenario were calculated for the non-road sources by multiplying the dispersion factor by the compound emission rate with the same averaging period. These results are summarized in Table 10. For example, the following calculation was completed for the 24-hour SPM maximum predicted concentration:

$$\text{Maximum Predicted Concentration} = 24-\text{hour Dispersion Factor } \left[\frac{\mu g}{m^3} \text{ per} \frac{g}{s}\right] \text{ x } 24-\text{hour Emisison Rate } \left[\frac{g}{s}\right]$$

$$\text{Maximum Predicted Concentration} = 49.0 \frac{\mu g}{m^3} \text{ per} \frac{g}{s} \text{ x } 0.346 \frac{g}{s}$$

$$\text{Maximum Predicted Concentration} = 16.93 \frac{\mu g}{m^3}$$

Please note that the annual emission rates were calculated following dispersion modelling based on the annual operating schedule of 250 days per year.

Table 10: Summary of Application Case Maximum Scenario Project Dispersion Modelling Results for Road and Non-Road Emissions

Contaminant	CAS No.	Averaging Period (hours)	Maximum Scenario Emission Rate (g/s)	Maximum Predicted Concentration (µg/m³)
Roads Dispersion Modelling				
SPM	N/A-1	24-hour	3.671	55.857
SPM	N/A-1	Annual	2.514	10.706
PM_{10}	N/A-2	24-hour	0.705	10.679
$PM_{2.5}$	N/A-3	24-hour	0.171	3.072
$PM_{2.5}$	N/A-3	Annual	0.117	0.589
NOx	10102-44-0	1-hour	0.026	1.200
NOx	10102-44-0	24-hour	0.011	0.493
NOx	10102-44-0	Annual	0.007	0.094
CO	630-08-0	1-hour	0.013	0.629
CO	630-08-0	8-hour	0.013	0.351
SO_2	7446-09-5	1-hour	0.00017	0.008
SO_2	7446-09-5	24-hour	0.00007	0.003
SO_2	7446-09-5	Annual	0.00005	0.001
Non-Roads Dispersion Modelling				
SPM	N/A-1	24-hour	0.346	16.93
SPM	N/A-1	Annual	0.237	2.22
PM_{10}	N/A-2	24-hour	0.289	14.17
$PM_{2.5}$	N/A-3	24-hour	0.096	4.72
$PM_{2.5}$	N/A-3	Annual	0.066	0.62
NOx	10102-44-0	1-hour	8.239	982.97
NOx	10102-44-0	24-hour	1.475	72.25
NOx	10102-44-0	Annual	1.010	9.48
CO	630-08-0	1-hour	2.150	256.49
CO	630-08-0	8-hour	2.150	143.28
SO_2	7446-09-5	1-hour	0.355	42.37
SO_2	7446-09-5	24-hour	0.020	0.98
SO_2	7446-09-5	Annual	0.014	0.13

SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; NO_X = nitrogen oxides; SO_2 = sulphur dioxide; CO = carbon monoxide; g/s = grams per second; µg/m^3 = micrograms per cubic metre.

The overall Application Case Maximum Scenario Project dispersion modelling results are summarized in Table 11 according to compound and averaging period.

Table 11: Summary of Application Case Dispersion Modelling Results

Contaminant	CAS No.	Averaging Period [hours]	Maximum Scenario – Maximum Predicted Concentration [µg/m³]
SPM	N/A-1	24-hour	72.79
SPM	N/A-1	Annual	12.93
PM_{10}	N/A-2	24-hour	24.85
$PM_{2.5}$	N/A-3	24-hour	7.79
$PM_{2.5}$	N/A-3	Annual	1.21
NOx	10102-44-0	1-hour	984.17
NOx	10102-44-0	24-hour	72.74
NOx	10102-44-0	Annual	9.58
NO_2	10102-44-0	1-hour	172.99
NO_2	10102-44-0	24-hour	72.74
NO_2	10102-44-0	Annual	9.58
CO	630-08-0	1-hour	257.12
CO	630-08-0	8-hour	143.64
SO_2	7446-09-5	1-hour	42.38
SO_2	7446-09-5	24-hour	0.98
SO_2	7446-09-5	Annual	0.13

NO_2 concentrations were calculated using the Ozone Limiting Method.

SPM = suspended particulate matter; PM_{10} = particles nominally smaller than 10 µm in diameter; $PM_{2.5}$ = particles nominally smaller than 2.5 µm in diameter; NO = nitrogen oxides; NO_2 = nitrogen dioxide; SO_2 = sulphur dioxide; CO = carbon monoxide; g/s = grams per second; µg/m^3 = micrograms per cubic metre.

2.6 Conservatism in Modelling and Post-Processing Approaches

Table 12 outlines the areas where conservatism was assumed in the modelling approach, which results in an assessment that is not likely to under-predict the air quality associated with the Project.

Table 12: Areas of Conservatism in the Modelling Approach

Area	Conservatism
The Project's Application Case (i.e., project phases 1 to 3) were assumed to occur simultaneously	The modelling assessment includes all operations occurring simultaneously and continuous over the entire modelling period.
Project activities were modelled as a volume source.	Modelling the emissions as a volume source is conservative since this model source type does not take advantage of favourable dispersion characteristics such as plume buoyancy and initial exit velocity of emissions for sources with stacks or exhausts (e.g., propane-fired boiler, batch mixing plant or other similar equipment). Further, the dispersion modelling source dimensions selected for the volume source result in a dispersion modelling source which is smaller than the corresponding real-life source. This is conservative since estimated emissions occur over a smaller area, and thus, are more concentrated (and therefore less dispersed) at the point of release.
Meteorology	Site-specific meteorological data were not used as SCREEN3 utilizes the worst-case meteorological conditions as part of the model. The worst-case meteorological conditions are those that produce the lowest dispersion of emissions over the distances considered by the model and, therefore, result in conservative predictions of concentrations.
Use of two dispersion models to assess cumulative effects	The cumulative effect from road and non-road emission sources is estimated by adding the maximum predicted concentrations from the SCREEN3 and CAL3QHC models. This is conservative as it is assumed that each model's worst-case meteorological conditions occur at the same time and the same receptor.

It is assumed that the conservative emission rates, when combined with the conservative operating conditions and conservative dispersion modelling assumptions and post-processing assumptions description herein, are not likely to under predict the modelled concentrations at each of the identified receptors.

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APPENDIX 6.4.2-1

Surface Water Quality Data

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Table 1: Atomic Mass and Half-life Used in the Assessment of Surface Water Quality

Radionuclide	Atomic Mass (g/mol)	Half-life (s)	Radionuclide	Atomic Mass (g/mol)	Half-life (s)
Actinium-225	$2.25 \times 10^{+02}$	$8.64 \times 10^{+05}$	Radium-225	$2.25 \times 10^{+02}$	$1.29 \times 10^{+06}$
Actinium-227	$2.27 \times 10^{+02}$	$6.87 \times 10^{+08}$	Radium-226	$2.26 \times 10^{+02}$	$5.05 \times 10^{+10}$
Bismuth-210	$2.10 \times 10^{+02}$	$4.33 \times 10^{+05}$	Radium-228	$2.28 \times 10^{+02}$	$1.80 \times 10^{+08}$
Calcium-41	$4.10 \times 10^{+01}$	$3.22 \times 10^{+12}$	Silver-108m	$1.08 \times 10^{+02}$	$1.38 \times 10^{+10}$
Carbon-14	$1.40 \times 10^{+01}$	$1.81 \times 10^{+11}$	Technetium-99	$9.89 \times 10^{+01}$	$6.65 \times 10^{+12}$
Chloride-36	$3.60 \times 10^{+01}$	$9.46 \times 10^{+12}$	Thorium-227	$2.27 \times 10^{+02}$	$1.61 \times 10^{+06}$
Gadolinium-152	$1.52 \times 10^{+02}$	$3.41 \times 10^{+21}$	Thorium-228	$2.28 \times 10^{+02}$	$6.03 \times 10^{+07}$
Iodine-129	$1.29 \times 10^{+02}$	$4.95 \times 10^{+14}$	Thorium-229	$2.29 \times 10^{+02}$	$2.30 \times 10^{+11}$
Lead-210	$2.10 \times 10^{+02}$	$7.03 \times 10^{+08}$	Thorium-230	$2.30 \times 10^{+02}$	$2.38 \times 10^{+12}$
Neptunium-237	$2.37 \times 10^{+02}$	$6.75 \times 10^{+13}$	Thorium-231	$2.31 \times 10^{+02}$	$9.19 \times 10^{+04}$
Nickel-59	$5.89 \times 10^{+01}$	$3.19 \times 10^{+12}$	Thorium-232	$2.32 \times 10^{+02}$	$4.45 \times 10^{+17}$
Niobium-94	$9.39 \times 10^{+01}$	$6.40 \times 10^{+11}$	Thorium-234	$2.34 \times 10^{+02}$	$2.08 \times 10^{+06}$
Plutonium-239	$2.39 \times 10^{+02}$	$7.60 \times 10^{+11}$	Tritium	$3.02 \times 10^{+00}$	$3.89 \times 10^{+08}$
Plutonium-240	$2.40 \times 10^{+02}$	$2.07 \times 10^{+11}$	Uranium-233	$2.33 \times 10^{+02}$	$5.02 \times 10^{+12}$
Polonium-210	$2.10 \times 10^{+02}$	$1.19 \times 10^{+07}$	Uranium-234	$2.34 \times 10^{+02}$	$7.74 \times 10^{+12}$
Protactinium-231	$2.31 \times 10^{+02}$	$1.03 \times 10^{+12}$	Uranium-235	$2.35 \times 10^{+02}$	$2.22 \times 10^{+16}$
Protactinium-233	$2.33 \times 10^{+02}$	$2.33 \times 10^{+06}$	Uranium-236	$2.36 \times 10^{+02}$	$7.40 \times 10^{+14}$
Radium-223	$2.23 \times 10^{+02}$	$9.88 \times 10^{+05}$	Uranium-238	$2.38 \times 10^{+02}$	1.41×10^{17}
Radium-224	$2.24 \times 10^{+02}$	$3.14 \times 10^{+05}$	Uranium-238	$2.38 \times 10^{+02}$	1.41×10^{17}

Table 2: Groundwater Flows Used in the Assessment of Surface Water Quality

Time (yr)	Pathway Flow (m^3/d)
0	0.17
500	0.17
1000	0.17
2000	0.18
5000	0.19
10000	0.19

Table 3: Solid/Liquid Partition Coefficients Used in the Assessment of Surface Water Quality for Radionuclides

Radionuclide	Solid/Liquid Partition Coefficient for Surface Water to Sediment (L/kg)	Source
Actinium-225	$1.70 \times 10^{+03}$	Used surrogate lanthanum from Table A.26 (CSA N288.1 2014)
Actinium-227	$1.70 \times 10^{+03}$	Used surrogate lanthanum from Table A.26 (CSA N288.1 2014)
Bismuth-210	$5.00 \times 10^{+03}$	Used surrogate antimony from Table A.26 (CSA N288.1 2014)
Calcium-41	$1.90 \times 10^{+02}$	Used surrogate strontium from Table A.26 (CSA N288.1 2014)
Carbon-14	$5.00 \times 10^{+01}$	Table A.26 (CSA N288.1 2014)
Chloride-36	$2.00 \times 10^{+01}$	Table A.26 (CSA N288.1 2014)
Gadolinium-152	$9.90 \times 10^{+02}$	Table A.26 (CSA N288.1 2014)
Iodine-129	$4.40 \times 10^{+03}$	Table A.26 (CSA N288.1 2014)
Lead-210	$1.30 \times 10^{+03}$	Used surrogate tin from Table A.26 (CSA N288.1 2014)
Neptunium-237	$1.00 \times 10^{+01}$	Table A.26 (CSA N288.1 2014)
Nickel-59	$1.40 \times 10^{+03}$	Table A.26 (CSA N288.1 2014)
Niobium-94	$1.70 \times 10^{+03}$	Table A.26 (CSA N288.1 2014)
Plutonium-239	$2.40 \times 10^{+05}$	Table A.26 (CSA N288.1 2014)
Plutonium-240	$2.40 \times 10^{+05}$	Table A.26 (CSA N288.1 2014)
Polonium-210	$1.30 \times 10^{+00}$	Used surrogate tellurium from Table A.26 (CSA N288.1 2014)
Protactinium-231	$5.40 \times 10^{+03}$	Table A.26 (CSA N288.1 2014)
Protactinium-233	$5.40 \times 10^{+03}$	Table A.26 (CSA N288.1 2014)
Radium-223	$7.40 \times 10^{+03}$	Table A.26 (CSA N288.1 2014)
Radium-224	$7.40 \times 10^{+03}$	Table A.26 (CSA N288.1 2014)
Radium-225	$7.40 \times 10^{+03}$	Table A.26 (CSA N288.1 2014)
Radium-226	$7.40x\ 10^{+03}$	Table A.26 (CSA N288.1 2014)
Radium-228	$7.40 \times 10^{+03}$	Table A.26 (CSA N288.1 2014)
Technetium-99	$5.00 \times 10^{+00}$	Table A.26 (CSA N288.1 2014)
Thorium-227	$1.90 \times 10^{+05}$	Table A.26 (CSA N288.1 2014)
Thorium-228	$1.90 \times 10^{+05}$	Table A.26 (CSA N288.1 2014)
Thorium-229	$1.90 \times 10^{+05}$	Table A.26 (CSA N288.1 2014)
Thorium-230	$1.90 \times 10^{+05}$	Table A.26 (CSA N288.1 2014)
Thorium-231	$1.90 \times 10^{+05}$	Table A.26 (CSA N288.1 2014)
Thorium-232	$1.90 \times 10^{+05}$	Table A.26 (CSA N288.1 2014)
Thorium-234	1.90×10^{5}	Table A.26 (CSA N288.1 2014)
Tritium	$0.00 \times 10^{+00}$	Table A.26 (CSA N288.1 2014)
Uranium-233	$5.00 \times 10^{+01}$	Table A.26 (CSA N288.1 2014)
Uranium-234	$5.00 \times 10^{+01}$	Table A.26 (CSA N288.1 2014)
Uranium-235	$5.00 \times 10^{+01}$	Table A.26 (CSA N288.1 2014)
Uranium-236	$5.00 \times 10^{+01}$	Table A.26 (CSA N288.1 2014)
Uranium-238	$5.00 \times 10^{+01}$	Table A.26 (CSA N288.1 2014)

Table 4: Solid/Liquid Partition Coefficients Used in the Assessment of Surface Water Quality for Non-radionuclides

Non-radionuclide	Solid/Liquid Partition Coefficient for Surface Water to Sediment (L/kg)	Source
Barium	$2.00 \times 10^{+03}$	Table A.26 (CSA N288.1 2014)
Bismuth	$5.00 \times 10^{+03}$	Used surrogate antimony from Table A.26 (CSA N288.1 2014)
Boron	$5.00 \times 10^{+01}$	Used surrogate carbon from Table A.26 (CSA N288.1 2014)
Cadmium	$5.00 \times 10^{+02}$	Used surrogate zinc from Table A.26 (CSA N288.1 2014)
Chromium	$1.30 \times 10^{+05}$	Used surrogate manganese from Table A.26 (CSA N288.1 2014)
Cobalt	$4.30 \times 10^{+04}$	Table A.26 (CSA N288.1 2014)
Copper	$5.00 \times 10^{+02}$	Used surrogate zinc from Table A.26 (CSA N288.1 2014)
Gadolinium	$9.90 \times 10^{+02}$	Table A.26 (CSA N288.1 2014)
HB40	$1.11 \times 10^{+04}$	Calculated by multiplying organic carbon coefficient (Koc) by the fraction of organic carbon (foc). Log Koc = 5.5 (Eastman MSDS, 2015).
Lead	$1.30 \times 10^{+03}$	Used surrogate tin from Table A.26 (CSA N288.1 2014)
Manganese	$1.30 \times 10^{+05}$	Table A.26 (CSA N288.1 2014)
Mercury	$1.60 \times 10^{+02}$	Table A.26 (CSA N288.1 2014)
Molybdenum	$1.00 \times 10^{+02}$	Table A.26 (CSA N288.1 2014)
Nickel	$1.40 \times 10^{+03}$	Table A.26 (CSA N288.1 2014)
Nitrogen	0	Table A.26 (CSA N288.1 2014)
Palladium	$5.40 \times 10^{+03}$	Table A.26 (CSA N288.1 2014)
Potassium	NA	Potassium is extremely soluble, therefore would not be found in sediment
Potassium Hydroxide	NA	Potassium hydroxide is extremely soluble, therefore would not be found in sediment
Ruthenium	$3.20 \times 10^{+04}$	Table A.26 (CSA N288.1 2014)
Sulphur	$1.10 \times 10^{+02}$	Table A.26 (CSA N288.1 2014)
Xylene	$1.55 \times 10^{+01}$	Calculated by multiplying organic carbon coefficient (Koc) by the fraction of organic carbon (foc). Log Koc = 2.6 (MOE, 2011).

foc = 0.035, based on medium/fine soil by MOE (2011) Risk assessment rationale.NA = Not applicable.

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APPENDIX 6.6-1

Valued Component Selection and Species at Risk Screening Table

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Scientific Name	Common Name	Confirmed at WL	Included as VC?	Justification for Inclusion/Exclusion	COSEWIC[a]	SARA[b]	ESEA[c]	G-Rank[d]	S-Rank[d]
Mammals									
Myotis lucifugus	Little Brown Myotis	Yes (Acoustic recording in 2015 in the LSA, an individual with an injured wing observed on pallet on north side of B412 – unverified species identification on visual observation)	Yes	Species may roost in buildings in LSA and decommissioning of buildings may result in roost loss. Also may be affected by noise if roosting in surrounding forested area in RSA	END	END	END	G3	S2N, S5B
Myotis septentrionalis	Northern Myotis	Yes (Acoustic recording in 2015 in the LSA)	Yes	Species unlikely to roost in buildings; may be affected by noise if roosting in surrounding forested area in RSA	END	END	END	G1G2	S3S4N, S4B
Reptiles									
Chelydra serpentina	Snapping Turtle	Yes (4 individuals recorded in 2014 and 2016 crossing road near lagoon, by east gate to the WMA (on east side of east gate at road crossing), and on Ara Mooradian Way (Plant Road), individuals were recorded in 2021 on the east side of Plant Road and on the far west side of the lagoon	Yes	Species has been recorded in the RSA at road crossings and populations are susceptible to increases in adult mortality, particularly due to vehicle collisions	SC	SC	-	G5	S3
Birds									
Cardellina canadensis	Canada Warbler	Yes (Acoustic recordings in 2018 at station 3 and in 2019 at stations 1 and 5, most likely originating from RSA outside of LSA)	No	Acoustic recordings can be detected from locations up to 2 km away from recording device. Suitable breeding habitat for this species likely present in the RSA, but unlikely in the LSA. Canada warbler breeding habitat is moist, mixed coniferous and deciduous forests with a well-developed understory near streams, swamps or bogs. The LSA contains manicured turf grass and scattered trees. Golden-winged warbler breeding and foraging habitat consists of early successional habitat at the interface of forest and open habitat (i.e., edge habitat). Golden-winged warbler was originally selected as the suitable VC species because it was determined to have a higher likelihood of occurrence, given the presence of mapped critical habitat in the region and the existing habitat conditions at WL. It serves as an appropriate surrogate for potential indirect effects of noise on Canada warbler as the potential effects on Golden-winged warbler would be predicted to be greater, based on the closer proximity of edge habitat than forests with well-developed understories to the LSA.	SC	THR	THR	G5	S3B
Chaetura pelagica	Chimney Swift	No	No	Species has not been recorded in the RSA	THR	THR	THR	G4G5	S2B
Chordeiles minor	Common Nighthawk	No	No	Species has not been recorded in the RSA	SC	THR	THR	G5	S2S3B
Contopus cooperi	Olive-sided Flycatcher	Yes (Acoustic recordings in 2019 at stations 5 and 6, most likely originating from RSA outside of LSA)	No	Acoustic recordings can be detected from locations up to 2 km away from recording device. Suitable breeding habitat for this species likely present in the RSA, but unlikely in the LSA. Olive-sided flycatcher breeding habitat consists of natural openings in coniferous or mixed forests, including bogs, burns, riparian zones, and cutover areas. They are also found in semi-open forest stands and early successional forest when tall snags and residual live trees are present. In the boreal forest it is often associated with muskeg, bogs, fens and swamps dominated by spruce and tamarack. Open areas with tall trees or snags for perching are used for foraging (COSEWIC 2007). Nests are usually built on horizontal branches of conifers (Peck and James 1987). The LSA contains manicured turf grass and scattered trees. Golden-winged warbler breeding and foraging habitat consists of early successional habitat at the interface of forest and open habitat (i.e., edge habitat). Golden-winged warbler was originally selected as the suitable VC species because it was determined to have a higher likelihood of occurrence, given the presence of mapped critical habitat in the region and the existing habitat conditions at WL.	SC	THR	THR	G4	S2S3B
Contopus virens	Eastern Wood-pewee	No	No	Species has not been recorded in the RSA and suitable habitat is not likely present in the LSA	SC	SC	-	G5	S3B
Cygnus buccinator	Trumpeter Swan	Yes (pair observed in 2015 in secondary cell of sewage lagoon)	No	Suitable breeding habitat is not likely present in the LSA	-	-	END	G4	S2B
Dolichonyx oryzivorus	Bobolink	No	No	Species has not been recorded in the RSA and suitable habitat is not likely present in the LSA	THR	THR	-	G5	S3S4B

Scientific Name	Common Name	Confirmed at WL	Included as VC?	Justification for Inclusion/Exclusion	COSEWIC[a]	SARA[b]	ESEA[c]	G-Rank[d]	S-Rank[d]
Hirundo rustica	Barn Swallow	Yes (2016 - breeding pair found with active nest in marine container west of B411 and one observed perching on north fence of WMA; 2015 – 13 nests observed on buildings within the main campus; 2018 – multiple individuals observed nesting at CRA marine container, two individuals observed sitting on south end Quonset, nesting pairs observed on marine containers WCF-C1 and WCF-C8, at least two individuals observed nesting/feeding young on a vent on the north side of B412; in 2021 an individual was found deceased inside B300)	Yes	Species nests in buildings and structures in the LSA. Culverts, as well as buildings and other infrastructure present in the LSA and RSA provide suitable nesting habitat; decommissioning of buildings may result in nest losses.	SC	THR	-	G5	S4B
Falco peregrinus anatum/tundrius	Peregrine Falcon	Yes (Observed in flight over Plant Road in 2018)	No	Although one Peregrine falcon has been observed in flight in the RSA, it has not previously been observed nesting on buildings in the LSA. Species breeding range extends across North America in scattered populations. Suitable breeding habitat includes cliffs along rivers or ocean coasts and anthropogenic structures such as buildings or towers. Pre-demolition surveys to determine the presence of barn swallow nests on the exterior of the WR-1 building will also determine the presence of Peregrine falcon nests (with appropriate mitigation applied to protect the species if confirmed to be nesting). Barn swallow serves as an appropriate surrogate for potential effects of building demolition on Peregrine falcon because the potential effects on barn swallow are predicted to be greater, based on the numerous LSA observation records to-date including confirmed nesting activity on buildings in the LSA.	NAR	SC	END	G4	S2BS3M

Scientific Name	Common Name	Confirmed at WL	Included as VC?	Justification for Inclusion/Exclusion	COSEWIC[a]	SARA[b]	ESEA[c]	G-Rank[d]	S-Rank[d]
Birds (cont'd)									
Ixobrychus exilis	Least Bittern	No	No	Species has not been recorded in the RSA and suitable habitat is not likely present in the LSA	THR	THR	END	G4G5	S2S3B
Lanius ludovicianus excubitorides	Loggerhead Shrike (Prairie subspecies)	Yes (individual observed in a tree by B401 in 2014)	No	Subspecies has been assigned based on updated taxonomy and range information. Although this species was recorded in the LSA in 2014, there is little suitable habitat present in the LSA and there is a low probability that this species will breed in the LSA.	THR	-THR	END	G4T4	S1B
Melanerpes erythrocephalus	Red-Headed Woodpecker	Yes (individual observed having a dust bath on east shoulder of Ara Mooradian Way (Plant Road) just outside of parking lot in 2014	No	Although this species was recorded in the RSA in 2014, there is little suitable habitat present in the LSA and there is a low probability that this species will breed in the LSA.	END	END	THR	G5	S3B
Riparia riparia	Bank Swallow	No	No	Species has not been recorded in the RSA and suitable habitat is not likely present in the LSA.	THR	THR	-	G5	S4B
Vermivora chrysoptera	Golden-winged Warbler	No	Yes	Species has not been recorded in the LSA or RSA; however, suitable breeding habitat is present in the RSA. Golden-winged warbler breeds in regenerating scrub habitat with dense ground cover and a patchwork of shrubs, usually surrounded by forest. Their preferred habitat is characteristic of a successional landscape associated with natural or anthropogenic disturbance such as rights-of-way, and field edges or openings resulting from logging or burning. Golden-winged warbler nests are built on the ground at the base of a shrub or leafy plant, often at the shaded edge of the forest or at the edge of a forest opening (Confer et al. 2011). Chosen as a VC to represent avian species potentially affected by noise in surrounding habitat in the RSA, and because the RSA is located within a 10x10 km standardized UTM grid square identified as containing critical habitat in the Recovery Strategy (ECCC 2016).	THR	THR	THR	G4	S2S3B
Invertebrates									
Danaus plexippus	Monarch	No	No	Species has not been recorded in the RSA and suitable breeding habitat (i.e., obligate larval host plant milkweed) is not likely present in the LSA.	END	SC	-	G4	S3S4B

Notes:

a) COSEWIC END = Endangered; THR = Threatened; SC = Special Concern; NAR = Not at Risk.

b) Federal *Species at Risk Act* (SARA), 2002. Schedule 1 (Last amended 03 February 2022); Part 1 (Extirpated - EXP), Part 2 (Endangered - END), Part 3 (Threatened – THR), Part 4 (Special Concern – SC).

c) Manitoba *Endangered Species and Ecosystems Act* (ESEA) (2015) (C.C.S.M. c. E111 Current as of May 6, 2022); END = Endangered; THR = Threatened; SC = Special Concern; NAR = Not at Risk.

d) Global Ranks (G-Rank) and Provincial Ranks (S-Rank) are rarity or conservation status ranks assigned to species or ecological communities by NatureServe and Manitoba Conservation Data Centre, respectively. These ranks are not legal designations. Rank definitions: G1 or S1 (Critically Imperiled); G2 or S2 (Imperilled); G3 or S3 (Vulnerable); G4 or S4 (Apparently Secure); G5 or S5 (Secure); G#G# or S#S# (Range Rank); GNR or SNR (Not Ranked); GU or SU (Unrankable – Data Deficient); GX or SX (Presumed Extinct or Extirpated); GH or SH (Possibly Extinct or Extirpated – Historical); SNA (Not Applicable). Qualifiers: B = Breeding; N = Non-breeding; M = Migrant; ? = Inexact or uncertain numeric rank.

WL = Whiteshell Laboratories; EIS = Environmental Impact Statement; VC = Valued Component; - = not listed/no status; COSEWIC = Committee on the Status of Endangered Wildlife in Canada.

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APPENDIX 6.9-1

Participants in Key Person Interview Program

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Participants in Key Person Interview Program

- Blair Skinner, Mayor, Local Government District of Pinawa
- Gisele Smith, Resident Administrator, Local Government District of Pinawa
- Ted Mathers, Councillor, Town of Lac du Bonnet
- Michelle Wazny, Chief Administrative Officer, Town of Lac du Bonnet
- Ed Dubray, Mayor, Town of Beausejour
- Alvin Klapprat, Councillor, Town of Beausejour
- Jack Douglas, Chief Administrative Officer, Town of Beausejour
- Cindy Kellendonk, Councillor, Rural Municipality of Lac du Bonnet
- Bill Dowbyhuz, Reeve, Rural Municipality of Whitemouth
- Colleen Johnson, Chief Administrative Officer, Rural Municipality of Whitemouth
- Anna Mondor, Marketing Director, Beausejour Brokenhead Development Corporation
- Shane Li, President, North Forge East

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APPENDIX 7.0-1

WR-1 ISD Hazard Identification

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CNL WR-1 IN SITU DECOMMISSIONING ACTIVITIES HAZARD IDENTIFICATION

ISR Report 3014-01-01
Version 2.0
28 August 2017

Presented to:

Alyson Beal
Golder Associates
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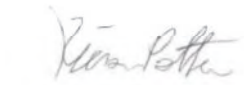
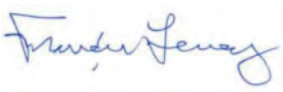
QUALITY ASSURANCE AND VERSION TRACKING

Authorization

Title	CNL WR-1 In Situ Decommissioning Activities Hazard Identification	
Report number	3014-01-01	
Version	2.0	Signature
Prepared by	R. Corrigan	
Reviewed by	K. Potter	
Approved by	T. Mahilrajan	
Approved for Corporate Release by	F. Lemay	

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1.0	Release to Client	M. McCall	18-Nov-16
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1. INTRODUCTION

1.1 Background

Decommissioning of Whiteshell Laboratories is being completed in two phases. Phase 1 activities for the WR-1 reactor included removal of the organic coolant, heavy water moderator, irradiated fuel, and some decontamination and dismantling activities and are complete. CNL has now proposed In Situ Decommissioning (ISD) as the strategy for the Phase 2 decommissioning of the WR-1 Reactor. This is a change to the original Phase 2 strategy of dismantlement and removal [1] and requires an EA under the Canadian Environmental Assessment Act, 2012. To support the EA, an Environmental Impacts Statement (EIS) is being developed, which includes a section on accidents and malfunctions.

1.2 Objective

The objective of this hazard identification report is to identify potential hazards and associated malfunctions and accidents which could arise during the Phase 2 decommissioning activities of WR-1, causing harm to people or the environment. The findings from this report support development of the *Accidents and Malfunctions* section of the EIS for the in-situ decommissioning of WR-1.

1.3 Scope

This hazard identification assesses Phase 2 activities, which encompass all remaining activities to place the WR-1 in a final decommissioned state. The Phase 2 activities include:

- Emplacement of radiological wastes from the above grade structure into the below grade structure.
- Crawlspace remediation into below grade structure.
- Establishment of a supply of mixed grout.
- Grouting of WR-1 reactor system components where void spaces cannot be effectively filled during final grouting.
- Grouting of WR-1 below grade building structure/systems including all remaining penetrations and void spaces.
- Installation of an engineered cover and environmental controls.

Potential radiological and non-radiological hazards associated with accidents and malfunctions are to be identified for the WR-1 ISD activities of Phase 2. The associated consequence and likelihood are also to be estimated for each hazard, as well as any mitigating factors.

Hazards which result in consequences only over long timeframes (i.e., after the engineered cover is complete and the WR-1 site closed) will be identified as part of the Decommissioning Safety Analysis Report and are not in the scope of this assessment.

2. METHODOLOGY

This hazard ID report was developed through the following activities:

- Document reviews
- What-If workshop

Document Reviews

Numerous documents from CNL and other sources were reviewed to identify the activities which will be carried out for decommissioning and to determine the types of hazards present. This review was also used to develop a checklist to guide the What-If Workshop.

What-If Workshop

This hazard identification was executed as a structured *What-If* workshop, which is a *What-If* workshop guided by a checklist. In this case, the checklist (shown in Appendix A) was populated with a set of hazards relevant to the decommissioning activities, identified from various sources. Team brainstorming of potential malfunctions and accidents was not constrained by the checklist and participants were encouraged to present all ideas which may result in the identification of hazards associated with malfunctions or accidents. An initial estimate of the consequence, likelihood, and mitigating factors was also attempted for each hazard or *What-If* question posed by the team. Likelihoods were roughly estimated based on the frequency indices shown in Table 1**Error! Reference source not found.**.

Table 1: Frequency Indices

Index	Events/Year
Occasional	$3x10^{-2}$ to $3x10^{-1}$
Rare	10^{-4} to $3x10^{-2}$
Extremely Rare	10^{-6} to 10^{-4}

The process is organized according to the Phase 2 Decommissioning Work Packages identified in [1]. These include the following:

1. Building Systems
2. Prepare Reactor Systems
3. Grout Installation
4. Building Demolition and Site Remediation

What-If tables (see Appendix B) were used to record results of the workshop discussions. A separate table was used for each Decommissioning Work Package.

3. RESULTS

3.1 Type of Hazards

The literature review identified the following radiological and non-radiological high level hazards.

3.1.1 Radiological Hazards

Radiological hazards associated with WR-1 decommissioning include potential exposure to beta, gamma, and alpha-emitting radionuclides produced during the operational period of WR-1. These consist primarily of the following:

1. Fission products
2. Activation products
3. Tritium
4. Corrosion products

Fission products are normally contained within the fuel, although fuel defects or failures result in the release of fission products in small quantities, which are then circulated throughout the reactor core and heat transport system during the operational life of the reactor.

Activation products are produced by irradiation of neutron absorbing materials, which become radioactive.

Tritium is produced when heavy water captures neutrons.

Corrosion products are small, mobile activation products, produced when small debris from corrosion is transported through the core (e.g., in the moderator or coolant) and are irradiated.

3.1.2 Non-Radiological Hazards

Non-radiological hazards present during the ISD of WR-1 include conventional construction and demolition hazards, chemical hazards, biological hazards, fire hazards, and hazards from external events.

Conventional industrial hazards associated with the decommissioning activities include working at heights, in confined spaces, and with energized systems, hoisting and rigging, grouting, and falling objects. Dismantling and demolition of B100, will involve the use of cranes and movement of heavy loads.

Hazardous materials that are present include asbestos, lead, PCBs, mercury, mould, and various chemicals.

Potential external events include fires, floods, aircraft strikes, earthquakes, extreme weather events (e.g., tornadoes, heavy precipitation).

3.2 Potential Accident Scenarios

The main results from the What-If workshop discussions are recorded directly in the What-If tables in Appendix B. These results include the What-If questions, consequences, likelihood, and mitigating factors.

4. REFERENCES

[1] AECL, "WLDP-03702-041-000, Rev. 2, - Whitehsll Laboratories Decommissioning Project Comprehensive Study Report, Vol. 1," 2001.

[2] CNL, "WLDP26400-DDP-001, Rev. 4D1, Detailed Decommissioning Plan: Volume 6 - Whiteshell Readtor #1: Building 100," 2016.

[3] NRC, "NUREG-0586, Supplement 1, Vol. 1 - Generic Environmental Impact Statement on Decommissioning of Nuclear Facilitie," 2002.

[4] IAEA, "TSS No. 439 - Decommissioning of Underground Structures, Systems and Components," Vienna, 2006.

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[9] DOE, "In Situ Decommissioning Lessons Learned - 14042," 2014.

APPENDIX A. WHAT-IF CHECKLIST/GUIDANCE SHEET

Table 2: What-If Guidance Sheet

Work Package	Item #	Hazards	Source
1. Building Systems Air gap building services, Remove Auxiliary Equipment, Remediate Crawlspace, Remove Building Support Systems	1	No unique hazards expected	WR-1 DDP [2]
	2	Some work will be in confined space – safety issues to consider	
	3	Some work will be in contaminated areas (e.g., crawlspace remediation).	
	4	Accidental cutting of contaminated piping	NUREG 0586 [3]
	5	Heavy equipment operation	IAEA, Decommissioning of Underground SSCs [4]
	6	Lifting and rigging	
2. Prepare Reactor Systems Prepare Heat Transport System, Reactor Vessel, Heavy Water & Helium Systems, Secondary Cooling and Auxiliary Systems and Active Ventilation Systems to receive grout; Remove, package and ship Fuel Transfer and Fuel Channel Flasks to CRL for long term management	7	Tritium removal procedures will need to be implemented to ensure worker safety.	WR-1 DDP [2]
	8	Radioactive water, organic coolant, particles and sludge may be present in some equipment.	
	9	Impact on ventilation patterns when active ventilation systems are shutdown, removed or if an opening needs to be cut.	
	10	High radiation fields exist in the reactor vault, upper and lower access rooms.	
	11	Damaged asbestos may be present on piping or tanks that require penetration or other preparatory work.	
	12	The need to remove some shielding to allow vessel preparation/grouting – use of temporary shielding to ensure worker safety.	
3. Grout Installation	13	Airborne particulate from grout constituents may be hazardous to respiratory health and precautions will	WR-1 DDP [2]

Work Package	Item #	Hazards	Source
Apply grout to selected areas, in and around special materials; Flood grouting of below grade structure		be taken to minimize dust generation and limit or prevent inhalation using respirators as appropriate.	
	14	Heavy truck traffic may occur at times during delivery of grout materials.	
	15	Impact on ventilation patterns when ventilation pathways are filled with grout.	
	16	Structural reinforcements may be necessary to ensure grout pressure does not compromise the structure and blow outs do not occur.	
	17	Deflagration/explosion: Aluminum scrap and metal alloys corrode when exposed to high pH (e.g., grout used at SRNL was 12+), producing hydrogen gas.	SRNL R-Reactor ISD [5]
	18	Structural failure: An unknown void space was discovered at the SRNL R-Reactor when a 3D CAD model was created.	[6]
4. Building Demolition and Site Remediation Demolition of B100 control room and office complex, reactor hall and ventilation stack; Installation of engineered cover; Site remediation and final grading	19	Work execution from heights – multiple floors above and below grade.	WR-1 DDP [2]
	20	Methods to backfill individual rooms in the lower levels need to be evaluated.	
	21	Radiological clearance needs to be completed well below ground prior to backfilling the excavation.	
	22	Heavy equipment operation	IAEA, Decommissioning of Underground SSCs [4]
	23	Lifting and rigging	
	24	Noise	
	25	Falling objects	
	26	Eye hazards	
	27	Explosion during demolition	WL CSR Vol. 1 [1]
	28	Weather event during dismantling activities.	DOE, Draft EIS [7]
General	29	Vehicle accident	DGR Malfunctions,

Work Package	Item #	Hazards	Source
			Accidents, Malevolent Acts [8]
	30	Fire: • At facility or involving equipment • During vehicle accident • During cutting	DGR Malfunctions, Accidents, Malevolent Acts [8]
	31	Electrical accidents • Misuse or poor maintenance of electrical equipment • Damage to electrical equipment • Access to live electrical equipment • Severe weather conditions, such as lightning	DGR Malfunctions, Accidents, Malevolent Acts [8]
	32	Spill of fuel, chemicals, lubricants and oils	DGR Malfunctions, Accidents, Malevolent Acts [8]
	33	Occupational accidents • Falls of workers • Injury during cutting • Injury during material handling • Heat exhaustion/stroke • Frostbite • Accidents related to moving/rotating machinery or other equipment • Machinery-related accidents during operation of drill, dozer or other equipment • Injury due to falling objects	DGR Malfunctions, Accidents, Malevolent Acts [8]
	34	Entrapment	

APPENDIX B. WHAT-IF WORKSHOP

Table 3: Workshop Form - 1 Building Systems

What-If	Potential Consequence	Likelihood	Mitigating Factors
1-1 What if the contamination levels of crawl spaces are higher than expected or take greater effort to remediate.	Higher worker exposure.	Rare	Previous characterization. RP surveys, PPE&C, contingency planning.
1-2 What if contaminated soil has spread (cross-contamination)	May require more cleanup/decontamination or higher worker exposures.	Occasional	Work planning to minimize potential spread of contamination. RP surveys, PPE&C.
1-3 What if there is more friable or loose asbestos in the soil or crawl spaces	Worker exposure to asbestos.	Occasional	Previous characterization. PPE&C
1-4 What if there is contamination released during cutting of tubing/conduit during air gapping. (e.g., cross contamination from other systems)	Potential spill or leak and higher worker exposure to radioactivity.	Occasional	Use of remote cutting techniques, PPE&C, radiation surveys, RP protection
1-5 What if there are some systems that are missed for isolation and air gapping (it's a large building)?	Electrical shocks, high pressure relief, industrial hazards, fire hazard, explosion hazard, etc.	Rare	Field verification, verification of design and design changes. Fire Protection, Emergency Preparedness plans.
1-6 What if the required systems (e.g., low level liquid waste collection, ventilation) are inadvertently isolated?	Loss of a safety-significant system. Higher radiological hazards. Potential loss of confinement and release of contamination (airborne and waterborne) to the environment. Potential worker injury.	Rare	Fail-safe modes of systems, backup power supplies. Detailed work plans. Verification of tie-ins.
1-7 What if failure of some remaining	Hazards may exist due to repair or maintenance being	Rare	Risks can be mitigated through careful assessment and work

What-If	Potential Consequence	Likelihood	Mitigating Factors
systems (e.g., low level liquid waste system) requires repair or more services than currently available to the building?	performed under conditions with limited building services.		planning for repair or remediation efforts.
1-8 What if organic coolant contains higher than expected levels of contaminated debris?	Higher exposure from coolant contaminated with radioactive debris.	Rare	RP surveys, PPE&C, potentially visible color change in coolant.

Table 4: Workshop Form - 2 Prepare Reactor Systems

What-If	Potential Consequence	Likelihood	Mitigating Factors
2-1 What if heavy equipment from the PHT or AVS is dropped or impacts the structure?	Structure could be damaged. Clean up for repair requires workers to spend more time in reactor incurring various hazards (e.g., industrial, radiological). Potential for airborne releases.	Rare	Procedural adherence. Verification of equipment. Personnel training, confinement by ventilation, emergency procedures.
2-2 What if negative pressure is not maintained in the reactor building?	Increased spread of airborne contamination, exposure to workers, and potential release to environment.	Occasional	Continuous air monitoring, PPE&C, work planning.
2-3 What if high levels of contamination exist in systems/components being prepared?	Potential for leaks and spills, worker exposure.	Occasional	Radiation Protection surveys, work permit, Personal Protective Equipment & Clothing (PPE&C), remote technology (e.g., automated guillotine cutters), temporary shielding, ventilation enclosure, conservative decision-making, work planning.
2-4 What if cutting or perforating causes	Potential for explosion.	Rare	Removal of combustibles. Use of cold cutting techniques, remote

What-If	Potential Consequence	Likelihood	Mitigating Factors
heating and pressurization of a sealed component during preparation?			technology. Fire protection. Emergency preparedness.
2-5 What if the systems state is unknown or different from expected? (more contamination than expected, or different in nature)	Various types of hazards (e.g., asbestos). The component may not be safe to prepare.	Occasional	Work planning, PPE&C, automated guillotine cutters.
2-6 What if there is an accident or incident resulting in a worker spending prolonged time in the reactor?	Higher worker exposure.	Rare	RP program, work plans, pre-job briefs, contingency plans, safety culture.
2-7 What if there is an accident during removal handling of heavy equipment (during hoisting, transferring)?	Heavy lifting, hoisting, transferring, transportation.	Rare	OSH procedures, PPE&C. Emergency procedures for rescue.
2-8 What if there is extreme weather during grouting (e.g., extreme cold)	See What-If **4-2.**		

Table 5: Workshop Form - 3 Grout Installation

What-If	Potential Consequence	Likelihood	Mitigating Factors
3-1 Can additional tritium be released during this phase (e.g., wet decontamination by, cutting of the ventilation system)?	Higher potential exposure to tritium.	Occasional	PPE&C, work plans, permit, decontamination techniques that do not create liquid waste. Temporary ventilation system during grouting.
3-2 What if there are unknown voids?	Structural integrity, chemical reactions? Higher likelihood of cracks near voids and potential release pathways.	Rare	Careful grout planning, sequencing. Use of visual tools (e.g., 3 D model, graphical method of display, video cameras during grouting).
3-3 What if there are reactions with metals, gases, or other materials (e.g., what if the grout is the wrong specification)?	Potential hydrogen explosion. Grout may not fill voids adequately. May affect post-closure environmental effects.	Rare	Design of grout plan. Knowledgeable grout specialist. Quality Control and Surveillance during grouting. Testing to determine performance of grout with HB-40.
3-4 What if it's not practical to reach certain areas with the grout (e.g., piping)?	Greater worker exposure to hazards such as radiation, confined spaces. Higher likelihood of void spaces.	Occasional	Identification of alternative methods for grouting difficult areas.
3-5 What if the contamination levels of crawl spaces are higher than expected or take greater effort to remediate.	Higher worker exposure.	Rare	Previous characterization.
3-6 What if heavy objects are dropped on the curing grout during this phase?	Potential damage to grout.	Rare /Occasional	Procedural adherence
3-7 What if the grout does not cure as expected to meet end-state objectives (e.g., thermal expansion during curing).	Failure modes of grout may be different or more likely.	Rare	Field testing of grout (including testing with HB-40) before ISD grouting. Grouting plan, and adherence to plan. Quality control

What-If	Potential Consequence	Likelihood	Mitigating Factors
			and surveillance in phases throughout grouting. Limit the grout lift volumes to prevent damage to the curing grout.
3-8 What if contaminated air is displaced by grout?	Spread of airborne contamination.	Rare	Provisions for controlling spread of contamination can be made (e.g., placement of filtered vents), temporary ventilation system during grouting.

Table 6: Workshop Form - 4 Building Demolition and Site Remediation

What-If	Potential Consequence	Likelihood	Mitigating Factors
4-1 What if heavy objects are dropped onto the grouted monolith?	Potential for generation of airborne contamination. Damage or breaks to contaminated systems or components below.	Rare	Ventilation system can confine airborne releases. Emergency and clean up procedures.
4-2 What if the grout behaves unexpectedly due to the organic coolant?	Failure modes of grout may be different or more likely. Migration of contaminants may be more likely.	Unknown	Study of HB-40.

Table 7: Workshop Form – 5 External Events

What-If	Potential Consequence	Likelihood	Mitigating Factors
5-1 What if there is extreme cold weather.	Electronic equipment, filters, respirators may not function, resulting in potential for dose.	Occasional	Work planning, contingency planning, stop work. Heat building.
5-2 What if fire fighting is necessary (also applies to internal fires)?	Large spread of contamination and release to environment. Higher worker doses during	Rare	Fire protection, PPE&C

What-If	Potential Consequence	Likelihood	Mitigating Factors
	cleanup/decontamination of reactor hall outside of ISD envelope. Higher worker doses due to contamination spread during reactor systems preparation (if not complete).		
5-3 What if there is an earthquake during ISD activities?	Worker hazards include falling objects, falling workers, potential collapse. Some spread of contamination is expected. Grout performance may be compromised if during or after grout installation (see What-If **4-2**).	Extremely Rare	WR-1 design basis. Grout design.
5-4 What if there is a flood during ISD activities?	Flooded areas could result in spread of contamination and greater worker doses. Electrical hazards.	Rare	[1] shows extremely low risk from flooding.
5-5 What if there are high winds or a tornado during ISD activities?	Most severe result is collapse of reactor hall, which could also cause a fire. This could result in spread of contamination and higher worker doses due to extensive clean-up activities.	Rare	Stop work during extreme weather events. WR-1 design basis.

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APPENDIX 7.0-2

Accidents and Malfunctions

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CNL WR-1 IN-SITU DECOMMISSIONING ACTIVITIES ACCIDENTS AND MALFUNCTIONS

ISR Report 3014-01-02
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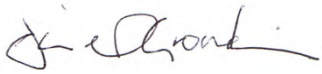
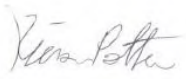
Reviewed by	D. Grondin	
Approved by	K. Potter	
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1. OVERVIEW

Decommissioning of Whiteshell Laboratories is being completed in two phases. Phase 1activities for the WR-1 reactor, which included removal of the organic coolant, heavy water moderator, irradiated fuel, and some decontamination and dismantling activities, were assessed in a 2002 Environmental Assessment and are complete. Canadian Nuclear Laboratories (CNL) has now proposed In-Situ Decommissioning (ISD) as the strategy for the Phase 2 decommissioning of the WR-1 Reactor. This is a change to the original Phase 2 strategy of dismantlement and removal [1] and is therefore expected to require an Environmental Assessment under the Canadian Environmental Assessment Act, 2012. To support the Environmental Assessment, an Environmental Impacts Statement (EIS) is being prepared, which includes a section on accidents and malfunctions. This report contains a description of the potential accidents and malfunctions identified for the WR-1 ISD activities.

1.1 Objective

The objective of this accidents and malfunctions report is to identify credible accidents and malfunctions which could arise during the WR-1 ISD activities, causing potential harm to people or the environment. Potential effects from the accidents and malfunctions, as well as factors which may mitigate the effects are also identified. Results presented in Section 5 of this report are recommended for inclusion in the *Accidents and Malfunctions* section of the EIS for In-Situ Decommissioning of WR-1.

1.2 Scope

The accidents and malfunctions assessed in this report apply to the Phase 2 decommissioning, which encompasses all remaining activities to place the WR-1 in a final decommissioned state. Phase 2 decommissioning of WR-1 is described in [2] will consist of the following generic steps:

- Isolation of building from site infrastructure.
- Preparation of reactor systems and materials to permit encapsulation with grout.
- Encapsulation of reactor systems and below grade structure with grout.
- Demolition of non-reactor systems and structures and installation of an engineered cap.
- Institution of ongoing environmental monitoring program and return to AECL control.

Hazards which result in consequences only over long time-frames (i.e., after the engineered cover is complete and the WR-1 site closed) are outside of the scope of this report and will be assessed in the Decommissioning Safety Analysis Report. Some accidents and malfunctions with potential long-term consequences and mitigation factors were identified in this report, but the consequences have not been assessed and further analysis is required to determine the effects.

3. METHODOLOGY

The accidents and malfunctions were identified through the following hazard assessment activities:

- Review of CNL documentation related to WR-1.
- Review of EIS accidents and malfunctions reports for other similar facilities.
- OPEX reviews.
- Structured *What-If* workshop and report based on five work packages identified for WR-1 ISD.

The identified accidents and malfunctions were assessed for potential consequences and likelihood of occurrence. Events which were evaluated to have very low likelihoods and/or consequences or were clearly bounded by other scenarios of similar nature were screened out and not considered further. Accident and malfunction scenarios screened in were then further developed and mitigation factors were considered.

4. RESULTS

4.1 WR-1 In-Situ Decommissioning Hazards

The following hazards were identified to be present during the WR-1 decommissioning activities.

4.1.1 Radiological Hazards

Radiological hazards associated with WR-1 decommissioning include potential exposure to beta, gamma, and alpha-emitting radionuclides produced during the operational period of WR-1. These consist primarily of the following types of radiological hazards:

Fission products

Fission products are normally contained within the fuel, although fuel defects or failures result in the release of fission products in small quantities, which are then circulated throughout the reactor core and heat transport system, during the operational life of the reactor.

Activation products

Activation products are produced by irradiation of neutron absorbing materials, which become radioactive. They are most abundant in structures and components in or near the core of the reactor, such as the fuel channels.

Tritium

Tritium is produced when heavy water captures neutrons. Residual moderator left from draining WR-1 is expected to contain tritium.

Corrosion products

Corrosion Products are small, mobile activation products, produced when small debris from corrosion is transported through the core (e.g., in the moderator or coolant) and are irradiated.

4.1.2 Non-Radiological Hazards

Non-radiological hazards present during the ISD of WR-1 include conventional construction and demolition hazards, chemical hazards, biological hazards, fire hazards, etc.

Conventional industrial hazards associated with the decommissioning activities include working at heights, in confined spaces, and with energized systems, hoisting and rigging, grouting, and falling objects. Dismantling and demolition of B100 will involve the use of cranes and movement of heavy loads.

Hazardous materials present include asbestos, lead, polychlorinated biphenyl

compounds (PCBs), mercury, mould, and various chemicals.

4.1.3 External Events

External events may result in radiological and non-radiological consequences. Potential external events include fires, floods, aircraft strikes, earthquakes, extreme weather events (e.g., tornadoes, heavy precipitation).

4.2 Accidents and Malfunctions

The subsections which follow present the potential accidents and malfunctions recommended for inclusion in the WR-1 EIS.

4.2.1 Occupational Accidents

Potential worker accidents and injury may arise from conventional, industrial hazards, including working at heights, in confined spaces, and with energized systems, hoisting and rigging, and falling objects. Dismantling and demolition of B100, in particular, will involve extensive use of cranes and movement of heavy loads. Failure to isolate all energized systems (e.g., electrical, pressurized) from the building during the building isolation, either through improper isolation or accidental exclusion, may also pose a hazard to workers.

The level of risk posed by the ISD activities is comparable to many other industrial settings for these types of hazards and is acceptable with careful mitigation.

Effects

In addition to the potential injury or accident itself, incidents during decommissioning activities may result in increased exposures to the attendant hazards since the injured personnel may require assistance of rescuers or face delays before exiting to a safe location. In particular, accidents or injuries in confined spaces increase exposure of the worker and rescuers to confined space hazards, such as poor air quality, chemicals, and radiation. The hazard initiating the accident or injury may pose a particular threat to rescuers.

The use of saws, drills, and compressors can cause injury to the operator. Accidental non-isolation of an energized system could result in shocks to workers (e.g., electrical or physical). Workers will be at risk of falling or having objects fall on them.

Mitigation

Industrial hazards are identified and assessed through CNL's Occupational Safety and Health (OSH) Program. Work can be carefully implemented with CNL procedures for hoisting and lifting, working at heights, confined space entry, and working with energized systems. Workplace controls, and Personal Protective Equipment and Clothing (PPE&C), including hard hats, gloves, fall protection, and hearing protection, will mitigate these hazards to an acceptable level.

WL Fire fighters are trained in confined space rescue and there are emergency

procedures for dealing with injured workers.

4.2.2 Spills and Leaks

Spills and leaks of radioactive contamination are possible during all stages of ISD activities. During cutting and perforation of components and structures, unknown or greater than expected quantities of radioactive substances may be encountered. Accidental cuts or breaks of contaminated piping may also release radioactive substances. Leaks could also occur from equipment failure, such as the Low Level Waste Collection system.

Non-radiological hazardous materials in excess of the regulated exemption quantities in the above grade structure (as well as easily removed quantities in the ISD boundary) will be removed and disposed of off-site. Spills and leaks are possible during removal, handling, and transport of these materials, including friable asbestos, lead, PCBs, and chemicals of various degrees of toxicity.

Effects

Spills and leaks during worker activities could lead to external and internal exposures to workers. Volatile contaminants released to the atmosphere may be transported and deposited in a new location. Releases of liquid contaminants during transport to an appropriate disposal area may contaminate soil, groundwater, surface water, and air.

Mitigation

The effects of spills and leaks of radiological substances can be minimized by following procedures and practices of CNL's RP Program. Procedures developed under CNL's Environmental Protection Program, Waste Management Program, and OSH Program will aid in protecting workers and the environment from radiological and non-radiological hazards.

Adequate ventilation during decommissioning activities will minimize worker exposures to airborne contaminants, as well as filtration. The use of PPE&C (e.g., chemical resistant gloves, eye protection), routine inspections of equipment, spill trays, spill kits, and established emergency procedures can be used to manage these hazards and mitigate the effects of spills and leaks. Chemical protection suits and self-contained breathing apparatuses will protect workers who may be potentially exposed to more toxic chemicals, such as potassium hydroxide. Due to its slow biodegradation and low water solubility, hydrogenated terphenyl should be collected to a practical extent and disposed of appropriately.

4.2.3 Material Handling Accidents

Various ISD activities will involve lifting and moving of large, potentially contaminated materials. The heat exchangers from the Primary Heat Transport system will be placed inside the ISD envelope. Other items, such as fume hoods, will be removed from B100. Wastes collected during decommissioning activities may be placed in containers and moved. Demolition activities will require significant handling of heavy loads.

Effects

Drops of, or impacts from, large objects pose physical hazards for workers nearby, including explosions or fires. The dropped objects could also damage other equipment or structures, resulting in leaks and spills. Cleanup or remediation required following such an incident results in higher worker exposures. Dropping of contaminated rubble or concrete could cause fine, radioactive particles to be suspended in air, posing an internal exposure hazard. Drops and ruptures of waste containers, or contaminated equipment, such as fume hoods, could also spread contamination and cause it to become airborne.

Mitigation

Confinement from ventilation will curtail airborne releases. Accidents during demolition activities will not release contaminants from the ISD boundary because they will be immobilized in the grout. The use of stabilizing and immobilizing agents prior to demolition can reduce the spread of any remaining B100 contaminants. Implementation of CNL procedures, including hoisting and rigging, will reduce the likelihood of a material handling accident. Emergency Preparedness plans reduce the consequences of an accident if it occurs.

4.2.4 Offsite Transportation Accidents

Non-radiological hazardous wastes above exemption limits will be transported to an appropriate off-site waste facility. Off-site transportation of radiological materials is not anticipated during the ISD activities.

Effects

Transportation accidents involving vehicles carrying hazardous wastes may expose the driver or other members of the public, or release contaminants to the environment.

Mitigation

Low risk from transportation accidents can be maintained through proper packaging and handling of hazardous waste and the use of CNL's procedures on Management of Non-Radiological Hazardous Chemical Waste and WL Waste Materials Management. WL's Emergency Preparedness Program has emergency plans for off-site accidents. No quantities of radioactive materials are expected to be transferred off-site under the ISD strategy.

4.2.5 System and Equipment Failure

Equipment failure and malfunctions may result from improper operation or maintenance, loss of services, or extreme environmental conditions. Safety-significant systems and equipment, including alarm and monitoring systems (e.g., continuous air monitors), contamination collection and confinement (e.g., Low Level Liquid Waste Collection system, ventilation system, storage tanks), could potentially be affected.

Effects

Failures of systems or equipment could result in the accumulation or release of airborne

and liquid contaminants, as well as increased worker exposure. Failure of alarm and monitoring systems could put workers at higher risks of exposures or fail to provide notification of unsafe conditions. Worker injuries and accidents are also possible with failed equipment or systems.

Mitigation

Design of equipment with fail-safe modes, use of reliable power supplies, maintenance programs, and depth-in-defense minimize the likelihood or effects of failures. Use of PPE&C and adherence to OSH procedures, contingency planning, and safe back-out procedures provide protection to workers from system and equipment failure.

4.2.6 Fires and Explosions

Fires may result by ignition of combustible materials, equipment malfunction, electrical faults, or lightning strikes. A number of systems and components will require cutting or perforating during reactor systems preparation. The use of saws, cutting torches, and drills poses a risk of ignition of combustible material.

Cutting of sealed components, which may be specifically targeted so that grout will infiltrate them and minimize voids, may pose an explosion hazard if they contain combustibles.

During grouting, metals and alloys exposed to high pH (e.g., an improperly specified or mixed grout) produce hydrogen which could potentially reach an explosive concentration above the grout surface.

Effects

Small radioactive releases to the environment are possible during fires from the burning of contaminants. Waste generated from decontamination activities, such as wipes, protective clothing, and HEPA filters introduces combustible contaminated material, which could be released to the atmosphere during a fire.

Firefighting methods may spread contamination, primarily inside the ISD envelope, but also outside of the envelope (e.g., contamination spread in the 500 and 600 level from sections of the PHT and AVS). Since most of the reactor hall outside of the ISD will be removed, cross-contamination in these areas will burden the removal process with greater decontamination effort and higher dose rates.

Mitigation

There are limited quantities of combustibles in WR-1 and Whiteshell's Fire Protection would minimize the duration and consequences of a fire. Wastes from decontamination activities will be packaged and managed in compliance with WL materials management procedures to reduce the likelihood of ignition.

Fire hazards can be reduced through implementation of Whiteshell's Fire Protection Program, removal of combustibles, and preferential use of cold cutting equipment. CNL maintains an Emergency Preparedness Program which curtails consequences from fires and explosions.

The hazard to workers from explosions of sealed components can be mitigated by careful surveying prior to cutting, and through preferential use of remote cutting equipment.

This risk of hydrogen explosion is avoided through proper specification and formulation of the grout (i.e., appropriate pH).

Worker doses during cleanup following a fire can be kept to a safe level through radiation protection practices.

4.2.7 Non-Conformant Monolith

Non-Conformant Grout

Improper curing of grout may be possible if the grout design is incorrect, or if the grout preparation and lift sequencing is not performed according to specifications. This may also be caused by extreme weather (e.g., extreme temperatures) during curing.

Excessive Voids

Larger voids that remain in the monolith, either because they were not identified or were not practical to fill during preparation, are more prone to cracking during temperature induced expansion [3].

Effects

Effects of a non-conformant monolith include reduced isolation and reduced immobilization of contaminants. The formation of cracks near voids may provide a pathway for releases of contaminants to the environment and exposure to the public. Releases due to a non-conformant monolith are anticipated to occur at a slow rate and over the long term.

Mitigation

Grout performance can be maximized by careful design, formulation, and sequencing during installation. Field testing, including tests of the grout with the organic coolant, can increase the reliability of the grouting method. Use of an experienced grout supplier with an appropriate QA Program can ensure adequate grout performance. Quality Control and Quality Surveillance should be incorporated during all phases of grout design and installation. Field demonstration tests should be performed to provide a higher level of assurance of the grout performance. The use of visual tools (e.g., 3D model, graphical method of display, video cameras during grouting) can minimize the likelihood of significant, unanticipated voids.

4.2.8 External Events

Extreme Rainfall

Effects

Extreme rain could result in a significant increase in surface water run-off and accompanying soil. This may result in worker safety issues, such as slippery surfaces, reduced visibility, and increased electrical hazards. Surface water run-off could lead to spread of contaminants exposed to the water.

Mitigation

Suspension of decommissioning activities and securing and containment of potentially contaminated materials associated with the activities during extreme rainfall can reduce the risks from extreme rainfall to acceptable levels.

Earthquake

Effects

An earthquake during ISD activities could result in damage to containment systems, hazards to workers, and non-conformance of the monolith. Implementation of CNL's Emergency Preparedness Program plans will mitigate the consequences of a potential earthquake.

Mitigation

WR-1 and the grout formula have been will be designed to withstand extreme environmental events.

Floods and Extreme Rainfall

Effects

Flooding of the site due to a rise in the Winnipeg River is remote. A failure of the Seven Sisters hydroelectric dam, which is upstream of the WL site, is considered to bound potential rises in the river due to extreme rainfall. There has never been a failure of a hydroelectric dam in Canada. Flood levels of the river at the WL site following a failure of the Seven Sisters Dam were previously estimated to reach a peak at 7 m above normal water levels [1]. This is below the level of the reactor building and such an incident would not flood the WR-1 site. The risk from flooding is therefore insignificant. WR-1 is currently protected by the reactor building. The reactor building will not be demolished until the grout has cured and the contaminants are isolated and immobilized. At this point, extreme rainfall will have a negligible effect.

Mitigation

During extreme rainfall, activities will be suspended to prevent occupational accidents.

Tornado

The WR-1 reactor building is designed to withstand very high winds and decommissioning activities would be suspended during extreme weather events to protect workers. A tornado is not anticipated to have any measurable effect following closure of the WR-1 site.

Aircraft Crash

Following closure, an aircraft crash at the WR-1 location is not likely to have a significant effect. Damage may occur to the grout, potentially reducing the long-term performance.

Decommissioning activities are planned to be begin in 2019 with demolition of the reactor building complete by June 2022. The likelihood of an aircraft crash directly affecting the WR-1 site during this time-frame is remote.

5. CONCLUSION

A number of accidents and malfunctions were identified for Phase 2 decommissioning activities for the WR-1 reactor. These scenarios were identified through document review (WR-1 literature and international guidance and reports for similar activities), a What-If workshop, and OPEX reviews.

Radiological consequences of accidents and malfunctions during ISD activities are anticipated to be significantly smaller than those identified in [1], which assessed the Phase 1 decommissioning activities, as well as the original Phase 2 approach of complete dismantlement and removal of WR-1. The completion of Phase 1 activities removed the majority of radiological hazards through removal of the spent fuel, coolant, and moderator. Further, the significant reduction of activities which would be required for the complete dismantling and removal reduces the likelihood of accidents and malfunctions, and their accompanying radiological and non-radiological effects.

Accidents and malfunctions during ISD activities are anticipated to have local effects only.

6. REFERENCES

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