CANADIAN NUCLEAR LABORATORIES

Canadian Nuclear Laboratories | Laboratoires Nucléaires Canadiens

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

Pinawa, Manitoba

Revision 1

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APPENDICES

APPENDIX 1 .0-1

Concordance Table

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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	Not Applicable

Section in Generic Guideline	Requirement	Section in the EIS
	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 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
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	Section 4.0 Aboriginal Engagement

Section in Generic Guideline	Requirement	Section in the EIS
	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, Aboriginal Engagement (CNSC); and ■ Aboriginal and Treaty Rights Information System (Indigenous and Northern Affairs Canada).	
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.	Not Applicable
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 Protection: Environmental Policy, 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
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.	Section 6.1 Environmental Assessment Approach Section 6.2 Atmospheric Environment Section 6.3 Geological and Hydrogeological Environment

Section in Generic Guideline	Requirement	Section in the EIS
	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 6.4 Surface Water 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 6.8.4.2.5 Traditional Land and Resource Use by Aboriginal Peoples
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
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

Section in Generic Guideline	Requirement	Section in the EIS
	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
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

Section in Generic Guideline	Requirement	Section in the EIS
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
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

Section in Generic Guideline	Requirement	Section in the EIS
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
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 Protection: Environmental Policy, 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	Section 2.5 Alternative Means for Carrying Out the Project

Section in Generic Guideline	Requirement	Section in the EIS
	■ 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.	
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

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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 3.5.1 In Situ Decommissioning Section 3.5.2 Temporary Supporting Infrastructure Section 3.5.3 Waste Generation and Management Section 3.5.4 End-State and Post-Closure Activities
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	Section 2.0 Purpose and Alternative Means Section 3.0 Project Description Section 4.0 Aboriginal 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 Surface Water Section 6.5 Aquatic

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	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.	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 Malfunctions and Accidents Section 8.0 Summary of Cumulative Effects Section 9.0 Summary of Significance of Residual Effects Section 10.0 Effects of the Environment on Project Section 11.0 Monitoring and Follow-up Programs
	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 6.1.2 Valued Components Section 6.2.1.2 Valued Components – Air Quality Section 6.2.2.2 Valued Components – Greenhouse Gases Section 6.3.1.2 Valued Components – Geology Section 6.3.2.2 Valued Components – Hydrogeology Section 6.4.1.2 Valued Components – Hydrology Section 6.4.2.2 Valued Components – Surface Water Quality Section 6.5.2 Valued Components – Aquatic Environment Section 6.6.2 Valued Components – Terrestrial Environment Section 6.7.2 Valued components – Human and Ecological Health Section 6.8.2 Valued Components – Land and Resource Use Section 6.9.2 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	Section 6.1.3.1 Spatial Boundaries Section 6.2.1.3 Assessment Boundaries – Air Quality Section 6.2.2.3 Assessment Boundaries – Greenhouse Gases Section 6.3.1.3 Assessment Boundaries – Geology Section 6.3.2.3 Assessment Boundaries – Hydrogeology Section 6.4.1.3 Assessment Boundaries – Hydrology Section 6.4.2.3 Assessment Boundaries – Surface Water Quality Section 6.5.3 Assessment Boundaries – Aquatic Environment Section 6.6.3 Assessment Boundaries – Terrestrial Environment Section 6.7.3 Assessment Boundaries – Human and Ecological Health Section 6.8.3 Assessment Boundaries – Land and Resource Use Section 6.9.3 Assessment Boundaries – Socio-economic Environment

Section in Generic Guideline	Requirement	Section in the EIS
	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. 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 5.3 Project-specific Public Engagement

Section in Generic Guideline	Requirement	Section in the EIS
7.0	**Aboriginal Engagement**	
	In accordance with the CNSC's REGDOC-3.2.2, Aboriginal 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 4.3 Project-specific First Nation and Métis 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 Protection: Environmental Policy, 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 Protection: *Environmental Policy, Assessments and Protection Measures*, to describe the baseline conditions in relation to these potential changes.	Section 6.1.4 Description of the Existing Environment Section 6.2.1.4 Description of the Environment – Air Quality Section 6.2.2.4 Description of the Environment – Greenhouse Gases Section 6.3.1.4 Description of the Environment – Geology Section 6.3.2.4 Description of the Environment – Hydrogeology Section 6.4.1.4 Description of the Environment – Hydrology Section 6.4.2.4 Description of the Environment – Surface Water Quality Section 6.5.4 Description of the Environment – Aquatic Environment Section 6.6.4 Description of the Environment – Terrestrial Environment Section 6.7.4 Description of the Environment – Human and Ecological Health Section 6.8.4 Description of the Environment – Land and Resource Use Section 6.9.4 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 Protection: Environmental Policy, Assessments and Protection Measures*, to assess the environmental effects of the project.	Section 6.1.8 Residual Effects Analysis Classification and Determination of Significance Section 6.2.1.8 Residual Effects Classification and Determination of Significance – Air Quality Section 6.2.2.8 Residual Effects Classification and Determination of Significance – Greenhouse Gases Section 6.3.2.6 Residual Effects Analysis – Hydrogeology Section 6.4.2.6 Residual Effects Analysis – Surface Water Quality Section 6.7.1.8 Residual Effects Classification and Determination of Significance - Human Health Section 6.7.2.8 Residual Effects Classification and Determination of Significance - Ecological Health Section 6.9.8 Residual Effects Classification and Determination of Significance - Socio-economic Environment

Section in Generic Guideline	Requirement	Section in the EIS
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 6.1.6 Residual Effects Analysis Section 6.2.1.6 Residual Effects Analysis – Air Quality Section 6.2.2.6 Residual Effects Analysis – Greenhouse Gases Section 6.3.2.6 Residual Effects Analysis – Hydrogeology Section 6.4.2.6 Residual Effects Analysis – Surface Water Quality Section 6.6.7 Residual Effects Assessment Results – Terrestrial Environment Section 6.7.1.6 Residual Effects Analysis – Human Health Section 6.7.2.6 Residual Effects Analysis – Ecological Health Section 6.9.6 Residual Effects Analysis – Socio-economic Environment
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 Protection: Environmental Policy, Assessments and Protection Measures*, to assess the potential health and environmental effects from postulated accident and malfunction scenarios.	Section 7.0 Malfunctions and Accidents
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 Protection: Environmental Policy, Assessments and Protection Measures*, to assess the project's potential cumulative effects.	Section 8.0 Summary of Cumulative Effects

Section in Generic Guideline	Requirement	Section in the EIS
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 Protection: *Environmental Policy, 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 Protection: Environmental Policy, Assessments and Protection Measures*, to assess the effects of the environment on the project (i.e., severe weather events).	Section 10.0 Effects of the Environment on the Project
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	Section 6.1.5 Project Interactions and Mitigation Section 6.2.1.5 Project Interactions and Mitigation – Air Quality Section 6.2.2.5 Project Interactions and Mitigation – Greenhouse Gases Section 6.3.1.5 Project Interactions and Mitigation – Geology Section 6.3.2.5 Project Interactions and Mitigation – Hydrogeology Section 6.4.1.5 Project Interactions and Mitigation – Hydrology Section 6.4.2.5 Project Interactions and Mitigation – Surface Water Quality Section 6.5.5 Project Interactions and Mitigation – Aquatic Environment

Section in Generic Guideline	Requirement	Section in the EIS
	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. 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.	Section 6.6.5 Project Interactions and Mitigation – Terrestrial Environment Section 6.7.1.5 Project Interactions and Mitigation – Human Health Section 6.7.2.5 Project Interactions and Mitigation – Ecological Health Section 6.8.5 Project Interactions and Mitigation – Land and Resource Use Section 6.9.5 Project Interactions and Mitigation – Socio-economic Environment
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 Protection: Environmental Policy, 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 Protection: Environmental Policy, 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	Section 6.1.9 Monitoring and Follow-up Section 6.2.1.9 Monitoring and Follow-up – Air Quality Section 6.2.2.9 Monitoring and Follow-up – Greenhouse Gases Section 6.3.1.6 Monitoring and Follow-up – Geology Section 6.3.2.8 Monitoring and Follow-up – Hydrogeology Section 6.4.1.8 Monitoring and Follow-up – Hydrology Section 6.4.2.9 Monitoring and Follow-up – Surface Water Quality Section 6.5.6 Monitoring and Follow-up – Aquatic Environment Section 6.6.8 Monitoring and Follow-up – Terrestrial Environment Section 6.7.1.9 Monitoring and Follow-up – Human Health Section 6.7.2.9 Monitoring and Follow-up – Ecological Health Section 6.8.6 Monitoring and Follow-up – Land and Resource Use Section 6.9.9 Monitoring and Follow-up – Socio-economic Environment

Section in Generic Guideline	Requirement	Section in the EIS
	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 ■ 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.	Section 11.0 Monitoring and Follow-up Programs

2.0 TABLE OF CONCORDANCE TO THE CNSC REGDOC 2.9.1 ENVIRONMENTAL POLICY, 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: ■ 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 in combination with other physical activities that have been or will be carried out ■ the significance of those environmental effects ■ comments from the public that are received in accordance with CEAA 2012 ■ mitigation measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the designated project ■ the requirements of the follow-up program in respect of the designated project ■ the purpose of the designated project ■ alternative means of carrying out the designated project that are technically and economically feasible and the environmental effects of any such alternative means ■ any changes to the designated project that may be caused by the environment ■ the results of any relevant study conducted by a committee established under section 73 or 74 of CEAA 2012 ■ any other matter relevant to the EA that the responsible authority requires to be taken into account	All EIS Sections and Appendices

Section in REGDOC 2.9.1	Requirement	Section in the EIS
	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 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 consultation 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 additional information, see 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 Aboriginal 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 for 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 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
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)	Section 7.1 Methods Section 7.2.1 Radiological Hazards Section 7.2.2 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
	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.	
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).	Section 9.0 Summary of Significance of Residual Effects

Section in REGDOC 2.9.1	Requirement	Section in the EIS
	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.	
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 6.10 Socio-economic Environment

Section in REGDOC 2.9.1	Requirement	Section in the EIS
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, Aboriginal Engagement [10] (for further information on the CNSC's expectations of applicants for Aboriginal engagement)	Section 6.9.4.3 Traditional Land and Resource Use by Aboriginal Peoples
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 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 6.1.9 Monitoring and Follow-up Section 6.2.1.9 Monitoring and Follow-up – Air Quality Section 6.2.2.9 Monitoring and Follow-up – Greenhouse Gases Section 6.3.1.6 Monitoring and Follow-up – Geology Section 6.3.2.8 Monitoring and Follow-up – Hydrogeology Section 6.4.1.8 Monitoring and Follow-up – Hydrology Section 6.4.2.9 Monitoring and Follow-up – Surface Water Quality Section 6.5.6 Monitoring and Follow-up – Aquatic Environment Section 6.6.8 Monitoring and Follow-up – Terrestrial Environment Section 5.7.1.9 Monitoring and Follow-up – Human Health Section 5.7.2.9 Monitoring and Follow-up – Ecological Health Section 5.8.6 Monitoring and Follow-up – Land and Resource Use Section 5.9.9 Monitoring and Follow-up – Socio-economic Environment Section 9.0 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 6.2.1.4 Description of the Environment – Air Quality Section 6.2.2.4 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 6.4.1.4 Description of the Environment – Hydrology Section 6.4.2.4 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 6.5.4 Description of the Environment – Aquatic Environment
B.4	**Geological and Hydrogeological Environment**	
	The geological and hydrogeological environment includes the bedrock and overburden geology at both the local and regional scales.	

Section in REGDOC 2.9.1	Requirement	Section in the EIS
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 6.3.1.4 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 6.3.2.4 Description of the Environment – Hydrogeology
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 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	Section 6.6.4 Description of the Environment – Terrestrial Environment

Section in REGDOC 2.9.1	Requirement	Section in the EIS
	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.	
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 6.7.1.4 Description of the Environment – Human Health Section 6.7.2.4 Description of the Environment – Ecological Health

Section in REGDOC 2.9.1	Requirement	Section in the EIS
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 6.7.1.4 Description of the Environment – Human Health
B.8	**Aboriginal Land Use**	
	Aboriginal 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 Aboriginal people. The applicant or licensee should identify the lands, water and resources of specific social, economic, archaeological, cultural or spiritual value to Aboriginal people, including established and asserted Aboriginal or treaty rights that may be affected by the facility or activity. The applicant or licensee should describe Aboriginal 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 Aboriginal people to pursue traditional activities or lifestyle.	Section 6.8.4.3 Traditional Land and Resource Use by Aboriginal 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 6.2.1.6 Residual Effects Analysis – Air Quality Section 6.2.2.6 Residual Effects Analysis – 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 Residual Effects Analysis – Hydrology Section 6.4.2.6 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.	6.5.5 Project Interactions and Mitigations – Aquatic Environment
C.4	**Geological and Hydrogeological Environment**	
	The geological and hydrogeological environment includes the bedrock and overburden geology at both the local and regional scales.	Section 6.3.1

Section in REGDOC 2.9.1	Requirement	Section in the EIS
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).	6.3.1.5 Project Interactions and Mitigations – 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 6.3.2.6 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 6.6.7 Residual Effects Assessment Results – 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 Aboriginal peoples.	Section 6.7.1.6 Residual Effects Analysis – Human Health Section 6.7.2.6 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 Aboriginal 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 6.7.1.6 Residual Effects Analysis – Human Health

Section in REGDOC 2.9.1	Requirement	Section in the EIS
C.8	**Aboriginal 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 Aboriginal group including effects on hunting, trapping, fishing and gathering. The licensee should identify any concerns raised by Aboriginal people about the facility or activity in relation to any Aboriginal or treaty rights. For further information on the CNSC's expectations of licensees for Aboriginal engagement, see REGDOC-3.2.2, Aboriginal Engagement. [10]	6.8.5 Project Interactions and Mitigations – Land and Resource Use

APPENDIX 4.0-1

Contact Tracker

Community	Related Activity	Date of Contact	Communication Medium	Inbound / Outbound	Reason	Employee Log	Other Comments	Follow-up required	Follow up required
Black River First Nation	Initial phone call re: Engagement/ Relationship building	6-Oct-16	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Mitch MacKay	Her group is interested in the WR-1 project. Wants a tour and community presentation. Interested in participant funding. Provided contact information for CNSC funding coordinator.	Yes	Sent information to: 'patricia2mitchell@gmail.com'
Black River First Nation	Engagement/ Relationship building	26-Oct-16	Phone Call	Outbound	Follow up re: community interest in participating in the WR-1 project	Mitch MacKay	Spoke with Patricia Mitchell. She was interested in the contracting/economic portion of the project. She was attempting to coordinate a large meeting with Brokenhead, Sagkeeng and Black River FNs. She will follow-up once she has coordinated with all chiefs and council. I stated that we could help with the cost of setting something like that up.	No	
Brokenhead Ojibway Nation	Follow up phone call re: Engagement/ Relationship building	26-Oct-16	Phone Call	Outbound	Gauge interest in the WR-1 project	Mitch MacKay	Spoke to Gord Bluesky, he is in charge of lands for the Ojibway Nation. He asked for CNL to send him the letter and he would follow-up. Very interested in the history of the site, and what is happening now. Wanted to know if he could stand by the reactor. Interested in partnering up with Black River and doing a tour. Also interested in bringing an elder and performing a ceremony.	Yes	Send Gord the project introduction letter.
Brokenhead Ojibway Nation	Engagement/ Relationship building	26-Oct-16	Email	Outbound	Provide additional project information	Mitch MacKay	Sent email to Gord Bluesky. Factsheet and project letter attached.	Yes	When are we following up with Gord (In a few days (Nov 8)?) to see if he has reviewed the material and discuss further engagement activities
Brokenhead Ojibway Nation	Initial phone call re: Engagement/ Relationship building	26-Oct-16	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Mitch MacKay	Asked if they received the letter. Was told to call Gord Bluesky.	Yes	Call Gord Bluesky
Grand Council of Treaty 3	Engagement/ Relationship building	26-Oct-16	Email	Outbound	Provide additional contact information	Mitch MacKay	Emailed contact information.	No	
Grand Council of Treaty 3	Engagement/ Relationship building	26-Oct-16	Phone Call	Inbound	Follow up re: organization interest in participating in the WR-1 project	Mitch MacKay	Grand Council #3 called back to inform that they could not find the letter.	Yes	Send introductory letter via email. Email: reception@treaty3.ca
Grand Council of Treaty 3	Engagement/ Relationship building	26-Oct-16	Email	Outbound	Follow up re: organization interest in participating in the WR-1 project	Mitch MacKay	Letter sent via email as requested. Requested follow-up re: organization's interest in participating.	No	
Grand Council of Treaty 3	Engagement/ Relationship building	26-Oct-16	Email	Outbound	Provide additional contact information	Mitch MacKay	Emailed contact information.	No	

Community	Related Activity	Date of Contact	Communication Medium	Inbound / Outbound	Reason	Employee Log	Other Comments	Follow-up required	Follow up required
Grand Council of Treaty 3	Initial phone call re: Engagement/ Relationship building	26-Oct-16	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Mitch MacKay	Called the council and spoke to reception. She was going to confirm receipt of letter and forward contact information to appropriate planning staff.	Yes	Email contact information to admin staff.
Hollow Water First Nation	Initial phone call re: Engagement/ Relationship building	26-Oct-16	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Mitch MacKay	Called the Band office no answer. Left a message.	No	
Iskatewizaagegan No.39 Independent First Nation	Initial phone call re: Engagement/ Relationship building	26-Oct-16	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Mitch MacKay	Called the band office and was forwarded to Delores. She requested a fax (807-733-3106) of the letter, to confirm with Chief if they received the letter. She explained she would call back tomorrow morning.	Yes	Fax project introduction letter and contact information to Dolores.
Iskatewizaagegan No.39 Independent First Nation	Engagement/ Relationship building	26-Oct-16	Fax	Outbound	Provide additional project information	Mitch MacKay	Fax of letter and contact information sent	No	
Manitoba Metis Federation	Initial phone call re: Engagement/ Relationship building	26-Oct-16	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Mitch MacKay	Letter Received. Follow up by email to get the process started.	Yes	Follow up via email to set up introductory meeting
Manitoba Metis Federation	Engagement/ Relationship building	26-Oct-16	Email	Outbound	Follow up re: setting up an appropriate time to meet	Mitch MacKay	Emailed follow-up.	No	
Northwest Angle No.33	Initial phone call re: Engagement/ Relationship building	26-Oct-16	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Mitch MacKay	Called no answer, no answering machine.	No	
Northwest Angle No.33	Initial phone call re: Engagement/ Relationship building	26-Oct-16	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Mitch MacKay	No answer, voicemail was full	No	
Northwest Angle No.33	Initial phone call re: Engagement/ Relationship building	26-Oct-16	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Mitch MacKay	Called and left a message, with call back information.	No	
Shoal Lake No.40 First Nation	Initial phone call re: Engagement/ Relationship building	26-Oct-16	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Mitch MacKay	Called the Band office and was forwarded to answering machine. Left message.	No	
Wabaseemoong Independent Nations	Initial phone call re: Engagement/ Relationship building	26-Oct-16	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Mitch MacKay	Called the band office and was forwarded to council. No answer so left a message.	No	
Black River First Nation	Follow up phone call re: Engagement/Relationship building	1-Nov-16	Phone Call	Outbound	Follow up re: engagement	Mitch MacKay	Patricia says that she is waiting to hear back from CNSC on funding.	No	
Brokenhead Ojibway Nation	Follow up phone call re: Engagement/Relationship building	1-Nov-16	Phone Call	Outbound	Follow up re: organization interest in participating in the WR-1 project	Mitch MacKay	Gord wanted me to email him specific request.	Yes	Send email outlining conversation.
Brokenhead Ojibway Nation	Follow up email	1-Nov-16	Email	Outbound	Responding to email request	Mitch MacKay	Offer of engagement.	No	

Community	Related Activity	Date of Contact	Communication Medium	Inbound / Outbound	Reason	Employee Log	Other Comments	Follow-up required	Follow up required
Grand Council of Treaty 3	Follow up phone call re: Engagement/Relationship building	1-Nov-16	Phone Call	Outbound	Follow up re: engagement	Mitch MacKay	Reception said she was just filling in while reception was getting the mail. Call back in 15 minutes.	Yes	
Iskatewizaagegan No.39 Independent First Nation	Follow up phone call re: Engagement/Relationship building	1-Nov-16	Phone Call	Outbound	Follow up on Fax	Mitch MacKay	Was told that person in charge of this was away. Call back next week.	Yes	
Wabaseemoong Independent Nations	Follow up phone call re: Engagement/Relationship building	1-Nov-16	Phone Call	Outbound	Follow up re: engagement	Mitch MacKay	Left message on machine.	No	
Black River First Nation	Email request to First Nation groups from Brokenhead	8-Nov-16	Email	Inbound	Soliciting feedback on group engagement possibilities	Mitch MacKay	Gord is interested in getting Hollow Water and Black River together for a shared engagement.	No	
Black River First Nation	Email to notify CNL of next steps	8-Nov-16	Email	Inbound	Replying to request to engage.	Mitch MacKay	I'm hoping to hear back from the Feds before setting up a mtg.. the Chiefs are aware too.	No	
Black River First Nation	Email to notify CNL of next steps	8-Nov-16	Email	Inbound	Replying to request to engage.	Mitch MacKay	We are aware of your request to meet, and we will contact you as soon as our calendars allow it.	No	
Sagkeeng	Follow up phone call re: Engagement/Relationship building	10-Nov-16	Phone Call	Outbound	Follow up re: engagement	Mitch MacKay	Left message on machine.	No	
Grand Council of Treaty 3	Engagement/ Relationship building	16-Nov-16	Phone Call	Outbound	Follow up re: organization interest in participating in the WR-1 project	Christina Blouw	Sam remembers speaking to Mitch personally. Reception duties rotate through a number of people. Sam will take a look and see if the email with the notification letter was received. She will call me back.	No	
Grand Council of Treaty 3	Engagement/ Relationship building	16-Nov-16	Phone Call	Inbound	Follow up re: organization interest in participating in the WR-1 project	Christina Blouw	Sam found the introductory letter and left a voicemail for me to call her back.	Yes - call Sam back	
Grand Council of Treaty 3	Engagement/ Relationship building	16-Nov-16	Phone Call	Outbound	Follow up re: organization interest in participating in the WR-1 project	Christina Blouw	Sam is fairly certain the information letter was forwarded on to the Grand Chief's email. The email would have also gone to the Territorial Planning Unit (TPU) and Roxanne Meawasige (communications and consultations officer) would have reviewed it. Sam will forward the introductory letter on to Roxanne again. Roxanne is out of the office today but Sam will send her my contact information for her to connect with me next week.		
Iskatewizaagegan No.39 Independent First Nation	Follow up phone call re: Engagement/Relationship building	16-Nov-16	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Christina Blouw	Called the band office, Delores was not in the office. A relief worker was answering the phone and he suggested that I try and call her back tomorrow.	Yes	Call back tomorrow.

Community	Related Activity	Date of Contact	Communication Medium	Inbound / Outbound	Reason	Employee Log	Other Comments	Follow-up required	Follow up required
Northwest Angle No.33	Initial phone call re: Engagement/ Relationship building	16-Nov-16	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Christina Blouw	Spoke with Darlene Sandy in the Band office on the reserve. She checked & indicated that they did not receive a notification via fax in August. I mentioned that the letter would have been mailed out. Darlene suggested I call Nancy Blackhawk in the Kenora finance office to see if they received it there.	Yes	Call Nancy Blackhawk in the Kenora NWA #33 office.
Northwest Angle No.33	Initial phone call re: Engagement/ Relationship building	16-Nov-16	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Christina Blouw	Spoke with Charlene, she took a my name and number and will get Nancy to call me back. Nancy will be in the office tomorrow morning.	No	
Shoal Lake No.40 First Nation	Initial phone call re: Engagement/ Relationship building	16-Nov-16	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Christina Blouw	Chief Erwin Redsky received the introductory letter on August 29, 2016. Samantha suggested I email Chief Redsky to see if he things the community would be interested in additional information about the project/engagement.	Yes	Email Chief Redsky - erwinredsky@hotmail.com
Iskatewizaagegan No.39 Independent First Nation	Follow up phone call re: Engagement/Relationship building	17-Nov-16	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Christina Blouw	Spoke with Delores. She will double check that she received the faxed information letter from Mitch and will get back to me.	No	
Northwest Angle No.33	Initial phone call re: Engagement/ Relationship building	17-Nov-16	Phone Call	Inbound	Initial phone call to gauge interest in the WR-1 project	Christina Blouw	Spoke with Nancy, she recalls getting the intro letter in August and she believes it made it to the Chiefs desk. There was an election in July so people are just getting used to their new positions within community administration. She will look into this with the Chief or her assistant and get back to me.	No	
Shoal Lake No.40 First Nation	Follow up re: Engagement/ Relationship building	17-Nov-16	Email	Outbound	Follow-up email to gauge interest in the WR-1 project	Mitch MacKay	Sent email to Chief Erwin Redsky re: introductory letter on August 29, 2016 & to see if he thinks the community would be interested in additional information about the project/engagement.	No	
Black River First Nation	Notification of Public Information Sessions	21-Nov-16	Email	Outbound	Notification of Public Information Sessions	Mitch MacKay		No	
Manitoba Metis Federation	Follow up on agenda feedback	21-Nov-16	Phone Call	Outbound	Confirming agenda for engagement	Mitch MacKay	Left message on machine.	Yes	
Manitoba Metis Federation	Follow up on agenda feedback	22-Nov-16	Phone Call	Outbound	Confirming agenda for engagement	Mitch MacKay	Left message on machine.	Yes	
Manitoba Metis Federation	Follow up on agenda feedback	22-Nov-16	Phone Message	Inbound	Confirming receipt of message	Mitch MacKay	Left message on machine.	Yes	
Manitoba Metis Federation	Notification of Public Information Sessions	23-Nov-16	Email	Outbound	Notification of Public Information Sessions	Mitch MacKay		No	

Community	Related Activity	Date of Contact	Communication Medium	Inbound / Outbound	Reason	Employee Log	Other Comments	Follow-up required	Follow up required
Manitoba Metis Federation	Confirmation on attendance	28-Nov-16	Phone Message	Outbound	Final confirmation of attendees	Mitch MacKay	Left message on machine.	No	
Black River First Nation	Follow up phone call re: Engagement/Relationship building	30-Nov-16	Phone Call	Outbound	Follow up re: engagement	Christina Blouw	Patricia mentioned that they have been busy with another project but she will touch base with Chief and Council re: the proposed plan they have drafted for CNL engagement. She would like Chief and Council to sign off on it and then she will get back to us (either Mitch or Christina)	No	
Brokenhead Ojibway Nation	Follow up phone call re: Engagement/Relationship building	30-Nov-16	Phone Call	Outbound	Follow up re: organization interest in participating in the WR-1 project	Christina Blouw	Left voicemail for Gord.	No	
Grand Council of Treaty 3	Engagement/ Relationship building	30-Nov-16	Phone Call	Outbound	Follow up re: organization interest in participating in the WR-1 project	Christina Blouw	Sam had stepped out of the office, alternate receptionist took a message and will get Sam to call me when she's back in about 20 min.	No	
Hollow Water First Nation	Initial phone call re: Engagement/ Relationship building	30-Nov-16	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Christina Blouw	Called and spoke with Henry Moneas. He indicated that he had not seen a Project Introductory letter. I indicated that we would send him a digital copy by email for his review. He thought that was a good plan, requested the letter also be emailed to the Chief. We agreed that it would be good for me to follow up with him one week after sending the email information.	Yes	Email Project Introductory letter to Henry Moneas and Chief Larry Baker. chieflarrybaker@hollowwater.com and henrymoneas@hollowwater.com
Hollow Water First Nation	Follow up re: Engagement/ Relationship building	30-Nov-16	Email	Outbound	Follow up re: engagement	Mitch MacKay	Sent Henry and Chief Larry Barker an email with attached copy of project intro letter	No	
Iskatewizaagegan No.39 Independent First Nation	Follow up phone call re: Engagement/Relationship building	30-Nov-16	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Christina Blouw	Delores was out of the office for the day. I indicated that I would call her back tomorrow.	Yes	Call back tomorrow.
Manitoba Métis Federation	Engagement/ Relationship building	30-Nov-16			Open the dialogue between the CNL and the MMF regarding the overall closure plans for the WL site, review the proposed changes to the WR-1 Reactor and associated environmental assessment (EA) process.	Mitch MacKay	Canadian Nuclear Laboratories Meeting with the Manitoba Metis Federation 10:00 am – 12:00 pm Wednesday, November 30, 2016 Manitoba Metis Federation 300-150 Henry Avenue		Provide MMF with meeting notes to review.

Community	Related Activity	Date of Contact	Communication Medium	Inbound / Outbound	Reason	Employee Log	Other Comments	Follow-up required	Follow up required
Northwest Angle No.33	Initial phone call re: Engagement/ Relationship building	30-Nov-16	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Christina Blouw	Spoke with Nancy. She was not able to find a copy of the letter and does not recall seeing the letter come in. It would be helpful if we could send her a copy of the letter via email. She will then print it out and forward it on to the Chief to review.	Yes	Send Nancy a copy of the Project Introductory letter. lee9nancy@gmail.com
Northwest Angle No.33	Initial phone call re: Engagement/ Relationship building	30-Nov-16	Email	Outbound	Follow up re: engagement	Mitch MacKay	Sent Nancy an email with attached copy of project intro letter	No	
Sagkeeng	Follow up phone call re: Engagement/Relationship building	30-Nov-16	Phone Call	Outbound	Follow up re: engagement	Christina Blouw	Myles was with someone in his office. Admin assistant took a message and will get him to give me a shout back.	No	
Wabaseemoong Independent Nations	Follow up phone call re: Engagement/Relationship building	30-Nov-16	Phone Call	Outbound	Follow up re: engagement	Christina Blouw	Spoke with the maintenance person who answered the phone. He indicated that I should call back tomorrow.	Yes	Call back tomorrow.
Iskatewizaagegan No.39 Independent First Nation	Follow up phone call re: Engagement/Relationship building	1-Dec-16	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Christina Blouw	No answer	No	
Sagkeeng	Follow up phone call re: Engagement/Relationship building	1-Dec-16	Phone Call	Inbound	Follow up re: engagement	Christina Blouw	Myles does not remember see in the CNL Intro letter in August. He requested we email the letter to him so he could review. I indicated that we would follow up with him next week re: community interest. He indicated that he would be out of the office next week but would have email access and could touch base that way.	Yes	Email Myles the Project Intro letter as sent to Sagkeeng in August. ceo@sagkeeng.ca
Sagkeeng	Follow up re: Engagement/Relationship building	1-Dec-16	Email	Outbound	Follow up re: engagement	Mitch MacKay	Sent Myles an email with attached copy of project intro letter	No	
Wabaseemoong Independent Nations	Follow up phone call re: Engagement/Relationship building	1-Dec-16	Phone Call	Outbound	Follow up re: engagement	Christina Blouw	Was transferred by reception to Valerie Fisher - Finance Officer. Left a voicemail for her to call me back.	no	
Hollow Water First Nation	Follow up re: Engagement/ Relationship building	2-Dec-16	Phone Call	Outbound	Follow up call as emails are bouncing back - need to confirm email addresses	Christina Blouw	No answer. Will call back later.		
Hollow Water First Nation	Follow up re: Engagement/ Relationship building	2-Dec-16	Phone Call	Outbound	Confirmed email addresses with Admin Staff	Christina Blouw	henry.moneas@hollowwater.ca chief.barker@hollowwater.ca	Yes	Re-send email to correct email addresses.

Community	Related Activity	Date of Contact	Communication Medium	Inbound / Outbound	Reason	Employee Log	Other Comments	Follow-up required	Follow up required
Manitoba Metis Federation	CNL MMF Preliminary Meeting and Follow-up	7-Dec-16	Email	Outbound	Follow-up after meeting attached meeting minutes presentation map VC feedback form and FTP link to larger files. Propose next meeting dates digital copies of the Comprehensive Study Report completed in 2003, CNL's 2015 Annual Safety Report, Environmental Monitoring Report, and Environmental Assessment Follow-up Program	Mitch MacKay		No	
Black River First Nation	Request to engage with Hollow Water, Black River, Brokenhead	8-Dec-16	Email	Inbound	Request to engage with Hollow Water, Black River, Brokenhead	Mitch MacKay	Requesting a date for next week along with Per Diem.	Yes	
Black River First Nation	Reply back to Patricia re: dates for engagement	9-Dec-16	Email	Outbound	Reply back to Patricia re: dates for engagement	Mitch MacKay	Suggested dates back along with format and location.	Yes	
Black River First Nation	Confirmation of date	12-Dec-16	Phone	Inbound	Confirmation of dates location and attendees	Mitch MacKay	Patricia says that three Nations will be attending, Chief and council, some technical advisors. Request for per diem and rental of hall. CNL asked for proposed budget and than to be invoiced. Patricia says she will follow-up with all details once she gets to the office.	Yes	
Black River First Nation	Job Opportunity	12-Dec-16	Email	Outbound	Summer Student Position for First Nation and Metis Affairs Coordinator	Mitch MacKay		No	
Manitoba Metis Federation	Job Opportunity	12-Dec-16	Email	Outbound	Summer Student Position for First Nation and Metis Affairs Coordinator	Mitch MacKay		No	
Grand Council of Treaty 3	Engagement/ Relationship building	14-Dec-16	Phone Call	Outbound	Follow up re: organization interest in participating in the WR-1 project	Mitch MacKay	Sent project intro email to Roxanne Meawasige, Communications and Consultations Officer, Territorial Planning Unit tpu.consultation@treaty3.ca re: follow up on additional community engagement. Attached original Project letter dated August 2016	No	
Grand Council of Treaty 3	Engagement/ Relationship building	14-Dec-16	Phone Call	Outbound	Follow up re: organization interest in participating in the WR-1 project	Christina Blouw	Sam indicated that it might be best if we just communicated directly with Roxanne Meawasige, Communications and Consultations Officer, Territorial Planning Unit tpu.consultation@treaty3.ca	yes	Email Roxanne Directly.
Iskatewizaagegan No.39 Independent First Nation	Follow up phone call re: Engagement/Relationship building	14-Dec-16	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Christina Blouw	Spoke with Delores. We had a good conversation re: the WR-1 project. She will make a note and speak to the Chief tomorrow. She will then call me back.	No	

Community	Related Activity	Date of Contact	Communication Medium	Inbound / Outbound	Reason	Employee Log	Other Comments	Follow-up required	Follow up required
Northwest Angle No.33	Initial phone call re: Engagement/ Relationship building	14-Dec-16	Phone Call	Outbound	Follow up re: engagement	Christina Blouw	Nancy has made copies of the Project Intro letter and distributed to Chief and Council. She does not think they will be able to review prior to Christmas. We spoke about re-connecting in the new year to see if the community was interested in any additional information.	Call back in January.	
Sagkeeng	Follow up phone call re: Engagement/Relationship building	14-Dec-16	Phone Call	Outbound	Follow up re: engagement	Christina Blouw	Myles was on another call, Admin will get him to give me a call back.	No	
Sagkeeng	Follow up phone call re: Engagement/Relationship building	14-Dec-16	Phone Call	Inbound	Follow up re: engagement	Christina Blouw	Spoke with Myles. He will talk to chief and Council tomorrow at their meeting and will get back to me either later tomorrow afternoon or on Monday. We spoke about the potential for CNL to go to Sagkeeng and present to Chief and Council. I also mentioned that Chief and Council were more than welcome to go to the WL site for a tour. Miles will get back to me.	No	
Shoal Lake No.40 First Nation	Follow up re: Engagement/ Relationship building	14-Dec-16	Phone Call	Outbound	Follow-up email to gauge interest in the WR-1 project	Christina Blouw	Spoke with Samantha, she indicated that I should speak to Darryl Redsky, Lands and Resource Manager (elkclan@hotmail.ca). I will call him back tomorrow.	Yes	Call back tomorrow.
Wabaseemoong Independent Nations	Follow up phone call re: Engagement/Relationship building	14-Dec-16	Phone Call	Outbound	Follow up re: engagement	Christina Blouw	Left a voicemail for Harry (Chief Financial Officer) to call me back.	no	
Black River First Nation	Engagement/ Relationship building	15-Dec-16	Meeting	Outbound	Project engagement with Black River, Brokenhead and Hollow Water First Nations at Swan Lake Office, Headingly, MB	Kristin Drewes	Project engagement meeting with Black River, Brokenhead and Hollow Water First Nations at Swan Lake Office, Headingly, MB		
Brokenhead Ojibway Nation	Engagement/ Relationship building	15-Dec-16	Meeting		Project engagement with Black River, Brokenhead and Hollow Water First Nations	Kristin Drewes	Project engagement meeting with Black River, Brokenhead and Hollow Water First Nations at Swan Lake Office, Headingly, MB	Yes	Provide meeting notes to participants
Hollow Water First Nation	Engagement/ Relationship building	15-Dec-16	Meeting	Outbound	Project engagement with Black River, Brokenhead and Hollow Water First Nations at Swan Lake Office, Headingly, MB	Kristin Drewes	Project engagement meeting with Black River, Brokenhead and Hollow Water First Nations at Swan Lake Office, Headingly, MB		

Community	Related Activity	Date of Contact	Communication Medium	Inbound / Outbound	Reason	Employee Log	Other Comments	Follow-up required	Follow up required
Sagkeeng	Follow up phone call re: Engagement/Relationship building	15-Dec-16	Phone Call	Inbound	Follow up re: engagement	Christina Blouw	Spoke with Myles. Chief and Council are interested in a presentation and an open house for the community. Email Miles with potential dates for holding these events in the community in the new year.	Yes	Email Myles with potential dates for community events.
Sagkeeng	Follow up phone call re: Engagement/Relationship building	15-Dec-16	Phone Call	Inbound	Follow up re: engagement	Christina Blouw	Spoke with Myles. He confirmed the January 25th date for the meeting with C&C along with the open house. He will book the gym at the SFN treatment centre and see if he can arrange to have chairs available. I will touch base with him in the new year.		
Shoal Lake No.40 First Nation	Follow up re: Engagement/ Relationship building	16-Dec-16	Phone Call	Outbound	Follow-up email to gauge interest in the WR-1 project	Christina Blouw	Phone line was busy for each attempted call throughout the day	No	
Sagkeeng	Follow up phone call re: Engagement/Relationship building	19-Dec-16	Email	Outbound	Follow up re: presentation and open house request	Christina Blouw	Emailed Myles with suggested dates for presentation to c&c and open house for Jan 2017. Also included the link for the CNL summer student position		
Sagkeeng	Follow up phone call re: Jan 25 C&C meeting and open house	3-Jan-17	Phone Call	Outbound	Follow up re: C&C meeting and open house	Christina Blouw	Myles had stepped out of the office but Admin indicated they would give him the message I called.		
Sagkeeng	Follow up phone call re: Jan 25 C&C meeting and open house	3-Jan-17	Phone Call	Inbound	Follow up re: C&C meeting and open house	Christina Blouw	Spoke with Myles. Offered to email him a notification poster for the community open house to be posted, put on the web site, radio announced and faxed to various organizations. Asked about inviting Powerview/Pine Falls residents to the community open house, he didn't see an issue with that; he will double check on this at the council meeting tomorrow afternoon.		Email Myles summary of our discussion and send along notification poster for distribution.
Sagkeeng	Follow up phone call re: Jan 25 C&C meeting and open house	5-Jan-17	Email	Outbound	Follow up re: C&C meeting and open house	Christina Blouw	Sent Myles the open house notification poster, links to the project webpage along with confirming logistical details for the open house Waiting for confirmation that Powerview/Pine Falls residents are welcome to attend the community open house.	no	
Black River First Nation	Follow up on actions from meeting	10-Jan-17	Email	Outbound	Follow through on actions from previous meeting, attached draft meeting notes for approval and ad for Sagkeeng First Nation Open house	Mitch MacKay		Yes	
Black River First Nation	Follow up on actions from meeting	10-Jan-17	Email	Outbound	Introducing Whiteshell Laboratories Procurement	Mitch MacKay		No	

Community	Related Activity	Date of Contact	Communication Medium	Inbound / Outbound	Reason	Employee Log	Other Comments	Follow-up required	Follow up required
Black River First Nation	Follow up on actions from meeting	10-Jan-17	Email	Outbound	Introducing the Whiteshell Economic Regeneration Partnership	Mitch MacKay		No	
Shoal Lake No.40 First Nation	Follow up re: Engagement/ Relationship building	12-Jan-17	Email	Outbound	Follow-up email to gauge interest in the WR-1 project	Mitch MacKay	Sent project intro email to Darryl Redsky Lands and Resource Manager (elkclan@hotmail.ca) re: follow up on additional community engagement. Attached original Project letter dated August 2016		
Shoal Lake No.40 First Nation	Follow up re: Engagement/ Relationship building	12-Jan-17	Phone Call	Outbound	Follow-up email to gauge interest in the WR-1 project	Christina Blouw	Spoke with Samantha, she indicated that Darryl will be back in the office on Monday. I will email him and call back on Monday.	Yes	Email Darryl (elkclan@hotmail.ca) & call back on Monday.
Wabaseemoong Independent Nations	Follow up phone call re: Engagement/Relationship building	12-Jan-17	Phone Call	Outbound	Follow up re: engagement	Christina Blouw	Spoke to Anthony Henry, Band Manager. He does not remember seeing this letter come to the band office. He requested that I fax the letter to him, he will review and I will touch base with him in couple of days.	Fax Project intro letter to Anthony 807-927-2107	
Wabaseemoong Independent Nations	Follow up phone call re: Engagement/Relationship building	12-Jan-17	Fax	Outbound	Follow up re: engagement	Christina Blouw	Faxed Cover letter and associated WIN Project Intro LTR to both 807- 927-2107 and 807-927-2419	Fax Project intro letter to Anthony 807-927-2107	
Sagkeeng	Follow up phone call re: Jan 25 C&C meeting and open house	17-Jan-17	Phone call	Outbound	Follow up re: C&C meeting and open house logistics	Christina Blouw	Left a voicemail for Lana requesting call back re: Jan 25th meeting logistics	no	
Sagkeeng	Follow up phone call re: Jan 25 C&C meeting and open house	18-Jan-17	Phone call	Outbound	Follow up re: C&C meeting and open house logistics	Christina Blouw	Lana has been sick the last two days. Christine, Admin, will email Lana re: confirming the Gym space booking and will get back to me	no	
Black River First Nation	Follow up on email	20-Jan-17	Email	Outbound	Introducing Whiteshell Laboratories Procurement	Gina Barnett	Gina Barnett is Manager of WLCP Procurement.	No	
Black River First Nation	Follow-up on various emails	23-Jan-17	Phone	Outbound		Mitch MacKay	Left a message outlining some of the information provided in emails sent.		
Black River First Nation	Invite to 2 day engagement	24-Jan-17	Email	Inbound	2-day gathering	Mitch MacKay		Yes	
Black River First Nation	Response to Invite to 2 day engagement	25-Jan-17	Email	Outbound	Confirm CNL attendance and compensation	Mitch MacKay			
Sagkeeng	Chief and Council Meeting & Community Information session	25-Jan-17					CNL representatives attended the meeting with Chief and Council. CNL and InterGroup (CB) attended the Community info session.	no	
Black River First Nation	Engagement/ Relationship building	2-Feb-17	Email	Inbound	Confirmation of date, time and location of 2-day gathering	Mitch MacKay	Brokenhead, Black River and Hollow Water two day engagement confirmed - Feb 21-22 at South Beach Casino	No	
Brokenhead Ojibway Nation	Engagement/ Relationship building	2-Feb-17	Email	Inbound	Confirmation of date, time and location of 2-day gathering	Mitch MacKay	Brokenhead, Black River and Hollow Water two day engagement confirmed - Feb 21-22 at South Beach Casino	No	

Community	Related Activity	Date of Contact	Communication Medium	Inbound / Outbound	Reason	Employee Log	Other Comments	Follow-up required	Follow up required
Hollow Water First Nation	Engagement/ Relationship building	2-Feb-17	Email	Inbound	Confirmation of date, time and location of 2-day gathering	Mitch MacKay	Brokenhead, Black River and Hollow Water two day engagement confirmed - Feb 21-22 at South Beach Casino	No	
Iskatewizaagegan No.39 Independent First Nation	Follow up phone call re: Engagement/Relationship building	2-Feb-17	Phone Call	Outbound	Initial phone call to gauge interest in the WR-1 project	Christina Blouw	Delores was out of the office until Monday. I indicated that I would call her back then.	No	
Shoal Lake No.40 First Nation	Follow up re: Engagement/ Relationship building	2-Feb-17	Phone Call	Outbound	Follow-up email to gauge interest in the WR-1 project	Christina Blouw	Spoke with reception. Darryl was busy on the phone. I left a message for Darryl to call me back.		
Black River First Nation	Response to Invite to 2 day engagement	6-Feb-17	Email	Outbound	Follow-up on agenda and possible invite to Sagkeeng First Nation	Mitch MacKay		No	
Grand Council of Treaty 3	Engagement/ Relationship building	8-Feb-17	Phone Call	Outbound	Follow up re: organization interest in participating in the WR-1 project	Christina Blouw	Follow up on email sent by Mitch in December. Left message with Emily as Roxanne is travelling to Whitefish today.	No	
Northwest Angle No.33	Engagement/ Relationship building	8-Feb-17	Phone Call	Outbound	Follow up re: engagement	Christina Blouw	Spoke with Darlene. The Kenora office has been closed and the duties/jobs transferred back to the community. Darlene mentioned that I could email her the information and she would pass it along to the appropriate people including the Chief & Council's admin assistant.	Request Mitch to send email to Darlene.	
Grand Council of Treaty 3	Engagement/ Relationship building	9-Feb-17	Phone Call	Inbound	Follow up re: organization interest in participating in the WR-1 project	Christina Blouw	Roxanne left a voicemail for me to call her back		
Manitoba Métis Federation	Engagement/ Relationship building	9-Feb-17	Conference call		Follow up conference call - continued discussion on updates, VC review, land use in project area, coordinating site visit, and site visit discussion	Mitch MacKay	Follow up conference call Feb 9, 1:30-3:30pm		
Northwest Angle No.33	Initial phone call re: Engagement/ Relationship building	9-Feb-17	Email	Outbound	Follow up re: engagement	Mitch MacKay	Sent Darlene an email with attached copy of project intro letter	Call back in a week or so to follow-up	
Black River First Nation	Response to Invite to 2 day engagement	13-Feb-17	Phone	Outbound	Follow-up on agenda and possible invite to AECL	Mitch MacKay	Left a message outlining some of the information provided in emails sent.	No	
Grand Council of Treaty 3	Engagement/ Relationship building	14-Feb-17	Email	Outbound	Follow up re: organization interest in participating in the WR-1 project	Mitch MacKay	Emailed additional project info to Roxanne Meawasige, Communications and Consultations Officer, Territorial Planning Unit tpu.consultation@treaty3.ca re: follow up on additional community engagement. Included links to: Project Overview video, Project Factsheet, Public Engagement Round 1 and 2 posters, project description, and project website.		Follow up in a week or two

Community	Related Activity	Date of Contact	Communication Medium	Inbound / Outbound	Reason	Employee Log	Other Comments	Follow-up required	Follow up required
Grand Council of Treaty 3	Engagement/ Relationship building	14-Feb-17	Phone Call	Outbound	Follow up re: organization interest in participating in the WR-1 project	Christina Blouw	Called Roxanne back, no answer at the GCT#3 office. Will try again later.		
Grand Council of Treaty 3	Engagement/ Relationship building	14-Feb-17	Phone Call	Outbound	Follow up re: organization interest in participating in the WR-1 project	Christina Blouw	Spoke with Roxanne, she would like more project information emailed to her. She is concerned about the nuclear waste management organization on the east side of their communities and would like to know more about the CNL project on the west side of them.	Request Mitch to send more information to Roxanne.	
Wabaseemoong Independent Nations	Follow up phone call re: Engagement/Relationship building	14-Feb-17	Phone Call	Outbound	Follow up re: engagement	Christina Blouw	Called to follow up with Anthony Henry re: faxed information. No answer, left a voicemail		
Black River First Nation	Response to Invite to 2 day engagement	15-Feb-17	Email	Outbound	Follow-up on agenda for Feb 21 and logistics of Site tour Feb 22.	Leah Adams		yes	
Black River First Nation	Response to Invite to 2 day engagement	16-Feb-17	Email	Inbound	Follow-up on agenda for Feb 21 and logistics of Site tour Feb 22.	Leah Adams	Responding to my email for an agenda. Nothing available yet, she is waiting to hear from Patricia Mitchell	no	
Black River First Nation	Response to Invite to 2 day engagement	16-Feb-17	Email	Inbound	Response to my Request for logistics information for site tour.	Leah Adams	Holly responded and said she had to cancel the bus, but we offered to pay for it and to provide lunch on site during the tour.	no	
Iskatewizaagegan No.39 Independent First Nation	Follow up phone call re: Engagement/Relationship building	16-Feb-17	Phone Call	Outbound	Follow-up phone call to gauge interest in the WR-1 project	Christina Blouw	Delores was out of the office doing a house to house survey. I left a voicemail requesting a call back.		
Shoal Lake No.40 First Nation	Follow up re: Engagement/ Relationship building	16-Feb-17	Phone Call	Outbound	Follow-up email to gauge interest in the WR-1 project	Christina Blouw	Spoke with reception. Darryl was busy on the phone. I left a message for Darryl to call me back.		
Black River First Nation	Response to Invite to 2 day engagement	17-Feb-17	Email	Outbound	Requested logistics information for site tour.	Leah Adams		no	
Wabaseemoong Independent Nations	Follow up phone call re: Engagement/Relationship building	16-Mar-17	Phone Call	Outbound	Follow up re: engagement	Christina Blouw	Called to follow up with Anthony Henry re: faxed information.		
Wabaseemoong Independent Nations	Follow up phone call re: Engagement/Relationship building	17-Mar-17	Phone Call	Outbound	Follow up re: engagement	Christina Blouw	Called to see if there was anyone else that I could connect with, no answer at general reception		

Community	Related Activity	Date of Contact	Communication Medium	Inbound / Outbound	Reason	Employee Log	Other Comments	Follow-up required	Follow up required
Manitoba Métis Federation	Follow up on letter	5-Apr-17	Email	Outbound	Confirm receipt of CNL letter response	Mitch MacKay	No response after week	Yes	
Manitoba Métis Federation	Follow up on letter	12-Apr-17	Phone	Inbound	Evan confirmed receipt of letter	Mitch MacKay	Even noted that the MMF were crafting another letter and would hope to have it along shortly. He expressed a desire to continue working together to find a mutual path forward.		
Manitoba Métis Federation	Follow up on letter	12-Apr-17	Phone	Outbound	Confirm receipt of CNL letter response	Mitch MacKay	Left a message to confirm receipt of letter.	Yes	
Black River First Nation	Follow up phone call re: Industry day	20-Apr-17	Phone Call	Outbound	Following up to see if FN need help promoting or level of interest in industry day.	Mitch MacKay	Answering machine full	Yes	
Sagkeeng	Follow up phone call re: Industry day	20-Apr-17	Phone Call	Outbound	Following up to see if FN need help promoting or level of interest in industry day.	Mitch MacKay	Left message on machine.	Yes	
Wabaseemoong Independent Nations	Follow up phone call re: Engagement/Relationship building	28-Apr-17	Phone Call	Outbound	Follow up re: engagement	Christina Blouw	Spoke with Anthony Henry - CNL project was not top of mind. He vaguely remembered he and I speaking in January. I mentioned the May 17th meeting and asked if maybe there was someone else on Council that might know about this or be interested in discussing. Mentioned WIN had received participant funding to participate in this assessment. He mentioned that it might be good to follow up with Marvin Quewezance, the Traditional Land Use Coordinator. Anthony mentioned he would leave a note for Marvin but that he travelled a lot.	I agreed to call back and speak with Anthony re: getting in touch with Marvin. If not able to connect with Marvin through Anthony try emailing him, contact info from WIN TLUA webpage Vincent Quewezance – nvq@live.ca TLUA Coordinator Marvin McDonald – marleeque@outlook.com Resources Information Officer	
Wabaseemoong Independent Nations	Follow up phone call re: Engagement/Relationship building	1-May	Phone Call	Outbound	Follow up re: engagement	Christina Blouw	Left voicemail for Anthony Henry.		
Wabaseemoong Independent Nations	Follow up phone call re: Engagement/Relationship building	1-May	email	Outbound	Follow up re: engagement	Christina Blouw	Emailed both Vincent and Marvin re: Project description and opportunity to participate.		

Community	Related Activity	Date of Contact	Communication Medium	Inbound / Outbound	Reason	Employee Log	Other Comments	Follow-up required	Follow up required
Wabaseemoong Independent Nations	Follow up phone call re: Engagement/Relationship building	2-May	Phone call	Inbound	Follow up re: engagement	Christina Blouw	Marvin left me a voicemail asking for me to give him a call back		
Wabaseemoong Independent Nations	Follow up phone call re: Engagement/Relationship building	2-May	Phone call	Outbound	Follow up re: engagement	Christina Blouw	Spoke with Marvin he is very interested in the email I sent him yesterday, we discussed the Project and the May 17th meeting briefly. He was aware that the community had applied for participant funding and seems to remember Darren Harper, a community member who often helps pull together proposals for funding, mentioning this Project to him last fall. Marvin will connect with Darren and see if he is still the contact for this community initiative and get back to me. One way or another Marvin was very interested in attending the May 17th meeting here in Manitoba.		
Wabaseemoong	Follow up email after 2017 May 18 Meeting	19-May-17	Email	Inbound	Marvin following up on a tour for Chief and Council	Mitch MacKay		Yes	
Wabaseemoong	Responding to Marvin's email	23-May-17	Email	Outbound	Suggesting dates for next tour	Mitch MacKay		Yes	
Sagkeeng	Follow up email after 2017 May 18 Meeting	25-May-17	Email	Outbound	Getting Myles up to speed on 2017 May 18 meeting and suggesting possible dates for tour and industry day	Mitch MacKay		Yes	
Sagkeeng	Follow up to email from Myles	25-May-17	Email	Inbound	Myles has asked Lana Lavadier to schedule with council	Mitch MacKay		Yes	
Manitoba Métis Federation	Follow up on engagement next steps	6-Jun-17	Phone	Outbound	Begin to schedule next round of engagements	Mitch MacKay		Yes	
Manitoba Métis Federation	Follow up on engagement next steps	12-Jun-17	Phone	Outbound	Begin to schedule next round of engagements	Mitch MacKay		Yes	
Sagkeeng	Coordinating site visit and industry day	14-Jun-17	Phone	Outbound	Discussion of logistics around site visit and Industry day	Mitch MacKay		No	
Wabaseemoong	Coordinating site visit	14-Jun-17	Phone	Outbound	Discussion of logistics around site visit	Mitch MacKay		No	
Manitoba Métis Federation	Follow up on engagement next steps	15-Jun-17	Phone	Inbound	Confirmation that the MMF is busy scheduling a leadership meeting	Mitch MacKay	Confirmed CNL's commitment to help with any and all aspect of meeting including monetary.	Yes	

Canadian Nuclear Laboratories | Laboratoires Nucléaires Canadiens

ENVIRONMENTAL IMPACT STATEMENT FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE
SECTION 6.1: ENVIRONMENTAL ASSESSMENT APPROACH
REVISION 1

APPENDIX 6.1-1

Project-Environment Interactions Matrix

Table 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 and Ecological Health	Human Health	
		Air Quality	Greenhouse Gases	Geology	Groundwater Quantity and Quality	Hydrology	Surface Water Quality	Fish and Fish Habitat	All VCs	All VCs	Worker	Public
Closure	General closure activities, including preparation for In Situ, grouting of below grade structures and systems, and removal of above grade WR-1 structures and systems.	■		●			●(a)	●(a)	●(a)	●	●■	●■
	Vehicle and equipment use on-site.	■	●						●(a)	●		
	Construction and operation of temporary supporting infrastructure during decommissioning (e.g., batch mixing plant for preparation of grout).			●					●(a)			
	Installation of the final 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 solutes 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 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 Tourism and Recreation	Cultural and Archaeological Sites	Traditional Land and Resource Use by Aboriginal People	Winnipeg River	Employment and Income	Business Opportunities	Government Finances	Community Services and Infrastructure	Community Well-Being	Public Safety
Closure and Post-closure Phase	General closure activities, including preparation for In Situ, grouting of below grade structures and systems, and removal of above grade WR-1 structures and systems.	●(a)	●(a)	●	●(a)	●(a)	●	●	■	■	■	●
	Installation of the final cover system, restoration and grading of the 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.

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 6.2.1.3.1 Spatial Boundaries of the EIS, the 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 rectangle that includes the SSA and the WL site. The 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-kilometre (km) by 12-km rectangle surrounding the LSA, centered on the WL Site. The SSA, LSA and RSA are presented in 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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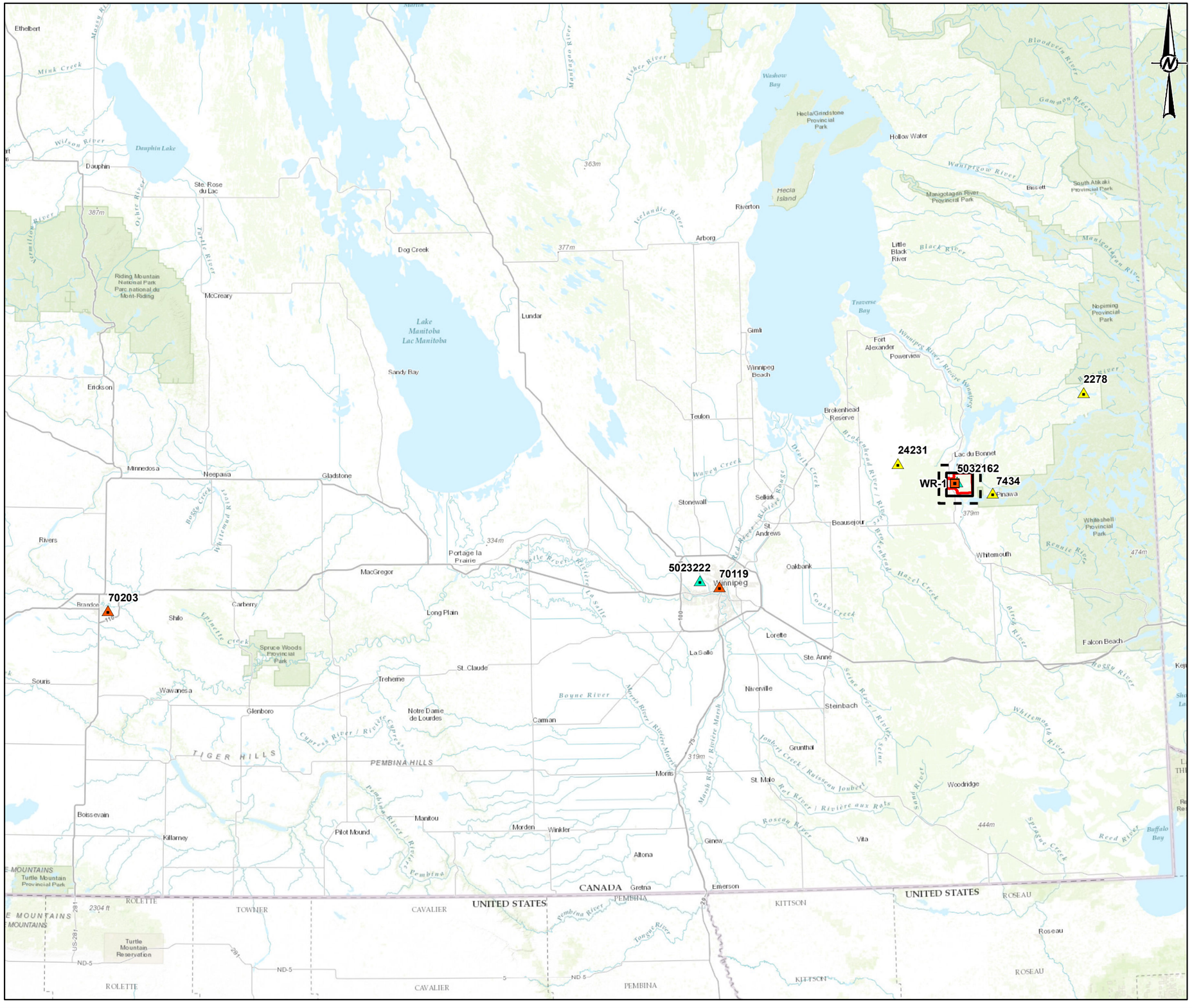

LEGEND

- WR-1
- METEOROLOGY STATION
- NAPS STATION
- NPRI FACILITY
- SITE STUDY AREA (WHITESHELL LABORATORIES SITE)
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

BASE FEATURES

- MAJOR ROAD
- WATERCOURSE
- WATERBODY

NAPS STATIONS:

NAPS ID	NAPS Station Location	NAPS Station Name
70119	Winnipeg	65 Ellen Street
70203	Brandon	Assiniboine Community College

METEOROLOGY STATIONS:

Station ID	ECCC Meteorological Station Name
5032162	Pinawa WNRE
5023222	Winnipeg Richardson International Airport

NPRI FACILITIES:

NPRI ID	Company Name	Facility Name
7434	Canadian Nuclear Laboratories	Whiteshell Laboratories
24231	Lehigh Hanson Materials Ltd.	Glacier Quarry
2278	Tantalum Mining pf Canada	Bernic Lake Minesite

0 25 50 75
1:1,250,000 KILOMETRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. PROJECT DATA - CNL, 2016
3. TOPOGRAPHIC MAP - SOURCES: ESRI, HERE, DELORME, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISSTOPO, MAPMYINDIA, © 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
Golder Associates

YYYY-MM-DD	2017-09-13
DESIGNED	CGE
PREPARED	CGE/PR
REVIEWED	KL/CST
APPROVED	CS

PROJECT NO. 1656897 | CONTROL | REV. 1 | FIGURE **1**

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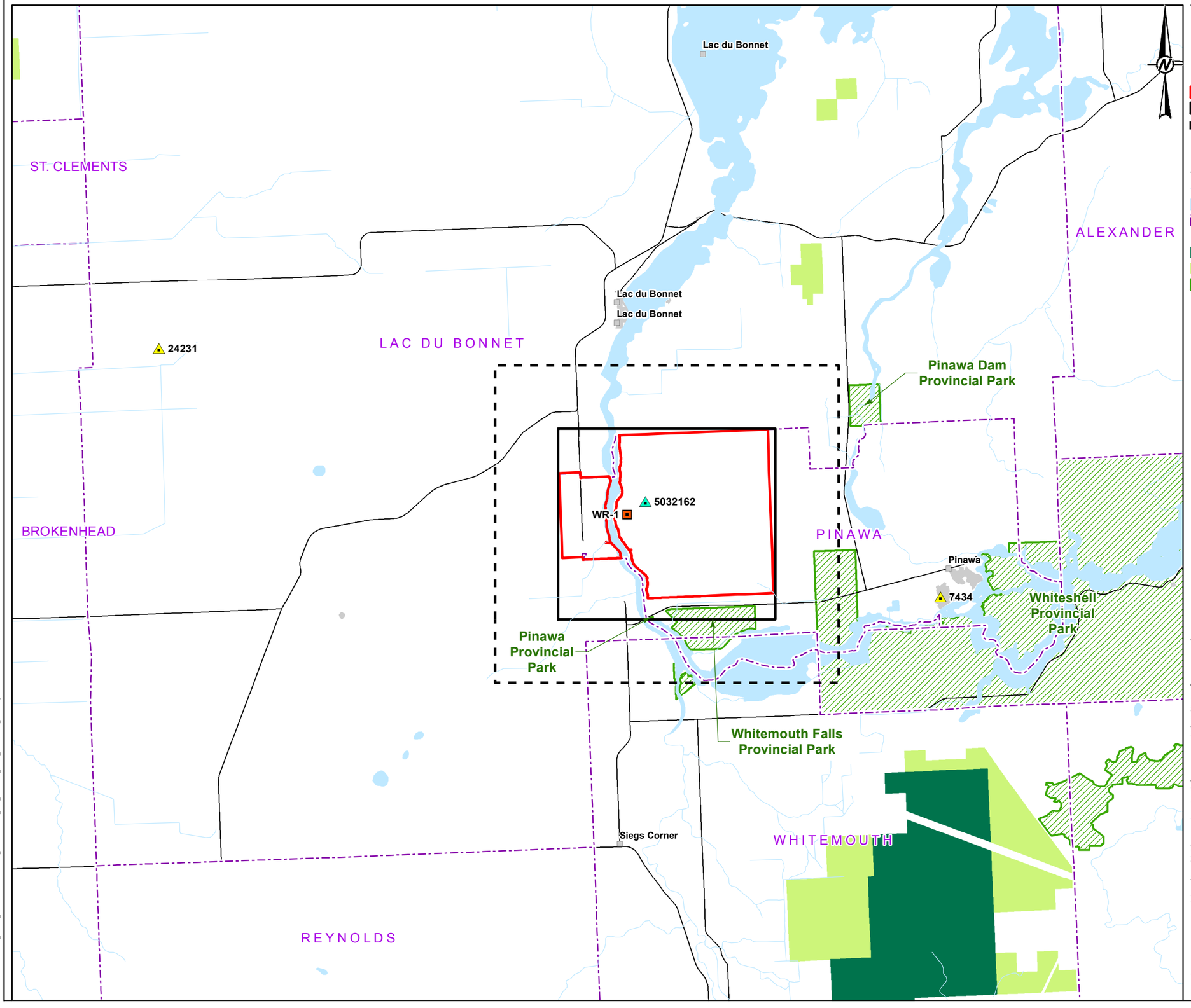

LEGEND

- WR-1
- METEOROLOGY STATION
- NAPS STATION
- NPRI FACILITY
- SITE STUDY AREA (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. PROJECT DATA - CNL, 2016
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
AIR QUALITY ASSESSMENT - SPATIAL BOUNDARIES

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-09-13
DESIGNED	CGE
PREPARED	CGE
REVIEWED	KL
APPROVED	CS

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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 the REGDOC-2.9.1, for the characterization of the atmospheric baseline environment (CNSC 2017).

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 Appendix 10-1 Climate Change. 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 Richardson International Airport (Winnipeg), 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 RICHARDSON INT'L A[(a)]	5023222	104.45 SW	239	1981 – 2010

Note:
a) ECCC 2016a.
b) Normal period as defined by ECCC.

Table 2: Availability of Climate Normals for Meteorological Parameters at the Climate Stations

	Available Parameter						
Station Name	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 RICHARDSON INT'L A	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note:
a) Some data is available but there is insufficient data for a climate normal.as per the Environment Canada 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. While the Pinawa 503B1ER station has hourly meteorological data for all parameters, the data is 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 station was used for the unavailable parameters. As discussed below, the Winnipeg 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 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

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

Note:

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 Richardson International Airport Station Climate Normals

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

Note:

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 Station Climate Normals

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.

Table 6: Seasonal Precipitation Summary for the Pinawa WNRE Station Climate Normals

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 station are shown in Table 7 and Table 8, respectively. The Winnipeg Richardson International 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 Station Climate Normals

Month	Rainfall (mm)	Snowfall (cm)	Total Precipitation (mm[eq]) [(a)]	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 = millimetres; cm = centimetres; mm[eq] = millimetres equivalent.

Table 8: Seasonal Precipitation Summary for the Winnipeg Station Climate Normals

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 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 Richardson International Airport station is provided in Table 9. Winds were from the south at the Winnipeg Richardson International Airport station, with an annual average wind speed of 17 kilometres per hour (km/h).

Table 9: Monthly Wind Meteorology Data from the Winnipeg Station Climate Normals

Month	Season	Average Wind Speed (km/h)	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

km/hr = kilometres per hour; 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 in Figure 3, there is variation in the annual wind speeds and direction in the area around 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 metres per second (m/s). Some “model calms” were identified, these are defined as hours having a wind speed less than 3.6 km/h or 1 m/s. Winds from the south were generally of lower wind speeds than winds from the northwest.

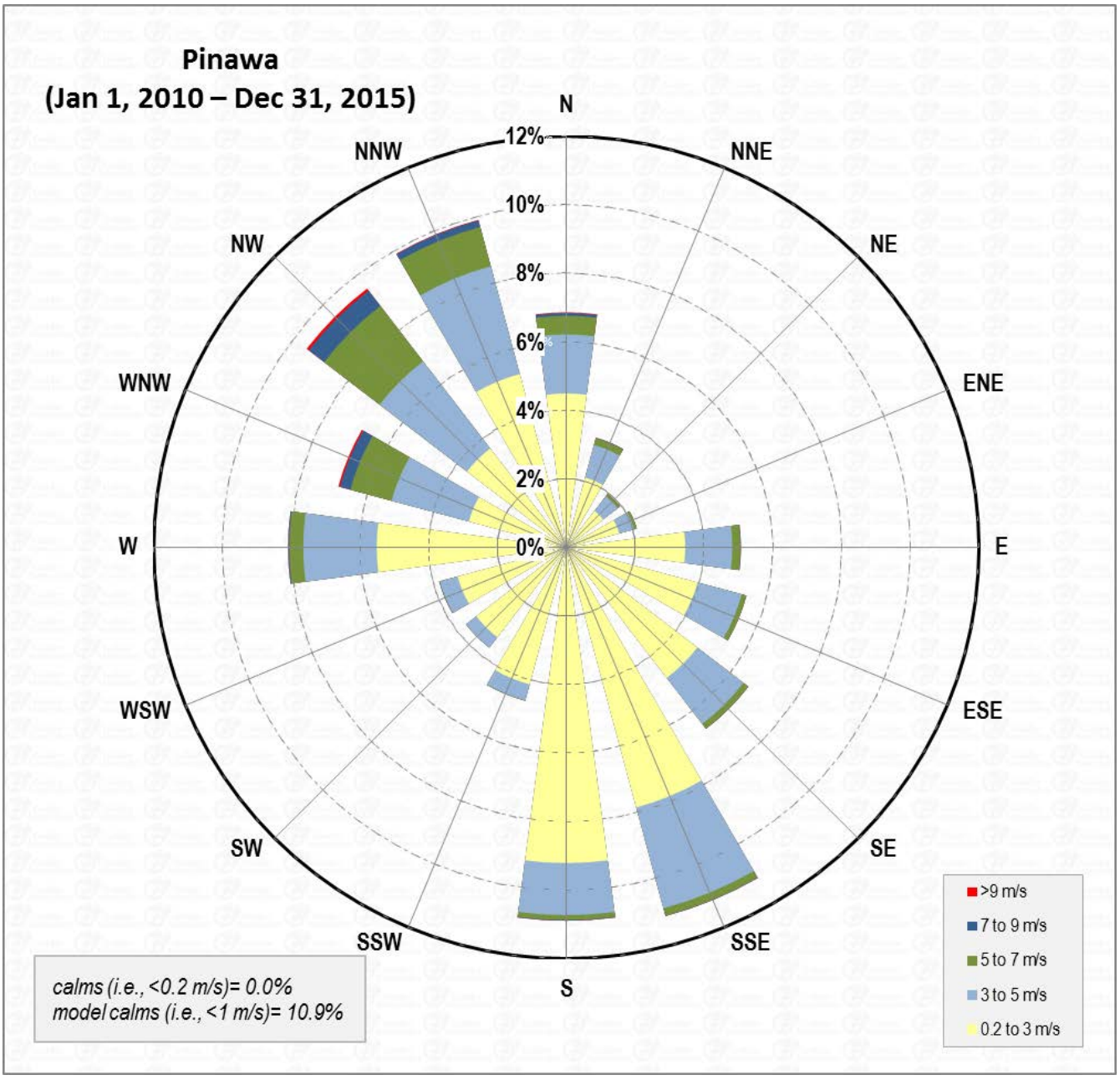

Figure 3: Annual Wind-Rose for the Pinawa Station (January 2010 to December 2015)

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 Richardson International Airport station recorded for 6:00 a.m. and 3:00 p.m. local time. Although the Winnipeg Richardson International 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 Climate Normals

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**

% = percent.

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 station is presented in Table 11. Although the Winnipeg 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 Station Climate Normals

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 is 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 ($kWh/m^2/d$)
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**

$kWh/m^2/d$ = kilowatt-hour per meter squared 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 the 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 the *Manitoba Ambient Air Quality Criteria* (AAQC) document (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; discussed below). 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 impacts, 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) document (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 NPRI 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.

km = kilometre; 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 Environment and Climate Change Canada (ECCC) National Air Pollution Surveillance Network (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). The Winnipeg (65 Ellen Street) monitoring station was the only air quality monitoring station located within 100 km of the Project[1]. The Winnipeg (65 Ellen Street) monitoring station includes all indicator compounds with the exception of SPM. The Winnipeg (65 Ellen Street) monitoring 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 fresh water 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 fresh water 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) and includes all indicator compounds with the exception of CO, SO_2 and SPM. The Brandon Station (Assiniboine Community College) 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 impacted by local sources and not on remote un-impacted areas like the WL site. Therefore for the Project, the Winnipeg (65 Ellen Street) monitoring 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 Brandon (Assiniboine Community College) monitoring station is farther away and has less indicator compounds compared to the Winnipeg (65 Ellen Street) monitoring station, it was selected to be included in the background air quality assessment for comparison to the Winnipeg (65 Ellen Street) monitoring station. Its geographical siting is not as remote as the Project, has little influence from water bodies, is located within an industrial setting and is not considered to be as representative as the Winnipeg 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., Winnipeg [65 Ellen Street] and Brandon Station [Assiniboine Community College]) 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, which is the most recent five year period at the time of this assessment for which all data is available and quality assured by Environment Canada.

[1] The second monitoring station in Winnipeg was not selected for this assessment as it monitors less

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.

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.

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

Compound	Winnipeg Station (65 Ellen Street)	Brandon Station (Assiniboine Community College)
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 (Alberta Environment 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 the vast majority 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 Winnipeg and Brandon 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 Winnipeg monitoring station (65 Ellen Street); however, the maximum monitored PM_{10} data is above the AAQC at the Brandon station (Assiniboine), as shown on Figure 4. As discussed above, the Brandon 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 Winnipeg station.

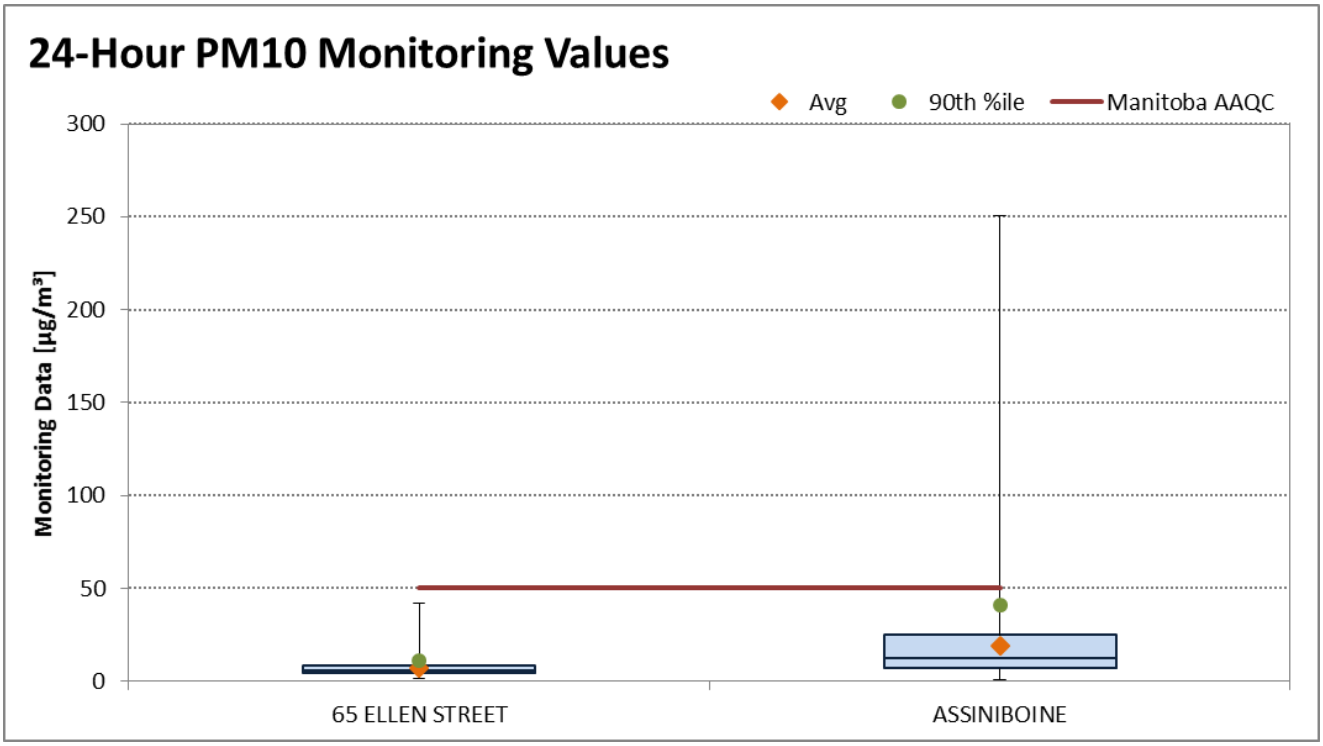

Figure 4: PM_{10} Monitoring Data for 2009 through 2013

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 the Winnipeg station (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 Winnipeg monitoring station, there were no periods of three consecutive years with monitored data after 2008. The Brandon monitoring 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 was calculated to be 6.64 µg/m³.

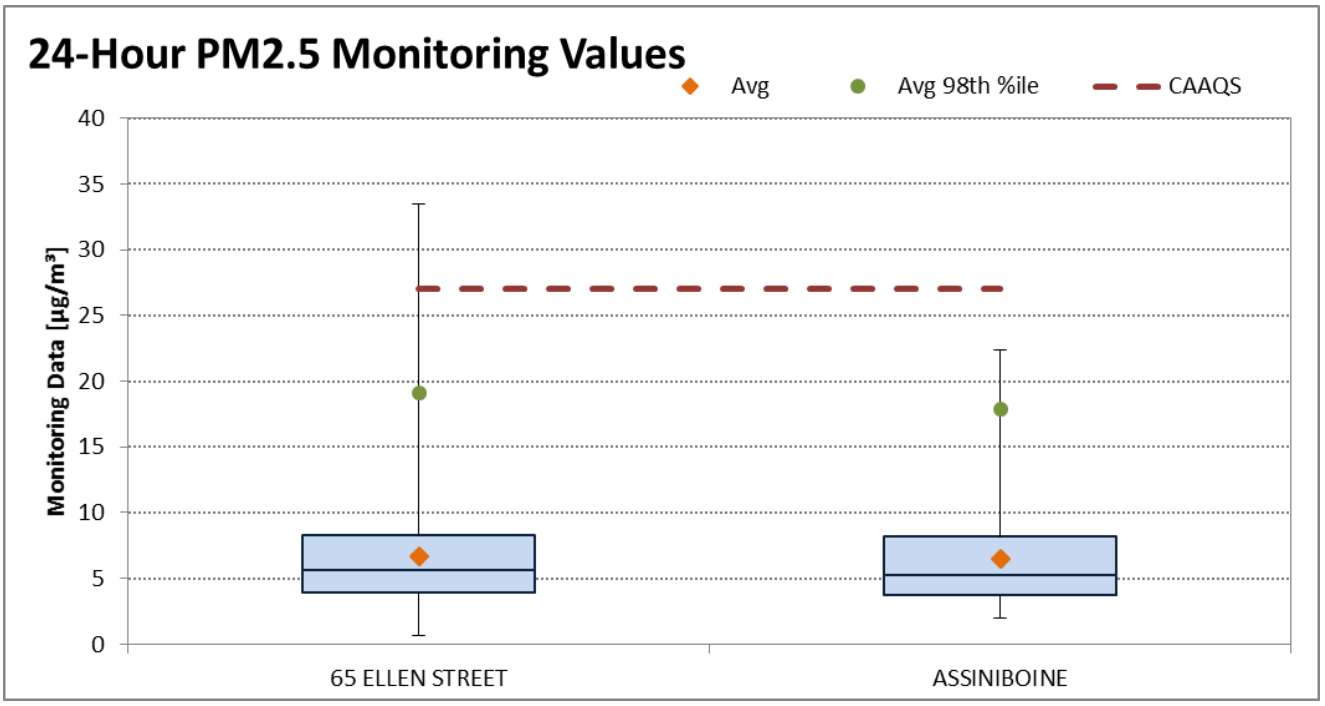

Figure 5: $PM_{2.5}$ Monitoring Data for 2013

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).

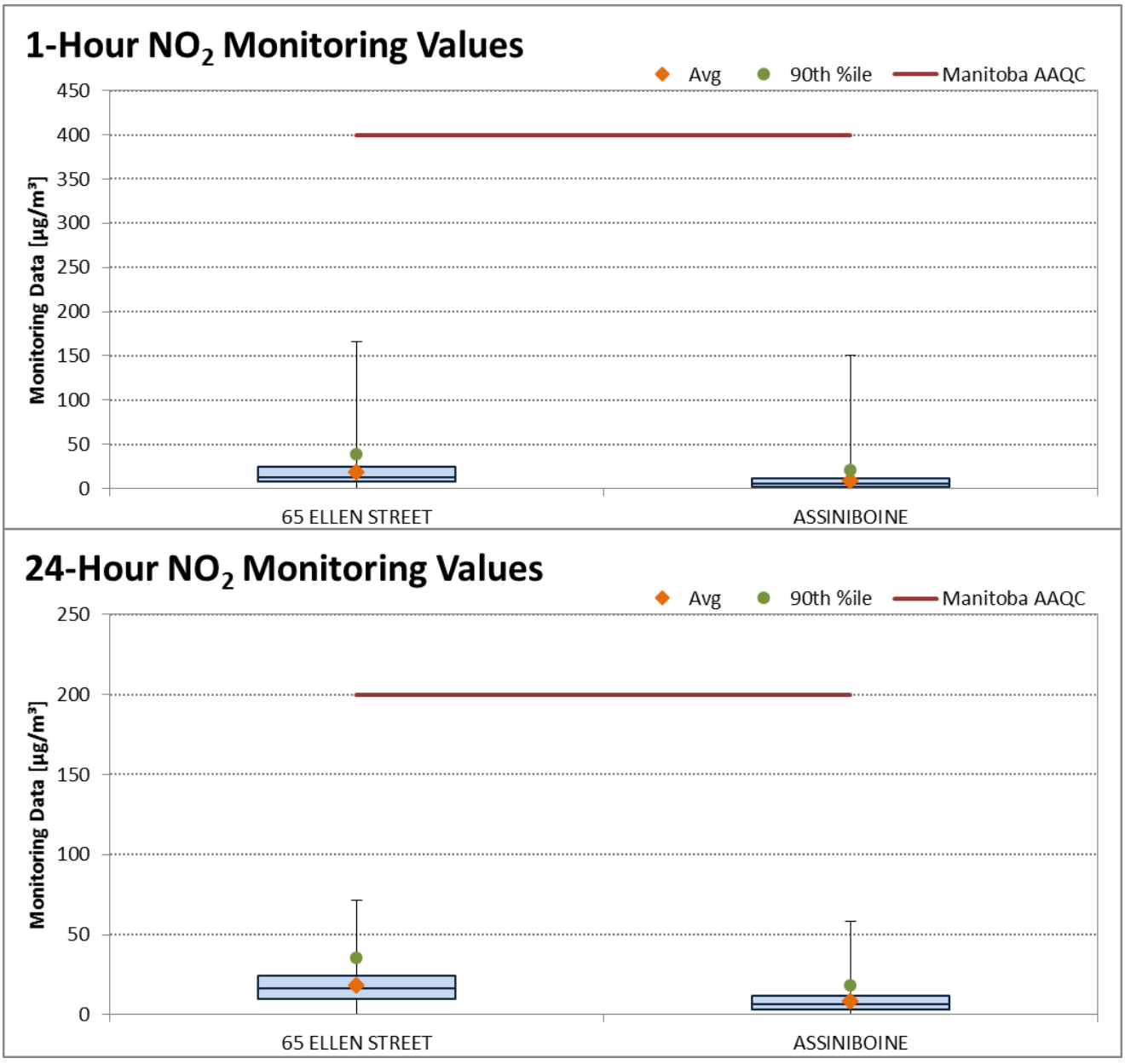

Figure 6: NO_2 Monitoring Data for 2009 through 2013

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 Brandon station (Assiniboine), no SO_2 values above the 1-hour or 24-hour AAQC (Desirable Level) for SO_2 were recorded at the Winnipeg station (65 Ellen Street) between 2009 and 2013.

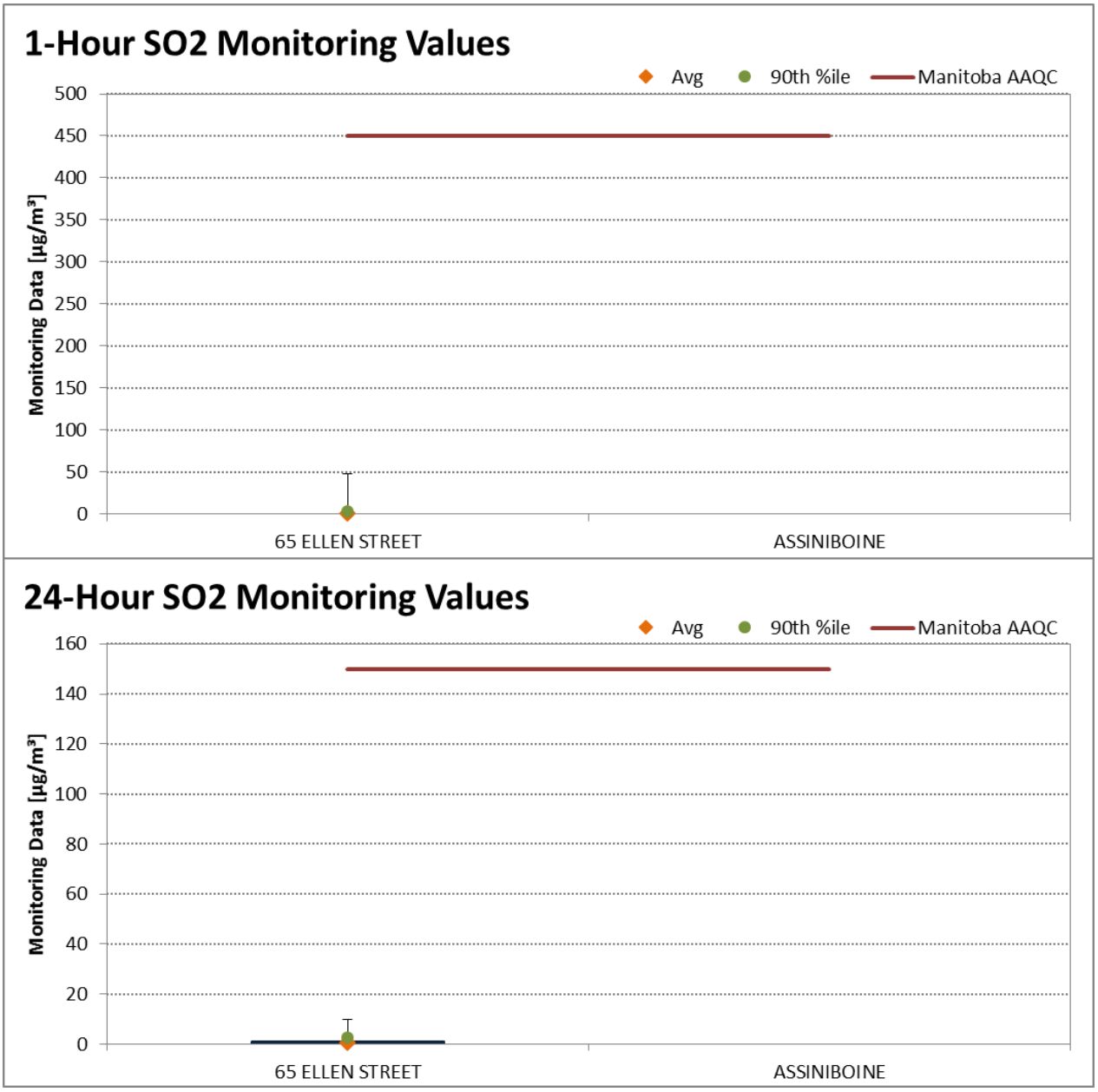

Figure 7: SO_2 Monitoring Data for 2009 through 2013

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 Brandon station (Assiniboine), there were no values above the 1-hour or 8-hour AAQC (Desirable Level) for CO recorded at the Winnipeg station (65 Ellen Street) between 2009 and 2013 (Figure 8).

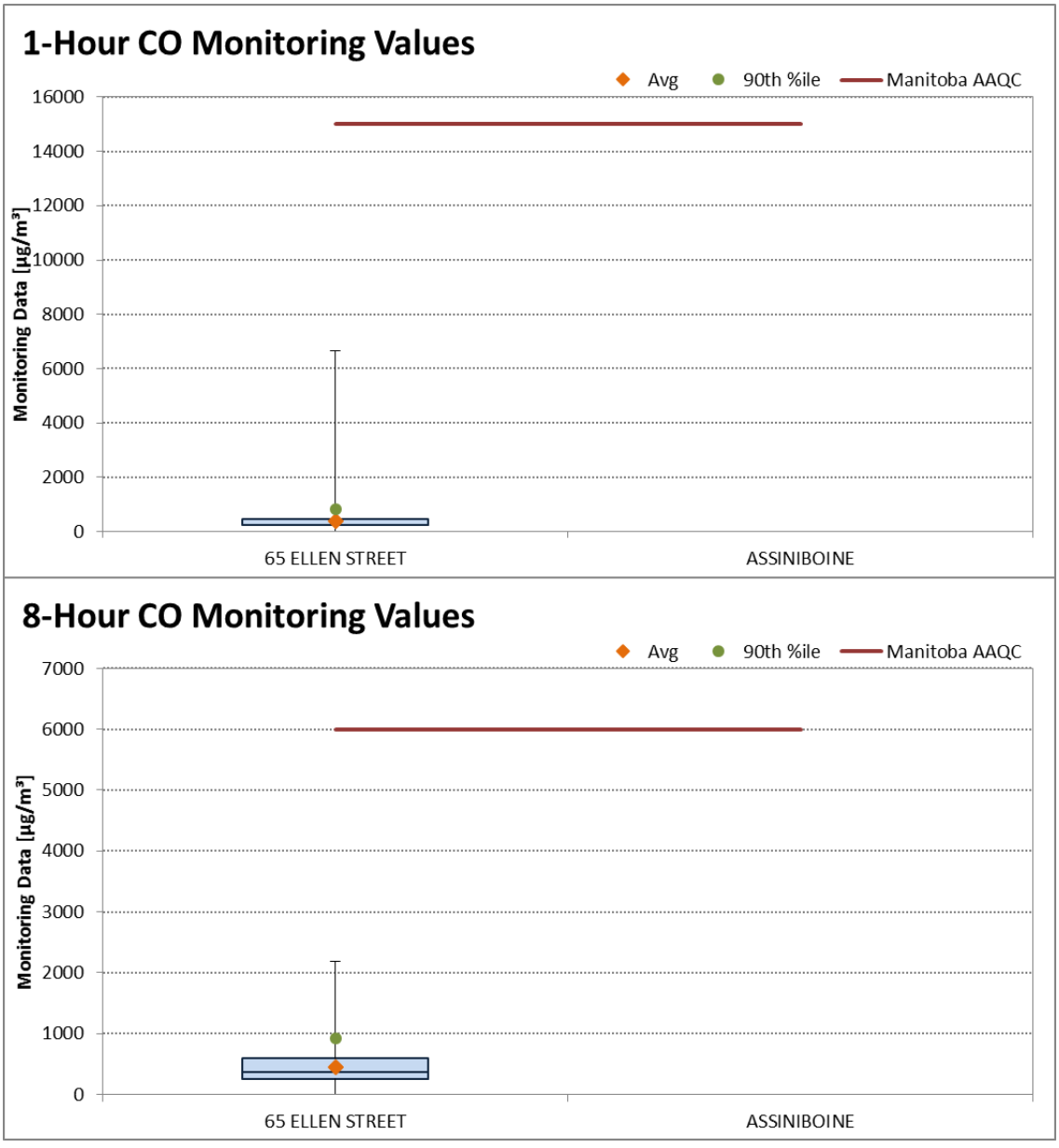

Figure 8: CO Monitoring Data for 2009 through 2013

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 in 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 Winnipeg station (65 Ellen Street) and Brandon station (Assiniboine) 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 Winnipeg station (65 Ellen Street), but was just below this standard at the Brandon station (Assiniboine). 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 – to 2013) average 4th highest concentrations were below the CAAQS. Table 17 presents a summary of the 3-year averaging methodology 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 station are located 84 km and 280 km from the WL site in urban settings with higher NO_X and volatile organic compounds (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; Brandon station (Assiniboine) it is not considered to be as representative of the WL site as the Winnipeg station, as previously described, and was not retained for the baseline assessment.

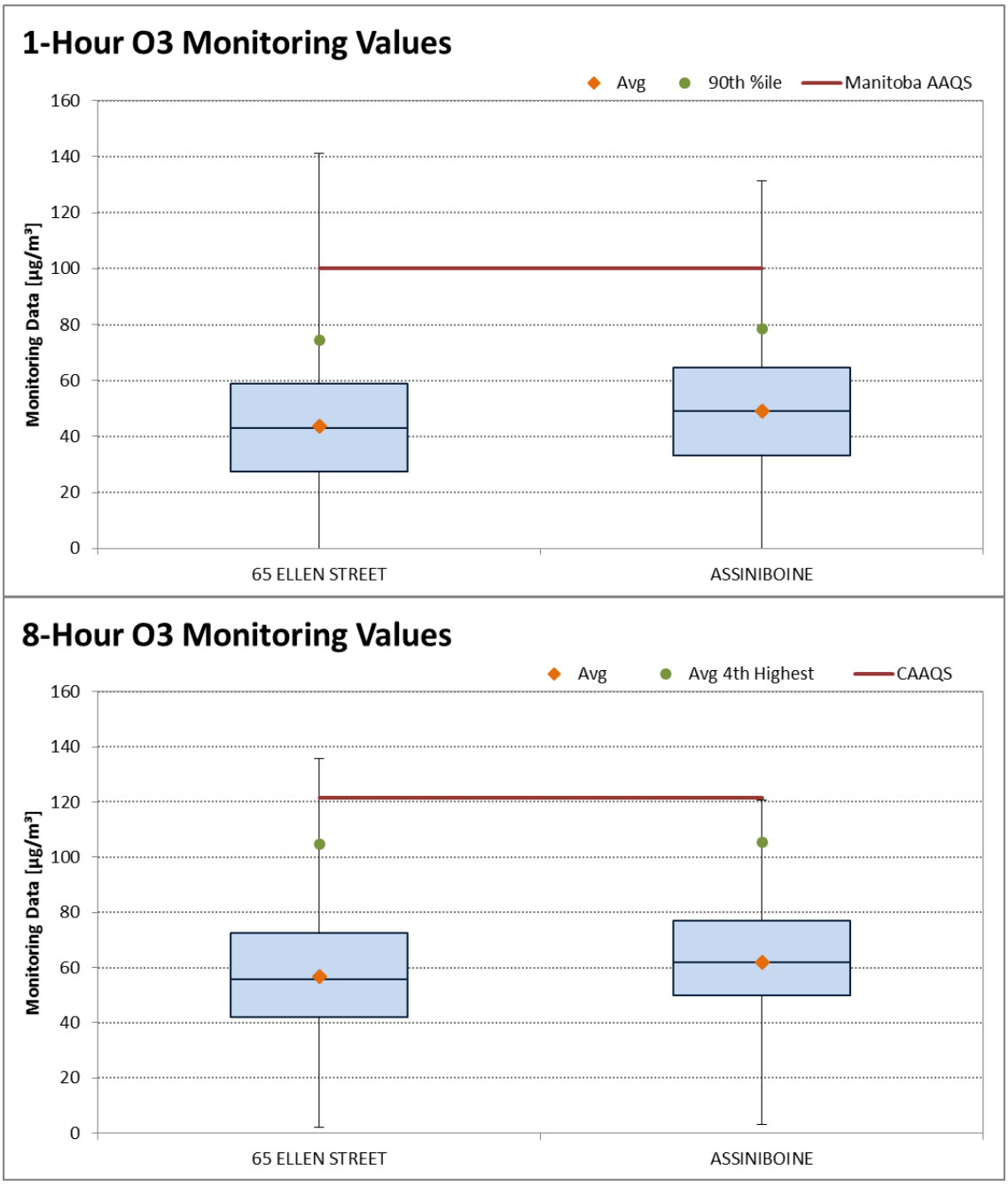

Figure 9: *O_3 Monitoring Data for 2009 through 2013*

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 Winnipeg (65 Ellen Street) and Brandon (Assiniboine) monitoring 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 station are summarized in Table 18 and Table 19.

Table 18: Summary of Background Air Quality at the Winnipeg Station (65 Ellen Street) (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 Brandon Station (Assiniboine) (2009 – 2013)

Indicator	Averaging Period	Average (µg/m³)[a]	75th (µg/m³)[a]	90th (µg/m³)[a]	Max (µg/m³)[a]
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 Winnipeg station (65 Ellen Street) 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 Winnipeg 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 Brandon (Assiniboine) Station was not retained for the background value as it is not considered to be as representative of the WL site as the Winnipeg station. The background air quality values retained for the assessment are presented below in Table 20 and are based on the Winnipeg monitoring 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	Winnipeg Station (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 (WL) 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 (CNSC 2017). Scientifically accepted by Manitoba Sustainable Development (Draft Guidelines) and well-documented emission factors, such as AP-42 from the United States Environmental Protection Agency (U.S. 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 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 U.S. 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. 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 phases 1 to 3, and therefore, the emissions and associated effects during these phases 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 Decommissioning	2019-2021	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	2021	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	2021-2022	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 engineered cover over grouted WR-1 Building	2022-2023	4.1	Installation of engineered cap and barrier	N(2)	—	—	—	—	—	—	—
					—	—	—	—	—	—	—
		4.2	Grading of area	N(2)	—	—	—	—	—	—	—
					—	—	—	—	—	—	—
		4.3	Installation of drainage measures	N(2)	—	—	—	—	—	—	—
					—	—	—	—	—	—	—
5 Final site restoration	2023	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	2024	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.

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 methodology described in the guidance documents for the 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 GHG assessment. This is consistent with the Greenhouse Gas Reporting Program 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 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.

3.0 ASSUMPTIONS

Table 4 documents the assumptions made as part of the estimation of non-radiological indicator compounds and GHG emission rates.

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	12	hr/day	CNL
	General Daily Schedule	10	hr/day (maximum)	CNL
		7.5	hr/day (average)	CNL
	Batch Mixing Plant Annual Schedule	50	days/year	Assumed
Project Stages				See table below
Batch Mixing Plant				
Grout	Grout Throughput	200	m³/day (maximum)	CNL
		125	m³/day (average)	CNL
	Grout Density	560	kg/m³ (maximum value)	IAEA Document provided by CNL (http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/44/122/44122428.pdf)
		480	kg/m³ (minimum value)	IAEA Document provided by CNL (http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/44/122/44122428.pdf)
	Grout Composition			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. This information was obtained from the IAEA Document provided by CNL (http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/44/122/44122428.pdf)
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 Decommissioning	2019-2021	3
2	Grouting of below-grade structures and systems	2021	1
3	Removal of above-grade WR-1 structures and systems	2021-2022	2
4	Installation of engineered cover over grouted WR-1 Building	2022-2023	2
5	Final site restoration	2023	1
6	Preparation for Institutional Control	2024	1
Project Description (WLDP-03700-ENA-001) pg. 3-12			

Grout Composition

Raw Material	Material [kg/m³]	% Composition
Cement	89	4%
Fly Ash	297	13%
Sand	1097	50%
Gravel	475	22%
Water	247	11%

Table 4: Air Quality and Greenhouse Gas Emissions Assessment Assumptions List

Activity	Data Sources / Assumptions			
	Parameter	**Value**	**Unit**	**Source / Assumption**
Raw Material	Silt Content	Varies	Based on raw material	**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
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	15,000	m³/year (expected)	CNL
		60	m³/day (expected)	
		42	tonne/day (maximum)	25% greater than CNL's prediction
		22	tonne/day (average)	25% less than CNL's prediction
	Grout Moisture Content	11	%	US EPA AP-42 Section 13.2.4, mean silt loading for Municipal solid waste landfills - misc. fill materials

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	177.60	m³/day (max)	3.7
				111.00	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 engineered cap 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.

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.

4.0 CALCULATIONS

The emission calculations expected during the closure phase were estimated as per REGDOC-2.9.1 (CNSC 2017), 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 and SO_2. 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_2e) per year, as required under the assessment frameworks discussed in Section 4.2.5.

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 methodology and emission factors, such as AP-42 from the U.S. 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 U.S. EPA document entitled *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources* (AP-42) (U.S. EPA 1995). Equations documented in AP-42 Section 13.2.4 – Aggregate Handling and Storage Piles (U.S. EPA 2006a). 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 U.S. 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.

$$\text{Emission Rate} = 3.19\text{E}-04\ \frac{\text{kg}}{\text{Mg}} \times \frac{42\ \text{Mg}}{\text{day}} \times \frac{1\ \text{day}}{24\ \text{hr}} \times \frac{1\ \text{hr}}{3{,}600\ \text{s}} \times \frac{1{,}000\ \text{g}}{1\ \text{kg}}$$

$$\text{ER} = 1.55\text{E}-04\ \frac{\text{g}}{\text{s}}$$

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:

$$\text{Emission Rate} = 0.42\frac{\text{ton}}{\text{acre} - \text{month}} \text{ x } 907{,}185\frac{\text{g}}{\text{ton}} \text{x } \frac{1 \text{ acre}}{0.004 \text{ km}^2} \text{ x } 0.0034 \text{ km}^2 \text{x } \frac{1 \text{ month}}{20 \text{ days}} \text{ x } \frac{1 \text{ day}}{24 \text{ hr}} \text{ x } \frac{1 \text{ hr}}{3{,}600 \text{ s}}$$

$$\text{Emission Rate} = 0.0.18 \frac{\text{g}}{\text{s}}$$

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) – U.S. 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} 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 (U.S. 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 U.S. 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)

Table 6: MOBILE 6.2C Inputs

External Conditions	Input
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

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.

[1] Federal Sulfur in Diesel Fuel Regulations and the Fuels Information Regulations.

Table 7: Emission Factors for Fleet Trucks Calculated Using MOBILE6

Compound	Emission Factor (g/VKT)
SPM	4.46E-02
PM_{10}	4.46E-02
$PM_{2.5}$	2.65E-02
NO_X	1.23E+00
SO_2	8.14E-03
CO	6.46E-01

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 kilometers travelled on one segment (P1) of the paved roads:

$$\text{Daily Vehicle Kilometers Travelled} = \frac{20 \text{ Trucks}}{\text{Hour}} \times 2\frac{\text{passes}}{\text{road}} \times 3.7 \text{ km}$$

$$\text{Daily Vehicle Kilometers Travelled} = 148\frac{\text{VKT}}{\text{day}}$$

Each of the road segments P1 to P4 and were calculated using the equation above. The road segments are presented in 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.

$$\text{Emission Rate} = 4.46\text{E}-02 \frac{\text{g}}{\text{VKT}} \times 148\frac{\text{VKT}}{\text{day}} \times \frac{1 \text{ day}}{24 \text{ hr}} \times \frac{1 \text{ hr}}{3{,}600 \text{ s}}$$

$$\text{Emission Rate} = 7.63\text{E}-05\frac{\text{g}}{\text{s}}$$

The SPM, PM_{10} and $PM_{2.5}$, SO_2, and CO were calculated using the same equation.

4.1.4 On-Road Vehicles – Paved Road Dust

The U.S. 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 U.S. EPA AP-42 Section 13.2.1-3, silt loading for concrete batching)
W = average weight (tons) of the vehicles traveling 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 42.1 tons.

$$\text{Emission Factor} = (3.23 \times (12)^{0.91} \times (42.1)^{1.02})$$

$$\text{Emission Factor} = 1{,}405.5 \frac{\text{g}}{\text{VKT}}$$

The emission rate of particulates was calculated according to the following equation.

$$\text{Daily Emission Rate } [\frac{\text{g}}{\text{s}}] = \text{Emission Factor } [\frac{\text{g}}{\text{VKT}}] \times \text{Daily Vehicle Kilometers Travelled } [\frac{\text{VKT}}{\text{day}}] \times (100\% - \text{Control Efficiency}) \times \text{Conversion Factors}$$

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:

$$\text{Emission Rate} = 1{,}405.5 \frac{\text{g}}{\text{VKT}} \times 148 \frac{\text{VKT}}{\text{day}} \times (100\% - 75\%) \times \frac{1 \text{ day}}{24 \text{ hr}} \times \frac{1 \text{ hr}}{3600 \text{ s}}$$

$$\text{Emission Rate} = 0.60 \text{ g/s}$$

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 50 to 200 cubic metres (m^3) of grout per day. The maximum scenario, is therefore, considered to have a throughout of 200 m^3/day and the average scenario is considered to have a throughput of 125 cubic metres per day (m^3/day). Based on a maximum material density of 560 kilograms per cubic metre (kg/m^3), these throughputs are 112 tonne/day and 70 tonne/day, respectively.

Emission factors for SPM and PM_{10} were obtained from US EPA AP-42 Chapter 11.12 – Concrete Batching, Table 1 (U.S. EPA 2006a). 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 (U.S. EPA 2006a).

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:

$$\text{Daily SPM Emission Rate} = 1.05\text{E}-03\,\frac{\text{kg}}{\text{Mg}} \times 112\,\frac{\text{tonne}}{\text{day}} \times \frac{1000\text{ g}}{1\text{ kg}} \times \frac{1\text{ day}}{24\text{ hr}} \times \frac{1\text{ hr}}{3{,}600\text{ s}}$$

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 on a typical composition of structural fill grout PR-ZB-FF-8-D (uncongested dry area placements; Langton et. al 2010). The mean moisture content for the raw material was based on US EPA AP-42 Chapter 13.2.4 (Table 1; U.S. EPA 2006a). 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/m³)(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	1097	50%	7.4	Sand
Gravel	475	22%	0.7	Crushed Limestone
Water	247	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 4.1.1.1. 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.

$$\text{Emission Factor} = 0.74 \times 0.0016 \times \frac{\left(\frac{5.0}{2.2}\right)^{1.3}}{\left(\frac{2.1}{2}\right)^{1.4}}$$

$$\text{Emission Factor} = 3.25\text{E}-03\,\frac{\text{kg}}{\text{Mg}}$$

$$\text{Emission Rate} = 3.25\text{E}-03\,\frac{\text{kg}}{\text{Mg}} \times 3.9\,\frac{\text{Mg}}{\text{day}} \times \frac{1\text{ day}}{24\text{ hr}} \times \frac{1\text{ hr}}{3{,}600\text{ s}} \times \frac{1{,}000\text{ g}}{1\text{ kg}}$$

$$\text{ER} = 4.37\text{E}-05\,\frac{\text{g}}{\text{s}}$$

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 U.S. 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 U.S. EPA AP-42 Chapter 3.3 – Gasoline and Diesel Industrial Engines (U.S. 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 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). 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 Environment and Climate Change Canada 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 methodology 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 methodology for calculating CO_2, CH_4 and N_2O emissions from mobile equipment:

$$\text{Emissions}\left[\frac{\text{tonnes}}{\text{yr}}\right] = \text{BSFC}_{i,k}\left[\frac{\text{lb}}{\text{hp}-\text{hr}}\right] \times \text{h}_{pi,k}\,[\text{hp}] \times \text{h}_{i,k}\left[\frac{\text{hr}}{\text{yr}}\right] \times \text{LF}_{i,k} \times \text{Daily \# of Units} \div \text{Diesel Density}\left[\frac{\text{kg}}{\text{L}}\right] \times \text{EF}_{i,CO2}\left[\frac{\text{g}}{\text{L}}\right] \times \text{Conversion Factors}$$

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 (U.S. 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, 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 methodology 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:

$$\text{Emissions}_{CO_2} = 1.58\frac{\text{GJ}}{\text{hr}} \times 5\frac{\text{hr}}{\text{day}} \times 250\frac{\text{days}}{\text{yr}} \times 63{,}100\ \frac{\text{kg}}{\text{TJ}} \times \frac{1\ \text{tonne}}{1{,}000\ \text{kg}} \times \frac{1\ \text{TJ}}{1\ \text{GJ}}$$

$$\text{Emissions}_{CO_2} = 124.8\ \frac{\text{tonnes}\ CO_2}{\text{yr}}$$

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 Project's 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 Decommissioning	2019-2021	1.1	Create pathways between rooms	Non-road Equipment Exhaust	4.38E-03	4.38E-03	4.24E-03	7.29E-02	1.46E-04	2.46E-02
		1.2	Batch mixing plant (temporary)	Process	6.63E-02	1.83E-02	4.75E-03	—	—	—
				Non-road Equipment Exhaust	2.08E-03	2.08E-03	2.02E-03	4.08E-02	4.81E-05	2.05E-02
				Raw Material Handling	1.22E-03	5.79E-04	8.77E-05	—	—	—
				Road Exhaust	7.63E-05	7.63E-05	4.53E-05	2.11E-03	1.39E-05	1.11E-03
				Paved Roads	6.02E-01	1.16E-01	2.80E-02	—	—	—
				Propane Combustion	4.13E-04	4.13E-04	4.13E-04	2.69E-02	3.10E-03	1.55E-02
2 Grouting of below-grade structures and systems	2021	2.1	Fill below-grade areas with grout according to engineered fill schedule (multiple lifts of grouting pours)	Non-road Equipment Exhaust	7.88E-03	7.88E-03	7.64E-03	1.31E-01	2.62E-04	4.26E-02
				Material Handling	1.55E-04	7.35E-05	1.11E-05	—	—	—

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	2021-2022	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	6.10E-02	6.10E-02	5.92E-02	1.02E+00	2.03E-03	3.39E-01
				Demolition	1.83E-01	1.83E-01	1.83E-02	—	—	—
		3.2	Removal of hazardous waste	Road Exhaust	3.20E-06	3.20E-06	1.90E-06	8.82E-05	5.84E-07	4.64E-05
				Paved Roads	2.52E-02	4.84E-03	1.17E-03	—	—	—
		3.3	Recycling of materials	Road Exhaust	9.59E-06	9.59E-06	5.70E-06	2.65E-04	1.75E-06	1.39E-04
				Paved Roads	7.56E-02	1.45E-02	3.51E-03	—	—	—
		3.4	Disposal of asbestos at the WL landfill(1)	Road Exhaust	4.64E-06	4.64E-06	2.76E-06	1.28E-04	8.48E-07	6.73E-05
				Paved Roads	3.66E-02	7.03E-03	1.70E-03	—	—	—
Miscellaneous			Emergency Power Generators	Combustion	—	—	—	2.18E-01	3.46E-01	1.13E+00
				Total	**1.07E+00**	**4.20E-01**	**1.31E-01**	**1.51E+00**	**3.52E-01**	**1.57E+00**

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 Decommissioning	2019-2021	1.1	Create pathways between rooms	Non-road Equipment Exhaust	3.28E-03	3.28E-03	3.18E-03	5.47E-02	1.09E-04	1.84E-02
			1.2	Batch mixing plant (temporary)	Process	4.14E-02	1.15E-02	2.97E-03	—	—	—
					Non-road Equipment Exhaust	1.56E-03	1.56E-03	1.52E-03	3.06E-02	3.61E-05	1.54E-02
					Raw Material Handling	7.66E-04	3.62E-04	5.48E-05	—	—	—
					Road Exhaust	4.96E-05	4.96E-05	2.95E-05	1.37E-03	9.06E-06	7.20E-04
					Paved Roads	3.91E-01	7.51E-02	1.82E-02	—	—	—
					Propane Combustion	4.13E-04	4.13E-04	4.13E-04	2.69E-02	3.10E-03	1.55E-02
2	Grouting of below-grade structures and systems	2021	2.1	Fill below-grade areas with grout according to engineered fill schedule (multiple lifts of grouting pours)	Non-road Equipment Exhaust	7.88E-03	7.88E-03	7.64E-03	1.31E-01	2.62E-04	4.26E-02
					Material Handling	7.99E-05	3.78E-05	5.72E-06	—	—	—

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	2021-2022	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	4.58E-02	4.58E-02	4.44E-02	7.63E-01	1.52E-03	2.54E-01
					Demolition	4.81E-02	4.81E-02	4.81E-03	—	—	—
			3.2	Removal of hazardous waste	Road Exhaust	3.20E-06	3.20E-06	1.90E-06	8.82E-05	5.84E-07	4.64E-05
					Paved Roads	2.52E-02	4.84E-03	1.17E-03	—	—	—
			3.3	Recycling of materials	Road Exhaust	9.59E-06	9.59E-06	5.70E-06	2.65E-04	1.75E-06	1.39E-04
					Paved Roads	7.56E-02	1.45E-02	3.51E-03	—	—	—
			3.4	Disposal of asbestos at the WL landfill (1)	Road Exhaust	4.64E-06	4.64E-06	2.76E-06	1.28E-04	8.48E-07	6.73E-05
					Paved Roads	3.66E-02	7.03E-03	1.70E-03	—	—	—
Miscellaneous				Emergency Power Generators	Combustion	—	—	—	2.18E-01	3.46E-01	1.13E+00
					Total	**6.78E-01**	**2.20E-01**	**8.96E-02**	**1.23E+00**	**3.51E-01**	**1.48E+00**

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 Decommissioning	2019-2021	1.1	Create pathways between rooms	Non-road Equipment Exhaust	<1%	1%	3%	5%	<1%	2%
			1.2	Batch mixing plant (temporary)	Process	6%	4%	4%	—	—	—
					Non-road Equipment Exhaust	<1%	<1%	2%	3%	<1%	1%
					Raw Material Handling	<1%	<1%	<1%	—	—	—
					Road Exhaust	<1%	<1%	<1%	<1%	<1%	<1%
					Paved Roads	56%	27%	21%	—	—	—
					Propane Combustion	<1%	<1%	<1%	2%	<1%	<1%
2	Grouting of below-grade structures and systems	2021	2.1	Fill below-grade areas with grout according to engineered fill schedule (multiple lifts of grouting pours)	Non-road Equipment Exhaust	<1%	2%	6%	9%	<1%	3%
					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	2021-2022	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%	15%	45%	67%	<1%	22%
				Demolition	17%	44%	14%	—	—	—
		3.2	Removal of hazardous waste	Road Exhaust	<1%	<1%	<1%	<1%	<1%	<1%
				Paved Roads	2%	1%	<1%	—	—	—
		3.3	Recycling of materials	Road Exhaust	<1%	<1%	<1%	<1%	<1%	<1%
				Paved Roads	7%	3%	3%	—	—	—
		3.4	Disposal of asbestos at the WL landfill(1)	Road Exhaust	<1%	<1%	<1%	<1%	<1%	<1%
				Paved Roads	3%	2%	1%	—	—	—
Miscellaneous			Emergency Power Generators	Combustion	—	—	—	14%	98%	72%

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 Decommissioning	2019-2021	1.1	Create pathways between rooms	Non-road Equipment Exhaust	<1%	1%	4%	4%	<1%	1%
		1.2	Batch mixing plant (temporary)	Process	6%	5%	3%	—	—	—
				Non-road Equipment Exhaust	<1%	<1%	2%	2%	<1%	1%
				Raw Material Handling	<1%	<1%	<1%	—	—	—
				Road Exhaust	<1%	<1%	<1%	<1%	<1%	<1%
				Paved Roads	58%	34%	20%	—	—	—
				Propane Combustion	<1%	<1%	<1%	2%	<1%	1%
2 Grouting of below-grade structures and systems	2021	2.1	Fill below-grade areas with grout according to engineered fill schedule (multiple lifts of grouting pours)	Non-road Equipment Exhaust	1%	4%	9%	11%	<1%	3%
				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	2021-2022	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	7%	21%	50%	62%	<1%	17%
				Demolition	7%	22%	5%	—	—	—
		3.2	Removal of hazardous waste	Road Exhaust	<1%	<1%	<1%	<1%	<1%	<1%
				Paved Roads	4%	2%	1%	—	—	—
		3.3	Recycling of materials	Road Exhaust	<1%	<1%	<1%	<1%	<1%	<1%
				Paved Roads	11%	7%	4%	—	—	—
		3.4	Disposal of asbestos at the WL landfill(1)	Road Exhaust	<1%	<1%	<1%	<1%	<1%	<1%
				Paved Roads	5%	3%	2%	—	—	—
Miscellaneous		Emergency Power Generators		Combustion	—	—	—	18%	99%	76%

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 decommissioning 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	0.739
PM_{10}	N/A-2	24-hour	0.142
$PM_{2.5}$	N/A-3	24-hour	0.034
NO_x	10102-44-0	1-hour	0.006
NO_x	10102-44-0	24-hour	0.003
CO	630-08-0	1-hour	0.003
CO	630-08-0	8-hour	0.003
SO_2	7446-09-5	1-hour	0.00004
SO_2	7446-09-5	24-hour	0.00002
Non-Roads Emissions			
SPM	N/A-1	24-hour	0.327
PM_{10}	N/A-2	24-hour	0.278
$PM_{2.5}$	N/A-3	24-hour	0.097
NO_x	10102-44-0	1-hour	3.222
NO_x	10102-44-0	24-hour	1.507
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	0.352

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_2e)
	CO_2	CH_4	N_2O	
	124-38-9	74-82-8	10024-97-2	
Mobile Equipment (Road & Non-Road)	12,054	17	738	12,808
Propane Combustion	125	0.05	0.06	125
Emergency Power Generators	3	0.004	0.13	3
Total	12,270	17	749	**12,936**

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 U.S. 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.

Table 17: Areas of Conservatism in the Emission Rate Calculations

Project Activity	Conservatism
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 (U.S. 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 U.S. 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 (MSD), 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 (SK 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,
- CALINE3HQ 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 (U.S. 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 U.S. 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 (SK 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 decommissioning 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 U.S. EPA and calculates 1-hour concentration estimates which are based on the U.S. EPA document titled "Screening Procedures for Estimating the Air Quality Impact of Stationary Sources" (U.S. EPA 1992). This model has been adopted in Manitoba (MSD 2006) and in Ontario and Saskatchewan as a regulatory model recommended for permitting and regulatory applications (MOECC 2009, SK MOE 2012). The SCREEN3 model uses a Gaussian plume model, which includes emission source parameters and worst-case meteorological data (U.S. EPA 1995).

In 1980, after careful validation with field data, the U.S. EPA endorsed CALINE3 as the official model for estimating concentrations of non-reactive criteria air contaminants near highways (and roadways). The U.S. 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 (SK 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 U.S. EPA prior to adopting SCREEN3 and CAL3HQC as screening and regulatory models (U.S. EPA 2004) was a peer review process to confirm that the model could accurately predict ground-level concentrations when compared to monitoring data (U.S. 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 U.S. 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 6.2-3 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 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.

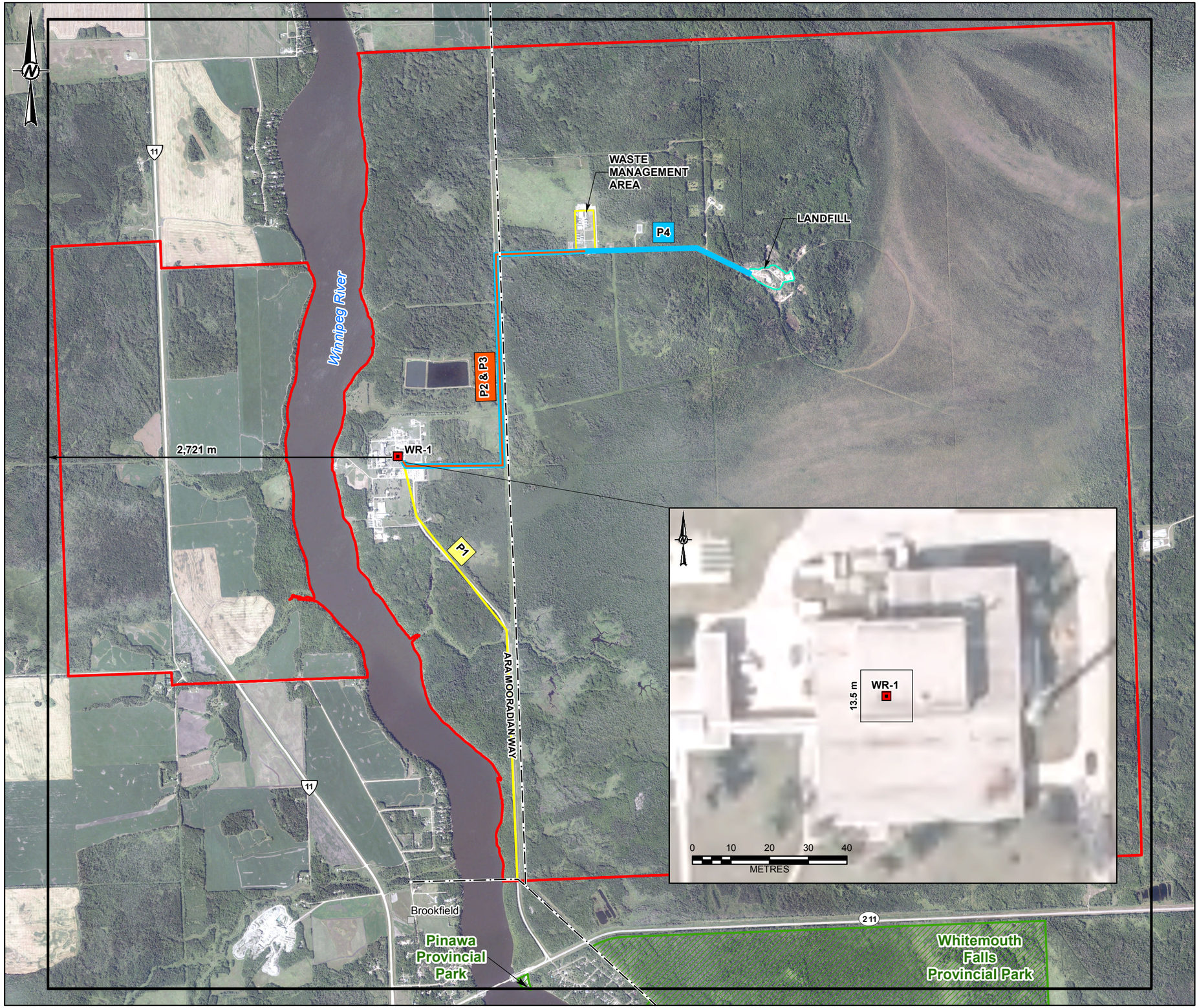
The in situ decommissioning of the WR-1 Building was modelled as a single volume source. The activities associated with the Project will occur either at the WR-1 Building or immediately next to it. As the WR-1 Complex has a larger footprint that will be decommissioned and/or demolished, its dimensions 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	—

Note: 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 m.



LEGEND

- VOLUME SOURCE SQUARE
- SITE STUDY AREA (WHITESHELL LABORATORIES SITE)
- LOCAL STUDY AREA

WHITESHELL LABORATORIES

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

BASE FEATURES

- CITY/TOWN
- TRANSMISSION LINE
- PROVINCIAL PARK

ROAD SEGMENT NAME	DESCRIPTION
P1	Raw material from property boundary to storage area
P2	Waste materials from WR-1 Complex to WMA
P3	Waste materials from WR-1 Complex to WMA
P4	Asbestos material from WR-1 Complex to WL Asbestos Disposal Site (WL landfill)

0 1,000 2,000
1:30,000 METRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - CANVEC AND MLI, 2016
2. PROJECT DATA - CNL, 2016
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 MODEL PLAN

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-09-13
DESIGNED	CGE
PREPARED	CGE
REVIEWED	KL
APPROVED	

PROJECT NO.	CONTROL	REV.	FIGURE
1656897		1	1

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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

Notes: m = metre
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

Note: LSA = Local Study Area; m = metre.

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 the 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 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 in Figure 1 and a simplified schematic diagram below in 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	P1B	3651.7	845.3	3566.1	2790.3	1947	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

Note: m = metre.

LEGEND

WHITESHELL LABORATORIES

- WR-1
- 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. PROJECT DATA - CNL, 2016
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
Golder Associates

YYYY-MM-DD	2017-09-13
DESIGNED	CGE
PREPARED	CGE
REVIEWED	CS
APPROVED	AB

PROJECT NO.	CONTROL	REV.	FIGURE
1656897		1	2

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

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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	6.02E-01	1.16E-01	2.84E-02	2.11E-02	1.39E-04	1.11E-02	2.18
P2	2.52E-02	4.87E-03	1.19E-03	8.82E-04	5.84E-06	4.64E-04	1.92
P3	7.57E-02	1.46E-02	3.57E-03	2.65E-03	1.75E-05	1.39E-03	1.92
P4	3.66E-02	7.07E-03	1.73E-03	1.28E-03	8.48E-06	6.73E-04	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	2.8	5.3	1.3	9.6	63.8	5.1	2.18
P2&3&4A, P2&3&4B and P2&3&4C	0.7	1.3	0.3	2.3	15.2	1.2	1.92
P4A and P4B	0.1	0.3	0.1	0.5	3.1	0.2	0.83
Inflation Factor	10	100	100	1000	—	—	—

Note: 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; 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 are 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 U.S. EPA guide [U.S. EPA B 1995]);
- 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 the 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).

The emissions rates of SO_2 and CO are lower than that of NOx. As a conservative approach without running the CAL3QHC model, the predicted maximum concentration of NOx is assumed to equal the maximum concentration of SO_2 and CO. The CAL3QHC output unit of NOx concentration is in parts per million (ppm). NOx, SO_2, and CO values in ppm were converted to µg/m³ by using the ideal gas law constant and assuming a temperature of 25 °C and an atmospheric pressure of 1 atmosphere, according to the following equation and sample conversion calculation for NOx:

$$\text{Concentration}\left[\frac{\mu g}{m^3}\right] = \frac{\text{Concentration [ppm]} \times \text{Pressure [atm]} \times \text{Molecular Weight}\left[\frac{g}{mol}\right]}{\text{Ideal Gas Law Constant}\left[\frac{m^3 - atm}{K - mol}\right] \times \text{Temperature [K]}}$$

$$\text{NOx Concentration} = \frac{\frac{0.6}{10^6} \times 1\ \text{atm} \times 46\frac{g}{mol}}{8.20\text{E}{-}05\ \frac{m^3 - atm}{K - mol} \times (25°C + 273.15)K} \times \frac{10^6 \mu g}{1\ g}$$

Table 6: Summary of CAL3QHC Predicted Maximum 1-Hour Concentrations

Contaminant	CAL3QHC Output	CAL3QHC Output Unit	Inflation Factor	Predicted Concentration (µg/m³)
SPM	150	µg/m³	10	15.0
PM_{10}	289	µg/m³	100	2.9
$PM_{2.5}$	87	µg/m³	100	0.9
NOx	0.6	ppm	1000	1.1
SO_2	—	ppm	—	1.6
CO	—	ppm	—	0.7

SO_2 and CO concentrations were conservatively assumed to equal NOx concentration.

NOx, SO_2, and CO values in ppm were converted to µg/m³ as described in the text above the table.

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	15.0	—	6.16	1.18
PM_{10}	N/A-2	2.9	—	1.19	0.23
$PM_{2.5}$	N/A-3	0.9	—	0.36	0.07
NOx	10102-44-0	1.1	—	0.46	0.09
CO	630-08-0	1.1	0.63	0.46	0.09
SO_2	7446-09-5	1.1	—	0.46	0.09

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 CACs, 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 et al. 1979). The following equations present the methodology:

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/m³ *(Winnipeg Richardson Airport Station, 2009-2013)*

Modelled 1-hour maximum $[NO_x]$ = 385.52 µg/m³

0.90 $[NO_x]$ = 346.97 µg/m³

$[O_3] < 0.90\ [NO_x]$, therefore $[NO_2] = [O_3] + 0.10\ [NO_x]$ applies:

$[NO_2]$ = 74.57 µg/m³ + 0.10 (385.52 µg/m³)

$[NO_2]$ = 113.12 µg/m³

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/m³)	NOx Estimated Concentration (µg/m³)	0.9 (NOx)	Required Approach	NO_2 Estimated Concentration (µg/m³)
1-hour	74.57	385.52	346.97	OLM	113.12
24-hour	67.85	74.32	66.89	Full Conversion	74.32
Annual	43.63	9.78	8.81	Full Conversion	9.78

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, in situ decommissioning 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:

$$\text{Maximum Predicted Concentration} = 24-\text{hour Dispersion Factor } \left[\frac{\mu g}{m^3} \text{ per} \frac{g}{s}\right] \text{x } 24-\text{hour Emisison Rate } \left[\frac{g}{s}\right]$$

$$\text{Maximum Predicted Concentration} = 49.0 \frac{\mu g}{m^3} \text{ per} \frac{g}{s} \text{ x } 0.372 \frac{g}{s}$$

$$\text{Maximum Predicted Concentration} = 16.02 \frac{\mu g}{m^3}$$

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	0.739	6.161
SPM	N/A-1	Annual	0.506	1.181
PM_{10}	N/A-2	24-hour	0.142	1.187
$PM_{2.5}$	N/A-3	24-hour	0.034	0.357
$PM_{2.5}$	N/A-3	Annual	0.024	0.068
NOx	10102-44-0	1-hour	0.006	1.128
NOx	10102-44-0	24-hour	0.003	0.463
NOx	10102-44-0	Annual	0.002	0.089
CO	630-08-0	1-hour	0.003	0.687
CO	630-08-0	8-hour	0.003	0.384
SO_2	7446-09-5	1-hour	0.00004	1.571
SO_2	7446-09-5	24-hour	0.00002	0.645
SO_2	7446-09-5	Annual	0.00001	0.124
Non-Roads Dispersion Modelling				
SPM	N/A-1	24-hour	0.327	16.02
SPM	N/A-1	Annual	0.224	2.10
PM_{10}	N/A-2	24-hour	0.278	13.63
$PM_{2.5}$	N/A-3	24-hour	0.097	4.74
$PM_{2.5}$	N/A-3	Annual	0.066	0.62
NOx	10102-44-0	1-hour	3.222	384.39
NOx	10102-44-0	24-hour	1.507	73.86
NOx	10102-44-0	Annual	1.032	9.70
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	0.352	17.24
SO_2	7446-09-5	Annual	0.241	2.26

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/m³ = 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	22.18
SPM	N/A-1	Annual	3.28
PM_{10}	N/A-2	24-hour	14.82
$PM_{2.5}$	N/A-3	24-hour	5.10
$PM_{2.5}$	N/A-3	Annual	0.69
NOx	10102-44-0	1-hour	385.52
NOx	10102-44-0	24-hour	74.32
NOx	10102-44-0	Annual	9.78
NO_2	10102-44-0	1-hour	113.12
NO_2	10102-44-0	24-hour	74.32
NO_2	10102-44-0	Annual	9.78
CO	630-08-0	1-hour	257.17
CO	630-08-0	8-hour	143.67
SO_2	7446-09-5	1-hour	43.94
SO_2	7446-09-5	24-hour	17.88
SO_2	7446-09-5	Annual	2.39

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). 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 was 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 impacts	The cumulative impact 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.

3.0 REFERENCES

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APPENDIX 6.4.2-1

Surface Water Quality Data

Table A-1: Atomic Mass and Half-life Used in the Assessment of Surface Water Quality

Radionuclide	Atomic Mass (mol/g)	Half-life (s)
Actinium-225	2.25E+02	8.64E+05
Actinium-227	2.27E+02	6.87E+08
Bismuth-210	2.10E+02	4.33E+05
Carbon-14	1.40E+01	1.81E+11
Calcium-41	4.10E+01	3.22E+12
Chloride-36	3.60E+01	9.46E+12
Gadolinium-152	1.52E+02	3.41E+21
Tritium	4.03E+00	3.89E+08
Iodine-129	1.29E+02	4.95E+14
Niobium-94	9.39E+01	6.40E+11
Nickel-59	5.89E+01	3.19E+12
Neptunium-237	2.37E+02	6.75E+13
Protactinium-231	2.31E+02	1.03E+12
Protactinium-233	2.33E+02	2.33E+06
Lead-210	2.10E+02	7.03E+08
Polonium-210	2.10E+02	1.19E+07
Plutonium-239	2.39E+02	7.60E+11
Plutonium-240	2.40E+02	2.07E+11
Radium-223	2.23E+02	9.88E+05
Radium-224	2.24E+02	3.14E+05
Radium-225	2.25E+02	1.29E+06
Radium-226	2.26E+02	5.05E+10
Radium-228	2.28E+02	1.80E+08
Technetium-99	9.89E+01	6.65E+12
Thorium-227	2.27E+02	1.61E+06
Thorium-228	2.28E+02	6.03E+07
Thorium-229	2.29E+02	2.30E+11
Thorium-230	2.30E+02	2.38E+12
Thorium-231	2.31E+02	9.19E+04
Thorium-232	2.32E+02	4.45E+17
Uranium-233	2.33E+02	5.02E+12
Uranium-234	2.34E+02	7.74E+12
Uranium-235	2.35E+02	2.22E+16
Uranium-236	2.36E+02	7.40E+14

Table A-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 A-3: Solid/Liquid Partition Coefficients Used in the Assessment of Surface Water Quality for Radionuclides

Parameter	Solid/Liquid Partition Coefficient for Surface Water to Sediment (L/kg)	Source
Actinium-225	1.70E+03	Used surrogate lanthanum from Table A.26 (CSA N288.1 2014)
Actinium-227	1.70E+03	Used surrogate lanthanum from Table A.26 (CSA N288.1 2014)
Bismuth-210	5.00E+03	Used surrogate antimony from Table A.26 (CSA N288.1 2014)
Carbon-14	5.00E+01	Table A.26 (CSA N288.1 2014)
Calcium-41	1.90E+02	Used surrogate strontium from Table A.26 (CSA N288.1 2014)
Chloride-36	2.00E+01	Table A.26 (CSA N288.1 2014)
Gadolinium-152	9.90E+02	Table A.26 (CSA N288.1 2014)
Tritium	0.00E+00	Table A.26 (CSA N288.1 2014)
Iodine-129	4.40E+03	Table A.26 (CSA N288.1 2014)
Niobium-94	1.70E+03	Table A.26 (CSA N288.1 2014)
Nickel-59	1.40E+03	Table A.26 (CSA N288.1 2014)
Neptunium-237	1.00E+01	Table A.26 (CSA N288.1 2014)
Protactinium-231	5.40E+03	Table A.26 (CSA N288.1 2014)
Protactinium-233	5.40E+03	Table A.26 (CSA N288.1 2014)
Lead-210	1.30E+03	Used surrogate tin from Table A.26 (CSA N288.1 2014)
Polonium-210	1.30E+00	Used surrogate tellurium from Table A.26 (CSA N288.1 2014)
Plutonium-239	2.40E+05	Table A.26 (CSA N288.1 2014)
Plutonium-240	2.40E+05	Table A.26 (CSA N288.1 2014)
Radium-223	7.40E+03	Table A.26 (CSA N288.1 2014)
Radium-224	7.40E+03	Table A.26 (CSA N288.1 2014)
Radium-225	7.40E+03	Table A.26 (CSA N288.1 2014)
Radium-226	7.40E+03	Table A.26 (CSA N288.1 2014)
Radium-228	7.40E+03	Table A.26 (CSA N288.1 2014)
Technetium-99	5.00E+00	Table A.26 (CSA N288.1 2014)
Thorium-227	1.90E+05	Table A.26 (CSA N288.1 2014)
Thorium-228	1.90E+05	Table A.26 (CSA N288.1 2014)
Thorium-229	1.90E+05	Table A.26 (CSA N288.1 2014)
Thorium-230	1.90E+05	Table A.26 (CSA N288.1 2014)
Thorium-231	1.90E+05	Table A.26 (CSA N288.1 2014)
Thorium-232	1.90E+05	Table A.26 (CSA N288.1 2014)
Uranium-233	5.00E+01	Table A.26 (CSA N288.1 2014)
Uranium-234	5.00E+01	Table A.26 (CSA N288.1 2014)
Uranium-235	5.00E+01	Table A.26 (CSA N288.1 2014)
Uranium-236	5.00E+01	Table A.26 (CSA N288.1 2014)

Table A-4: Solid/Liquid Partition Coefficients Used in the Assessment of Surface Water Quality for Non-Radionuclides

Parameter	Solid/Liquid Partition Coefficient for Surface Water to Sediment (L/kg)	Source
Boron	5.00E+01	Used surrogate carbon from Table A.26 (CSA N288.1 2014)
Barium	2.00E+03	Table A.26 (CSA N288.1 2014)
Bismuth	5.00E+03	Used surrogate antimony from Table A.26 (CSA N288.1 2014)
Cadmium	5.00E+02	Used surrogate zinc from Table A.26 (CSA N288.1 2014)
Cobalt	4.30E+04	Table A.26 (CSA N288.1 2014)
Chromium	1.30E+05	Used surrogate manganese from Table A.26 (CSA N288.1 2014)
Copper	5.00E+02	Used surrogate zinc from Table A.26 (CSA N288.1 2014)
Gadolinium	9.90E+02	Table A.26 (CSA N288.1 2014)
HB40	1.11E+04	Calculated by multiplying organic carbon coefficient (Koc) by the fraction of organic carbon (foc). Log Koc = 5.5 (Eastman MSDS, 2015).
Mercury	1.60E+02	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
Manganese	1.30E+05	Table A.26 (CSA N288.1 2014)
Molybdenum	1.00E+02	Table A.26 (CSA N288.1 2014)
Nitrogen	0	Table A.26 (CSA N288.1 2014)
Nickel	1.40E+03	Table A.26 (CSA N288.1 2014)
Lead	1.30E+03	Used surrogate tin from Table A.26 (CSA N288.1 2014)
Palladium	5.40E+03	Table A.26 (CSA N288.1 2014)
Ruthenium	3.20E+04	Table A.26 (CSA N288.1 2014)
Sulphur	1.10E+02	Table A.26 (CSA N288.1 2014)
Xylene	15.5085	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

APPENDIX 6.6-1

Valued Component Selection and Species at Risk Screening Table

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EIS FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WL SITE
APPENDIX 6.6-1: VALUED COMPONENT SELECTION AND SPECIES AT RISK SCREENING TABLE
REVISION 1

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)	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)	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	No	No	Suitable breeding habitat may be present in the RSA, but unlikely in LSA.	THR	THR	THR	G5	S3B
Chaetura pelagica	Chimney Swift	No	No	Species has not been recorded in the RSA	THR	THR	THR	G5	S2B
Chordeiles minor	Common Nighthawk	No	No	Species has not been recorded in the RSA	THR	THR	THR	G5	S3B
Contopus cooperi	Olive-sided Flycatcher	No	No	Species has not been recorded in the RSA and suitable habitat is not likely present in the LSA	THR	THR	THR	G4	S3B

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)									
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	-	-	G5	S4B
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	NAR	-	END	G4	S1B
Dolichonyx oryzivorus	Bobolink	No	No	Species has not been recorded in the RSA and suitable habitat is not likely present in the LSA	THR	-	-	G5	S4B
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)	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.	THR	-	-	G5	S4B
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	G5	S2B
Lanius ludovicianus migrans	Loggerhead Shrike	Yes (individual observed in a tree by B401 in 2014)	No	Subspecies has been assigned by Golder based on known range maps. 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.	Non-active	END	END	G4T3Q	S1B

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)									
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	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.	THR	THR	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	-	-	G5	S5B
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. 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 2016a).	THR	THR	THR	G4	S3B

Notes:

WL = Whiteshell Laboratories; EIS = Environmental Impact Statement; VC = Valued Component; - = not listed/no status.

a) Committee on the Status of Endangered Wildlife in Canada (COSEWIC) http://www.cosewic.gc.ca/; END = Endangered; THR = Threatened; SC = Special Concern; NAR = Not at Risk.

b) Federal *Species at Risk Act* (SARA), 2002. Schedule 1 (Last amended 15 May 2015); 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 December 30, 2016); 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 (Imperiled); 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.

APPENDIX 6.9-1

Participants in Key Person Interview Program

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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