Environmental Impact Statement

Volume II of V

Boat Harbour Remediation Project
Pictou Landing, Nova Scotia

Nova Scotia Lands Inc.

November 17, 2020

Environmental Impact Statement

Section 1 | Introduction

Boat Harbour Remediation Project
Pictou Landing, Nova Scotia

Nova Scotia Lands Inc.

Table of Contents

Figure Index

Table Index

1. Introduction and Overview

This report documents the Environmental Impact Statement (EIS) prepared by Nova Scotia Lands Inc. (NSLI) for the Boat Harbour Remediation Project (the Project or BHRP) in accordance with the *Guidelines for the Preparation of an Environmental Impact Statement* pursuant to the *Canadian Environmental Assessment Act,* 2012 (CEAA 2012) for the BHRP[1]. The EIS addresses the content requirements specified as follows:

- ***Section 1.0 – Introduction and Overview* |** Identifies the proponent, provides an overview of the Project and its location, and defines the regulatory framework and role of the government.
- ***Section 2.0 – Project Justification and Alternatives Considered* |** Describes the purpose of the Project, identifies the alternative means of carrying out the Project (alternative means) considered for the Project, and provides the evaluation of alternative means to identify the recommended solution.
- ***Section 3.0 – Project Description* |** Defines the components of the Project and details all activities involved in implementing the Project throughout all Project phases, including: site preparation and construction, operation, and decommissioning and abandonment (this includes closure and post-closure of on-site infrastructure included as part of the Project).
- ***Section 4.0 – Public Participation and Concerns* |** Describes all communication and consultation undertaken with the public throughout the Project.
- ***Section 5.0 – Engagement with the Mi'kmaq of Nova Scotia and Concerns Raised* |** Describes all communication and engagement that took place with the Mi'kmaq of Nova Scotia throughout the Project and documents how each concern raised was considered.
- ***Section 6.0 – Impacts to Potential or Established Aboriginal or Treaty Rights* |** Discusses the potential impacts of the Project on Aboriginal or Treaty Rights.
- ***Section 7.0 – Effects Assessment* |** Describes the Project setting and baseline conditions, documents predicted changes to the physical environment and valued components, identifies measures to mitigate the predicted changes to the physical environment and valued components, describes residual effects and their significance following application of mitigation measures, identifies the effects of potential accidents and malfunctions, documents the effects of the environment on the Project, and assesses cumulative effects.
- ***Section 8.0 – Summary of Environmental Effects Assessment* |** Condenses the information provided in Section 7.0 into the following two tables:
    1. A summary of the potential environmental effects on valued components, proposed mitigation measures to address the effects identified, and potential residual effects and the significance of the residual environmental effects.

[1] Canadian Environmental Assessment Agency, Guidelines for the Preparation of an Environmental Impact Statement pursuant to the *Canadian Environmental Assessment Act, 2012*, Boat Harbour Remediation Project, Nova Scotia Lands Inc., May 2019.

2. A summary of all key mitigation measures and commitments which will mitigate any significant adverse effects of the Project on valued components.

- ***Section 9.0 – Follow-up and Monitoring Programs*** | Describes the proposed follow-up program to verify the accuracy of effects assessment and effectiveness of the mitigation measures, as well as the monitoring program to ensure that proper measures and controls are in place in order to decrease the potential for environmental degradation during all phases of Project development, and to provide clearly defined action plans and emergency response procedures to account for human and environmental health and safety.

1.1 The Proponent

NSLI is the Proponent for the BHRP and is a provincial crown corporation whose mandate is to access and, where required, remediate and redevelop crown-owned properties. NSLI's portfolio includes a number of industrial parks in Cape Breton, Pictou County, and Queens County. NSLI also has taken responsibility for remediation of a number of former industrial and mine sites throughout Nova Scotia.

Maw-Lukutinej Waqama'tuk A'se'k
"Let us work together and clean up Boat Harbour"

Project contact information is as follows:

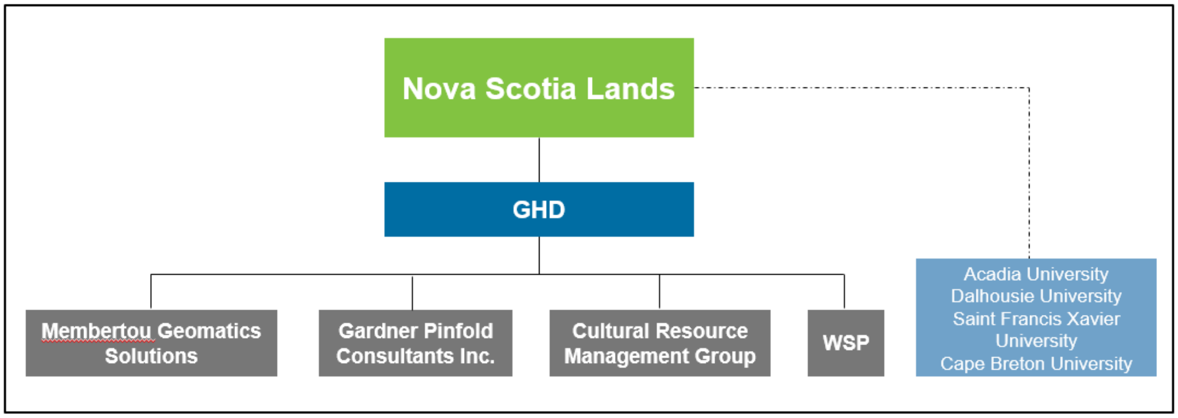
Nova Scotia Lands
P.O. Box 397
Station Central
Halifax, Nova Scotia, Canada B3J 2P8

Ken Swain
Project Leader, Boat Harbour Remediation Project
Tel: (902) 403-9744 | Fax: (902) 424-7710 | Email: Ken.Swain@novascotia.ca

The principal contact person for the purposes of this EIS is:

Angela Swaine
Senior Project Manager, Boat Harbour Remediation Project
Tel: (902) 497-9847 | Fax: (902) 424-7710 | Email: Angela.Swaine@novascotia.ca

Figure 1.1-1 Project Organizational Chart



As shown in the organizational chart (Figure 1.1-1, above) NSLI has retained GHD to assist in the preparation of this EIS. GHD has retained other experts (subconsultants, including Membertou Geomatics Solutions, Gardner Pinfold Consultants Inc., Cultural Resource Management Group, and WSP) to carry out studies related to the EIS. Through its advisory outreach, NSLI consulted with academic advisors from Nova Scotia universities for purposes of attaining scientific advice and enabling applied research on the Project.

1.2 Project Overview

Boat Harbour, formerly known as A'se'k in Mi'kmaq, was originally a tidal estuary[2] connected to the Northumberland Strait in Nova Scotia. The Province of Nova Scotia (Province) constructed the Boat Harbour Effluent Treatment Facility (BHETF) in 1967 to treat effluent from industrial sources including a chlor-alkali plant and a bleached Kraft Pulp Mill. Its construction included reconstructing the natural tidal estuary into a closed effluent stabilization basin. In accordance with the *Boat Harbour Act* (BHA) 2015, the Facility ceased the reception and treatment of effluent from the Mill in January 2020.

Following approvals, the Province will remediate Boat Harbour and lands associated with the BHETF and restore Boat Harbour to a tidal estuary. The existing causeway along Highway 348 and the dam will be removed and replaced with a bridge to allow return to tidal conditions and permit boat access to Boat Harbour. As part of the remediation work, hazardous and non-hazardous waste-bearing sediment from the BHETF will be removed and stored in the existing hazardous waste containment cell located adjacent to the BHETF, on the BHETF property.

As illustrated in Figure 1.2-1, the main components of the BHETF include the wastewater effluent pipeline (over 3 kilometres [km] in length) that runs from the Kraft Pulp Mill and extends eastward, below the East River of Pictou (East River), to the BHETF property; settling basins and an aeration stabilization basin (ASB) west-southwest of Boat Harbour; and the Boat Harbour stabilization lagoon (Boat Harbour or BHSL). Effluent from the BHSL discharges through a dam (northeast of Boat Harbour) into an estuary before being released to the Northumberland Strait. Prior to the construction of the settling basins and ASB, effluent was routed by open ditch from the pipeline on

2 Partially enclosed coastal body of water, having an open connection with the ocean, where freshwater from inland is mixed with saltwater from the sea

the east side of Highway 348 to natural wetland areas (Former Ponds 1, 2, and 3) before being discharged into the BHSL. The current containment cell is also shown on Figure 1.2-1.

Source: Imagery @2017 Google CNES / Airbus, DigitalGlobe, Landsat / Copernicus

0 200 400 600
Meters

Coordinate System:
NAD 1983 CSRS UTM Zone 20N

N

NOVA SCOTIA LANDS INC
BOAT HARBOUR, NS
ENVIRONMENTAL IMPACT STATEMENT

11148275-31-03
Feb 3, 2020

STUDY AREA

FIGURE 1.2-1

GIS File: I:\GIS_DATA\Projects\8-chars\1114----\11148275 Boat Harbour\11148275-REPORTS\11148275-Rpt-20\11148275-31-03(020)GIS-HX001.2-1.mxd

The remedial solution for the BHETF includes the following:

- Management of residual mill effluent within the BHETF
- Management and removal, treatment, and disposal of impacted sludge/sediment from former effluent ditches, settling basins, ASB, and BHSL
- Risk management and/or removal, treatment, and disposal of impacted sludge/sediment from the wetlands and estuary
- Management, treatment, and disposal of impacted water including bulk water, dewatering effluent, and leachate
- Risk management and/or removal, treatment, and disposal of impacted soil and surface water
- Vertical expansion, modification, and use and closure of the existing containment cell
- Decommissioning of BHETF infrastructure including the pipeline, causeway, dam, and support facilities
- Restoration of Highway 348 including construction of a bridge in the location of the existing causeway

The Impact Assessment Agency of Canada (IAAC or Agency) has determined that an Environmental Impact Assessment (EIA) is required under CEAA 2012 and will include the construction, operation, decommissioning, and reclamation of the following Project components (Note: not all components are represented in each phase of the Project):

- Wastewater effluent pipeline
- Effluent ditches (current and historical)
- Existing settling basins
- Existing ASB
- Existing BHSL
- Boat Harbour estuary and adjacent marine environment in the Northumberland Strait
- Wetlands
- Existing containment cell (including overflow pond, spillways, and catch basin)
- Existing liner and leachate collection system
- Geotubes® or equivalent technology
- New containment cell gas management system
- Residual mill effluent
- Existing causeway along Highway 348
- Existing dam
- New replacement bridge
- Pilot study berm and cove

- Dredging
- Wastewater management system
- Site clearing, earthmoving, leveling, and drilling activities
- New and upgraded access roads
- Transportation corridor construction or improvement
- Storage of petroleum products and reagents
- Water supply (industrial and drinking)
- Power supply
- Infrastructure decommissioning
- Existing administrative, maintenance, support, treatment, and storage buildings

The BHRP is comprised of the above-listed components and is the subject of this EIS.

The anticipated Project implementation schedule has an estimated duration of 4-7 years, following approval of the EIS. The components of the Project are detailed in Section 3.1 and the anticipated sequencing and implementation schedule for each component is provided in Section 3.2.

1.3 Project Location

The Site Study Area for the Project spans from the wastewater effluent pipeline, described above, from the first standpipe on the Kraft Pulp Mill property, through existing and historic BHETF lands, Boat Harbour and its banks, extending to Northumberland Strait, and Pictou Landing First Nation (PLFN), located between Boat Harbour and Northumberland Strait. The total Study Area is approximately 546 hectares (ha) of which 141 ha is Boat Harbour. A plan showing the Study Area is provided on Figure 1.2-1.

1.3.1 Project Coordinates

The coordinates of the centre of Boat Harbour are: NAD 83/20 N/527179E/5056702N.

1.3.2 Current Land Use in the Area

The Study Area is situated within a relatively rural area of Nova Scotia and is identified by Service Nova Scotia and Municipal Relations (SNSMR) as being comprised of 34 parcels of land.

PLFN is located on the banks of Boat Harbour, within the Study Area, and is granted Indian Reserve Lands, which are federal crown lands. Approximately 485 residents reside within the PLFN lands. A Mi'kmaq Ecological Knowledge Study (MEKS) was conducted to identify land and resource use, which is of particular importance to the Mi'kmaq people, within the Study Area. The MEKS was conducted by Membertou Geomatics Solutions and completed in June 2018. Archaeological Assessment work was completed in 2017-2018 including reconnaissance work and shovel testing in select areas to identify known and potential sites of significance, for areas planned to be disturbed as part of the Pilot Scale Testing program.

In general, the Study Area and surrounding properties are not zoned, according to the (Draft) Pictou County Land Use By-Law, dated May 6, 2014. The southern portion of the PLFN land within the Study Area, however, is zoned as "Forest Management Area" and the northern portion, containing residences, is zoned as "Residential", according to the Pictou Landing Band By-Law No. 1. Approximately half of the Study Area is water-covered and most of the water features within the Study Area were formerly or are currently utilized as part of the wastewater effluent treatment process. The Study Area has operated as the BHETF since 1967 and has been reconfigured on several occasions.

Current industrial operations in the area include Michelin Canada's tire manufacturing facility, Advocate Printing's large-scale printing operations, and Nova Scotia Power's coal-powered electricity generating station. As noted above the Industrial Approval for the operation of the Kraft Pulp Mill expired on January 30, 2020, as such the Kraft Pulp Mill is undertaking a shutdown of its facility to an indefinite hibernation condition.

Future projects in the vicinity of the Study Area are limited, with the exception of the development of a new wastewater treatment facility for the Kraft Pulp Mill, which would allow the Kraft Pulp Mill to resume operations (subject to necessary permitting and approvals). The proposed plan would see mill wastewater, up to 75,000 cubic metres (m^3) per day, managed through an activated sludge treatment system. The effluent would be aerated and settled in a large tank on the mill property. Treated effluent would then be sent to a new submerged marine outflow for discharge into the Northumberland Strait. The provincial EIA for this proposed project is ongoing.

1.3.3 Environmentally Sensitive Areas

The Site Study Area does not include any protected or designated areas, but it does contain a total of 25 wetland and wetland complexes. As noted previously, the Boat Harbour estuary is located within the Study Area. To date six Species at Risk (SAR) were identified within the Site Study Area through dedicated bird surveys, including Common Nighthawk (*Chordeiles minor*), Eastern Wood-Pewee (*Contopus virens*), Bank Swallow (*Riparia riparia*), Barn Swallow (*Hirundo rustica*), Evening Grosbeak (*Coccothraustes vespertinus*), and Canada Warbler (*Cardellina canadensis*).

From a marine perspective, there are a number of known SAR outside of the Site Study Area.

Further information on baseline environmental conditions is provided in Section 7.1.

1.3.4 Local Communities

A portion of PLFN is located within the Study Area. Across Pictou Harbour, approximately 2 kilometres (km) to the northwest of the Study Area, is the Town of Pictou, with a reported 2016 population of 3,186 residents. Approximately 3 km to the south of the Study Area is the Town of Trenton, with a reported 2016 population of 2,474 residents.

1.3.5 Use of Aboriginal Lands

The PLFN is a Mi'kmaq First Nation located at the mouth of Pictou Harbour on the Northumberland Strait of Nova Scotia. The Mi'kmaq people have a long-existing, unique, and special relationship with the land and its resources, which involves the use and conservation of natural resources and spiritual ideologies regarding such. PLFN has a long-standing history of concern related to the effluent flowing from the nearby mill to Boat Harbour, known as A'se'k, that later became the site of the BHETF. Furthermore, PLFN was instrumental in negotiating with the Province to close the BHETF, which was embodied in the BHA. Historically, A'se'k was a gathering place where food, knowledge, and skills were exchanged between generations and amongst family groups. The land was traditionally used by the Mi'kmaq for refuge, recreation, fishing, hunting and gathering, as well as for physical, mental, spiritual, and emotional purposes. Through the proposed remediation Project, it is PLFN's hope that A'se'k will eventually be naturally restored to allow the community to re-establish its relationship with the water and land of A'se'k. The relationship of PLFN to their traditionally occupied lands and waters, and the importance of continued engagement with PLFN in the planning and design phases of the proposed Project to restore A'se'k is recognized. First Nation engagement is an essential component of the overall Project and specifically, the EIA process.

The June 2018 MEKS found that Mi'kmaq land and resource use was reported within the Study Area, and that hunting and gathering were found to be the most common activities described as occurring. Beyond the boundaries of the Study Area, hunting, fishing, and gathering were the most commonly reported activities. All activities were recounted as taking place in the recent and long-term past. Current use is limited mainly to fur-bearing creatures as species of harvest.

Recreational aquatic activities, such as swimming and canoeing, are reported as having been historically common in the waters surrounding PLFN in Pictou Harbour, Boat Harbour, and other local waters.

Archaeological assessment work identified that the Study Area contains known and potential sites of significance and recorded archaeological sites in the provincial registry. All aspects of the Project planning carefully consider known and potential sites with appropriate studies completed in any area where land disturbance has or will occur as part of the Project.

Numerous stories were also shared of dead fish floating on the water's surface shortly after pulp mill effluent began to flow through Boat Harbour. A high level of distrust of anything harvested in the area of Boat Harbour such as fish, plants, or game was reported. Stories were told of fish and animals exhibiting bumps or cancer. Returning Boat Harbour to the way it used to be, before being utilized by the Kraft Pulp Mill, and before the pollution, is reported as a strong desire among the PLFN community.

1.4 Regulatory Framework and the Role of Government

1.4.1 Federal

In Canada, the Project is regulated by the IAAC under CEAA 2012. Section 16(d) of the Regulations Designating Physical Activities states the Project triggers CEAA 2012, and it has been determined that an EIA is required for the Project.

1.4.1.1 Federal Financial Support

A provincial submission for federal funding was filed with Infrastructure Canada under the Investing in Canada Infrastructure Program (ICIP) for the Project. The following were included in the provincial submission for the Project:

- A Climate Change Resilience Assessment (a submission requirement completed by a qualified assessor)
- A Greenhouse Gas Mitigation Assessment (a submission requirement completed by a qualified assessor)
- A Project Management Accountability Framework (based upon federal Treasury Board Secretariat's framework)
- A Project Risk Profile (based upon federal Treasury Board Secretariat's Risk Management Framework)
- A Project Socioeconomic Impact Analysis

The federal government announced on May 23, 2019 that it will contribute $100 million to the remediation of Boat Harbour.

1.4.1.2 Federal Lands

PLFN is located on the banks of Boat Harbour, within the Study Area, and has been granted Indian Reserve (IR) Lands which are federal crown lands. As illustrated in Figure 1.2-1, the PLFN community is located on IR24, additional federal lands include IR37 and IR24G, both of which are also within the Project Study Area.

1.4.1.3 Federal Legislative and Regulatory Requirements

Table 1.4-1 lists the federal legislative and regulatory requirements that may be applicable to the Project.

Table 1.4-1 Anticipated Federal Legislative and Regulatory Requirements

Project Activity	Activity Description	Applicable Legislation	Agency	Required Approval or Permit
Entire Project	Access and all remediation activities on federal crown lands	• *Indian Act (*1985*)*	• Indigenous Services Canada (ISC) (in conjunction with PLFN Band Council Resolution)	• Approval is required for access and remediation activities on federal crown land from ISC in conjunction with PLFN Band Council Resolution. ISC has granted approvals for access to three Indian Reserve Lands adjacent to Boat Harbour during the planning period and further approvals may be required for the remediation implementation. NSLI is working directly with ISC to determine the associated regulatory approval and compliance matters
Entire Project	All remediation activities	• *Canadian Environmental Assessment Act,* (CEAA, 2012) and Regulations • *Migratory Birds Convention Act* (MBCA, 1994) • *Species at Risk Act* (SARA, 2002) • Section 36(3) to (6) of the *Fisheries Act*[3] (1985) • *Canadian Environmental Protection Act* (1999)	• IAAC • Environment & Climate Change Canada (ECCC) • Health Canada (HC)	• EIA Approval and associated permits or exemptions

[3] While DFO is responsible for administering the *Fisheries Act*, ECCC is responsible for administering particular subsections of the *Fisheries Act, including* Section 36(3) to (6).

Table 1.4-1 Anticipated Federal Legislative and Regulatory Requirements

Project Activity	Activity Description	Applicable Legislation	Agency	Required Approval or Permit
Bridge construction at Highway 348 and estuary widening	Construction of a single-span concrete structure	• *Canadian Navigable Waters Act,* (1985) • *Fisheries Act* (1985)	• Transport Canada (TC) • Department of Fisheries and Oceans Canada (DFO)	• Navigation Protection Program Approval • Authorization for work that may result in death of fish or harmful alteration, disturbance, or destruction (HADD) of fish habitat
Waste Management	Handling and transportation of liquid and solid waste off-site	• *Transportation of Dangerous Goods Act* (1992) and Regulations	• TC	• Off-site transport of waste materials classified under this Act - carrier must comply with all applicable regulations
		•	•	•
Infrastructure Decommissioning – Dam	Removal of earthen berm connecting the dam to the banks	• *Canadian Navigable Waters Act* (2019) • *Fisheries Act* (1985)	• TC • DFO	• Navigation Protection Program Approval • Authorization for work that may result in death of fish or HADD of fish habitat
Sediment Management	BHETF components: Sludge removal, hydraulic dredging, and mechanical excavation from effluent ditching, twin settling basins, ASB and BHSL Estuary if needed: Sludge removal, hydraulic dredging and mechanical excavation effluent and leachate pretreatment, and discharge to estuary	• *Canadian Navigable Waters Act* (2019) • *Fisheries Act* (1985)	• TC • DFO	• Navigation Protection Program Approval • Authorization for work that may result in death of fish or HADD of fish habitat
Bulk Water Management and Dewatering Effluent Management	Water treatment and discharge of treated water to the estuary	• To be Determined	• ECCC	• Authorization for this specific discharge will need to be determined
Leachate Management	Off-site hauling and disposal of leachate	• *Transportation of Dangerous Goods Act* (1992) and Regulations	• TC	• Carrier must comply with all applicable regulations

1.4.1.4 Federal Scientific, Regulatory and Technical Advice

NSLI has convened a Boat Harbour Environmental Advisory Committee (BHEAC), meeting monthly since January 2016, comprised of representatives of the Proponent, PLFN, academic scientific advisors from four Nova Scotia universities, and federal and provincial regulators and technical advisors. Representatives with subject matter expertise from ECCC, HC, DFO, TC, Public Services and Procurement Canada, and ISC participate. Project plans, progress reports and planning proposals are regularly vetted through the participants and federal advice on science, regulatory, and technical matters is actively solicited and incorporated in Project plans and Project direction.

1.4.2 Provincial

Under the Nova Scotia *Environment Act*, Schedule A of the EIA Regulations lists Designated Undertakings that will be subject to an Environmental Assessment. It was determined by the Minister of Environment on April 28, 2018 that the Project is a rehabilitation of an undertaking and is required to register as a Class II undertaking. Whereas pulp mills are listed as a Class II undertaking in Schedule A, and the Project consists of rehabilitating pulp mill effluent and treatment areas; the following sections of the Regulations may be applied to the proposed undertaking:

> *3. Application of the regulations*
>
> *(2) The Act and these regulations may apply to a modification, extension, abandonment, demolition or rehabilitation of an undertaking listed in Schedule "A" which was established either before or after March 17, 1995.*
>
> *11. Class I and Class II undertakings*
>
> *(3) If the Minister is of the opinion that any of the following is an undertaking, the Minister must classify the undertaking as either Class I or Class II and must advise the proponent in writing of the classification and, if not already registered, the requirement to register the undertaking in accordance with the Act and regulations:*
>
> *(b) a modification, extension, abandonment, demolition or rehabilitation of an undertaking*

The Minister of the Environment informed NS Lands on April 10, 2019 that a provincial Environmental Assessment (EA) is no longer required for this Project (see Appendix B – Record of Consultation). As such, the Project is subject to the federal EA process under CEAA 2012 only.

1.4.2.1 Provincial Legislative and Regulatory Requirements

Table 1.4-2 summarizes the provincial legislative and regulatory requirements that may be applicable to the Project.

Table 1.4-2 Anticipated Provincial Legislative and Regulatory Requirements

Project Activity	Activity Description	Applicable Legislation	Agency	Required Approval or Permit
Entire Project	Use of Crown Lands	• *Crown Lands Act* (1989)	• Government of Nova Scotia - Department of Lands and Forestry (NS DLF)	• Application for the Use of Crown Land
Entire Project	Breaking ground	• *Special Places Protection Act* (1989)	• Department of Communities, Culture, and Heritage	• Category C Archaeological Resource Impact Assessment Permit may be required depending on conditions in Environmental Assessment Approval
Entire Project	All remediation activities. (Note: a separate Industrial Approval [IA] will be obtained for waste management, see waste management activity below)	• *Environment Act* (1995) • *Beaches Act* (1989)	• NSE • NS DLF	• New Industrial Approval • Decommissioning of the BHETF including: – Decommissioning – Remediation – Wastewater treatment – Monitoring – Composting • A permit may be required where crossing a beach is needed or for removal of materials
Entire Project	Service connection/ modification for overall Site power	• *Nova Scotia Power Privatization Act* (1992)	• Nova Scotia Power (Emera Company)	• Service Connection
Bridge construction at Highway 348	Construction of a single-span concrete structure	• *Environment Act* (1995) • *Public Highways Act* (1989)	• NSE • Transportation and Infrastructure Renewal	• Watercourse Alteration • Highway Right of Way (ROW) Permit
Bridge Construction at Highway 348	Service connection for lighting (NSTIR)	• *Nova Scotia Power Privatization Act* (1992)	• Nova Scotia Power (Emera Company)	• Service Connection
Bridge Construction at Highway 348	Service connection for water main heat tracing (PLFN)	• *Nova Scotia Power Privatization Act* (1992)	• Nova Scotia Power (Emera Company)	• Service Connection

Table 1.4-2 Anticipated Provincial Legislative and Regulatory Requirements

Project Activity	Activity Description	Applicable Legislation	Agency	Required Approval or Permit
Waste Management	Vertical expansion and enhancement of existing containment cell including temporary waste relocation, waste placement, and long-term leachate management	• *Environment Act* (1995) • *Beaches Act* (1989)	• NSE • NS DLF	• An Amendment to the existing IA • A permit may be required where crossing a beach is needed or for removal of materials
Wetland Management	Ex Situ remediation – de-watering of impacted wetlands in former settling ponds 1, 2, and 3. Excavation using land-based earthmoving equipment. Subsequent infilling, regrading, planting, and re-seeding	• *Environment Act* (1995)	• NSE	• Wetland Alteration Approval(s)
Infrastructure Decommissioning – Pipeline	Cap pipe and abandon in place. Complete removal of a section of the pipeline from the shoreline of Indian Cross Point east up to the Highway 348 property line	• *Environment Act* (1995) • *Beaches Act* (1989)	• NSE • NS DLF	• Include in IA for entire Project • A permit may be required for crossing a beach or for removal of materials associated with removal of the pipeline at the shoreline of Indian Cross Point
Infrastructure Decommissioning – Treatment buildings	Chemical sweep, cleaning, substance removal, potential demolition. Footing and foundations cut and buried	• *Environment Act* (1995)	• NSE	• Include in IA for entire Project
Infrastructure Decommissioning - Dam	Demolished using mechanical equipment. Removal of earthen berm connecting the dam to the banks	• *Environment Act (1995)*	• NSE	• Watercourse Alteration Approval

NOVA SCOTIA

Table 1.4-2 Anticipated Provincial Legislative and Regulatory Requirements

Project Activity	Activity Description	Applicable Legislation	Agency	Required Approval or Permit
Sediment Management	Sludge removal, hydraulic dredging and mechanical excavation from effluent ditching, twin settling basins, ASB, and BHSL	• *Environment Act* (1995)	• NSE	• Watercourse Alteration Approval • Wetland Alternation Approval • Include in IA for entire Project
Bulk Water Management and Dewatering Effluent Management	Effluent and leachate pretreatment and discharge to estuary	• *Environment Act* (1995)	• NSE	• Water Allocation Approval
Construction of Leachate Management Infrastructure	Pump station construction	• *Special Places Protection Act* (1989)	• Department of Communities, Culture, & Heritage	• Category C Archaeological Resource Impact Assessment Permit may be required depending on conditions in EIS Approval
Leachate Management	Operation of long-term leachate management system (holding and haulage)	• *Environment Act* (1995)	• NSE	• Include in IA for entire Project

1.4.3 Municipal

As noted in Section 1.3.2, the Study Area is subject to the (Draft) Pictou County Land Use By-Law, dated May 6, 2014, and the majority of the lands are not zoned. The southern portion of the PLFN land within the Study Area, however, is zoned as "Forest Management Area" and the northern portion, containing residences, is zoned as "Residential", according to the Pictou Landing Band By-Law No. 1.

Table 1.4-3 summarizes the municipal legislative and regulatory requirements that may be applicable to the Project.

Table 1.4-3 Anticipated Municipal Legislative and Regulatory Requirements

Project Activity	Activity Description	Applicable Legislation	Agency	Required Approval or Permit
Entire Project	Construction of new building(s) and demolition of existing treatment buildings and structures	• *Municipal Government Act* (1998)	• Municipal By-Laws of the Municipality of Pictou County	• A building permit will be required for the demolition works • Adherence to the following Pictou Country by-laws will be required: – Building By-Law – Sewage and Sludge Licensing By-Law – Solid Waste Resource Management By-Law – Spring Road Weight Restriction By-Law

Environmental Impact Statement

Section 2 | Project Justification and Alternatives Considered

Boat Harbour Remediation Project
Pictou Landing, Nova Scotia

Nova Scotia Lands Inc.

Table of Contents

Figure Index

Table Index

NOVA SCOTIA

2. Project Justification and Alternatives Considered

2.1 Project Purpose

The purpose of the Boat Harbour Remediation Project (the Project or BHRP) is to remediate Boat Harbour, and lands associated with the Boat Harbour Effluent Treatment Facility (BHETF), following environmental approvals. The goal of the Project is to return Boat Harbour to a tidal estuary, which necessitates the remediation of contaminated sediments within Boat Harbour. Through the proposed Project, it is Pictou Landing First Nation's (PLFN) desire and vision that Boat Harbour, (known to PLFN as A'se'k) be remediated and eventually be naturally restored to allow the community to re-establish its relationship with the water and land of A'se'k. In this regard, the Project's effects on health, socio-economic conditions, and physical and cultural heritage as a result of changes caused through remediation activities are net positive in relation to PLFN.

The Project reflects the Province of Nova Scotia's (Province) commitment to ceasing the reception and treatment of new effluent to the BHETF by January 31, 2020 in accordance with the *Boat Harbour Act* 2015. As part of the remediation work, the existing causeway along Highway 348 and the dam would be removed and replaced with a bridge to allow return to tidal conditions and permit boat access to Boat Harbour.

As noted in Section 1.2, the main components of the BHETF include the wastewater effluent pipeline (over 3 kilometres [km] in length) that extends from the Kraft Pulp Mill eastward, underneath the East River, to the BHETF property, settling basins and an Aeration Stabilization Basin (ASB) west-southwest of Boat Harbour, and Boat Harbour Stabilization Lagoon (BHSL). Effluent from Boat Harbour discharges through a dam (northeast of Boat Harbour) into an estuary before being released to the Northumberland Strait. Prior to the construction of the settling basins and ASB, effluent was routed by open ditch from the pipeline on the east side of Highway 348 to natural wetland areas (Former Ponds 1, 2, and 3) before being discharged into BHSL. A complete list of Project components to be constructed, operated, decommissioned, and reclaimed is provided in Section 1.2.

As shown on Figure 1.2-1 (Section 1.2), the Site Study Area spans from the first standpipe on the Kraft Pulp Mill property, through the effluent pipeline, described above, through existing and historic BHETF lands, Boat Harbour and its banks, extending to Northumberland Strait, and PLFN, located between Boat Harbour and Northumberland Strait.

Under operating conditions until January 30, 2020 when the use of the BHETF ceased, up to 75,000 cubic metres (m^3) of wastewater was discharged from the Kraft Pulp Mill to the BHETF daily. Wastewater was conveyed by the wastewater effluent pipeline and raw effluent ditch to the settling basins where partial removal of suspended solids occurred. One settling basin was used at a time (duty basin), while the other basin was dewatered, and previously settled solids were removed from the basin and transported off-site to the Kraft Pulp Mill for disposal. An automated nutrient addition system added urea and diammonium phosphate to the effluent as it was conveyed through a second effluent ditch to the ASB. Floating aerators were used to aerobically treat the effluent within the ASB prior to discharge into Boat Harbour. The ASB discharge point to Boat Harbour (Point C) was governed by the discharge criteria specified in the BHETF Industrial Approval (IA)

(No. 2011-076657-A01). As the effluent flowed through the dam from Boat Harbour into the estuary, it was also monitored at Point D in accordance with the IA and Pulp and Paper Effluent Regulation (PPER). A schematic representation is provided as Figure 2.1-1.

NOVA SCOTIA

Figure 2.1-1 Boat Harbour Effluent Treatment Facility Site Schematic

The 6.7 hectare (ha) containment cell is located southeast of the ASB. As shown on Figure 1.2-1, the containment cell is located on provincially-owned lands. The containment cell is adjacent to undeveloped mixed woodlands and Indian Reserve Lands (including IR37 to the south and IR24G to the east). Access to the containment cell is via a single lane gravel roadway via the ASB perimeter road. The containment cell is secured by a perimeter fence with an access gate at the northwest corner. The containment cell is operated under IA No. 94-032 and is separate from the BHETF.

Hydraulically dredged sludge from the ASB is conveyed as a slurry into the containment cell on a routine basis, typically annually. In addition, dewatered sludge from the settling basins was reportedly transferred to the containment cell from 1996 to 1998. It is understood that prior to 2004, sludge material in the containment cell was pushed/dozed into a mound on the western portion of the cell which currently forms a solid mass. Hydraulically dredged sludge is placed in the eastern portion of the cell, which is currently under wet conditions. Based on a survey completed by GHD in 2016, the containment cell contains approximately 180,000 m^3 of waste; including approximately 51,000 m^3 of sludge forming the western solid portion of the cell, and approximately 129,000 m^3 of sludge/water in the eastern wet portion of the cell.

The containment cell was designed as a single cell with a total capacity of 220,000 m^3 (waste) to facilitate placement of sludge to the top of the perimeter berm (elevation 12 metres above mean sea level [mAMSL]). The containment cell is lined with 0.6 metres (m) of clay-till, with a hydraulic conductivity of approximately 1×10^{-6} centimeters per second (cm/s). The containment cell includes leak detection system and a leachate collection system and decanting system. All systems are connected by a 0.3 m diameter polyvinyl chloride (PVC) pipe gravity pipe and manhole system that discharges to the ASB.

An overflow pond is located immediately east of the containment cell. The eastern berm of the containment cell includes two emergency overflow spillways to discharge excess surface water from the containment cell to the overflow pond. A catch basin, located within the overflow pond, discharges surface water from the pond to a manhole (MH4) and ultimately to the ASB.

Samples of the Kraft Pulp Mill raw effluent (collected during production and while under routine maintenance) were compared to applicable provincial or federal surface water criteria, as well as provincial or federal human health criteria for drinking water. Results indicated both polychlorinated biphenyls (PCBs) and dioxins and furans were below the applicable criteria, while metals exceed the marine criteria for barium, boron, cadmium, copper, lead, mercury, and zinc. Metals parameters reported to exceed the provincial human health criteria were sodium and vanadium.

The BHETF contains approximately 1,390,000 m^3 of unconsolidated contaminated sludge/sediment including approximately 634,000 m^3 unconsolidated sludge/sediment within Boat Harbour, 311,000 m^3 in the wetlands, 129,000 m^3 in the ASB and smaller amounts throughout the BHETF. In addition, approximately 180,000 m^3 of sludge has historically been placed in the containment cell. Once consolidated through dewatering, the total dewatered sludge/sediment volume to be managed is estimated to be between 770,000 and 922,400 m^3. The sludge is impacted with metals, polycyclic aromatic hydrocarbons (PAHs), and dioxins and furans. In addition to management of sludge/sediment, the anticipated volume of wastewater to be generated through remediation of the BHETF is an estimated 5,700,000 m^3. This volume includes bulk water (wastewater in the settling basins, ASB, and BHSL) and sludge/sediment dewatering effluent. In addition to bulk water and dewatering effluent, combined groundwater and surface water contributions to BHSL is estimated at an average of 28,000 m^3 per day, which will also need to be managed during remediation of the BHETF.

2.2 Alternative Means

2.2.1 Alternative Means Process

Environmental Impact Assessments (EIAs) for designated projects must consider alternative means of carrying out the Project that are technically and economically feasible, as well as the environmental effects of any such alternatives.

The process for consideration of alternative means is outlined in the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) Operational Policy Statement entitled, "Addressing", "Purpose of" and "Alternative Means" under the CEAA 2012.

Alternative means of carrying out the Project are defined as means of similar technical character or methods that are functionally the same. Alternative means differ from alternatives in that they represent the various technical and economically-feasible ways that a project can be carried out, and which are within the Proponent's scope and control.

With the above in mind, alternative means of carrying out the Project that are technically and economically feasible were identified and considered in addressing the purpose of the BHRP in accordance with the Environmental Impact Statement (EIS) Guidelines. Although not required under the Operational Policy Statement, the evaluation also considered the regulatory, environmental, and social aspects. The EIS Guidelines specify that, at a minimum, the alternative means analysis must address the following Project components:

- Remediation and disposal options for hazardous waste (solid and liquid)
- Dredging methods
- Access to the Site
- Location of key Project components
- Energy sources to power the Site
- Management of water supply and wastewater
- Water management

In light of this, the Alternative Means of carrying out the Project were defined to address the following components:

- Waste Management – remediation and disposal options for hazardous waste (solid and liquid)
- Dredging – dredging methods
- Wetland Management
- Water Management
  - Bulk Water Management
  - Dewatering Effluent Management

- – Leachate Management
- Bridge at Highway 348
- Infrastructure Decommissioning
  - – Pipeline – on land
  - – Pipeline – under water
  - – Treatment buildings
  - – Dam
- Remediation Infrastructure
  - – Energy sources to power the Site

2.2.1.1 Identification of Alternative Means

The process of identification of Alternative Means involved the establishment of design requirements, development of an evaluation and weighting matrix, option analysis, pilot scale testing and assessment of risks through the completion of a Human Health and Ecological Risk Assessment (HHERA).

Design Requirements

Prior to the identification of Alternative Means, design requirements were developed for each of the Project components. The design requirements were developed using a brainstorming approach with subject matter experts and a collaborative design requirements workshop with NS Lands Inc. (NSLI) and selected stakeholders, to identify required design elements and gain consensus on the criteria to be used.

Design requirements established for each Project component included:

- *Functional Requirements* **|** States what the system is required to do and what legislation must be met, (if any). Functional requirements include technical details or other specific functionality that define what a system is supposed to accomplish - functional requirements specify particular results of a system.
- *Non-Functional Requirements* **|** State what the system shall be; that is, an overall property of the system as a whole. Non-Functional requirements identify the required physical characteristic of the system or component (i.e., mass, dimension, volume).
- *Performance Requirements* **|** State how well the system does what it is required to do; that is, performance is an attribute of the system's function. Performance requirements are a type (or sub-set) of non-functional requirements which impose constraints on the design or implementation.
- *Safety Requirements* **|** State the means to protect the health and safety of workers and general public.
- *Operational Requirements* **|** State the requirements of the system during implementation and the post remediation operation and maintenance phase, and the applicable permit requirements.

- *Proven Technology Requirements* **|** State that the system proposed is a proven technology that has been used in similar applications.

The design requirements are documented in the Design Requirement Document (GHD, September 2017).

Evaluation and Weighting Matrix

The evaluation criteria and weighting matrix was developed for evaluating Feasible Concepts for each of the Project components. The evaluation criteria and weighting matrix included both qualitative and quantitative components and serves to establish project priorities. The criteria and weighting matrix was developed in advance of developing Feasible Concepts to ensure that the recommended remediation approach is unbiased, traceable, and best aligns with projects goals. The evaluation and weighting matrix was developed by GHD and collaborative workshop with NSLI and selected stakeholders, to identify and gain consensus on the evaluation criteria to assess the Feasible Concepts.

The evaluation criteria was developed for Indicator categories: Regulatory, Technical, Environmental, Social, and Economic Indicators and is presented in the Evaluation Criteria and Weighting Matrix technical memorandum (GHD, September 2017).

Option Analysis

GHD implemented a logical and stepped approach for the identification and assessment of remedial components; the methodology began with the identification of Approaches for each remedial component, which were then broken down to Alternative Means. The initial identification of Alternative Means for each remedial component was largely based on technical expertise of the team, collaboration with subject matter experts, and research. The Alternative Means were refined through collaborative workshops with NSLI and select stakeholders. As necessary, the process was supported by communication with vendors to obtain proof of performance and/or to better understand limitations and challenges associated with specific approaches. Bench scale testing was also performed to identify optimum technologies for treatment of sediment, surface water, and dewatering effluent.

Alternative Means remaining following the workshop were carried into the assessment of potential remedial technologies, as documented in the Remedial Option Decision Document (RODD) (GHD, May 2018).

Through the application of filters (binary and comparative), Alternative Means that were not feasible were eliminated. The remaining feasible Alternative Means, which were likely to be most suitable for application on the Project, were then assembled into Feasible Concepts. The Feasible Concepts were screened to confirm compliance with the design requirements identified in the Design Requirement Document (GHD, September 2017). The Feasible Concepts passing the screening were further developed to provide more detailed information (in the form of detailed concept descriptions) and evaluated using comparative Evaluation Criteria and Weighting Matrix (GHD, September 2017). The results of the comparative evaluation process yielded the selected Qualified Remedial Options put forward as recommended components for the BHRP. As part of the RODD development and assessment of Approaches and Alternative Means, a workshop approach was applied. Two workshops were held throughout the process to identify Approaches and Alternative

Means and then to assess the Alternative Means carried forward. The workshop participants included team members from GHD, Nova Scotia Lands Inc. (NSLI), and selected regulatory agencies.

NSLI initiated formal consultation with the Mi'kmaq of Nova Scotia on April 19, 2018 (under the existing Mi'kmaq-Nova Scotia-Canada Consultation Terms of Reference, August 31, 2010) which included the provision of the RODD for their review. NSLI received formal correspondence from the Mi'kmaq of Nova Scotia, because of the consultation, on May 31, 2018.

NSLI then developed and presented specific remedial options relative to each Project component to the Nova Scotia Executive Council on August 9, 2018. The remedial options presented to Nova Scotia Executive Council considered the Preliminary Draft Project Description, the positions laid out in the formal correspondence from the Mi'kmaq of Nova Scotia arising from the consultation, and the analysis of the Proponent Project Team. The Project description detailed herein incorporates direction subsequently received from the Nova Scotia Executive Council.

Pilot Scale Testing

To resolve uncertainties and verify the assumptions carried in the RODD, pilot scale testing was completed and consisted of the determination, validation, and verification of selected technologies for the remediation of the BHETF. The Pilot Scale Testing Program included isolation berm construction, aqua dam installation, silt curtain installation, bulk dewatering, sludge excavation using mechanical and hydraulic dredging technologies, slurry dewatering using Geotubes® or equivalent technology, n-site management of dewatered sludge, dewatering effluent treatment system optimization, provision for Cape Breton University's (CBU) dewatering effluent treatment process, and bulk water treatment system optimization. The pilot scale testing results (with the exception of CBU dewatering effluent treatment process) are provided in the Pilot Scale Testing Report (GHD, December 2019) and include separate memos on the success of and favourable results for water treatment (excluding CBU results), hydraulic dredging and Geotube® or equivalent technology dewatering, air quality, geotechnical, and confirmatory sampling.

HHERA

GHD also conducted a quantitative HHERA and Supplemental Site Investigation (SSI) for the Boat Harbour Effluent Treatment Facility (including the outfall to the Northumberland Strait) (collectively referred to as HHERA Study Area). The purpose of the HHERA was to assess potential risk to human health and ecological receptors from exposure to chemicals of potential concern (COPCs) previously identified to exceed the Nova Scotia Tier 1 Environmental Quality Standards (EQSs) in soil, sediment, surface water, and groundwater at the Site. Specific components of the HHERA program included refining the Conceptual Site Models (CSMs) previously developed for the BHETF, as well as completing a preliminary pathway specific screening of COPCs in various media and a detailed review of potential human and ecological receptors. The SSI was completed to supplement the existing dataset and provide Site-specific data, including invertebrate, plant, fish and game tissue analyses, to develop robust and scientifically defensible HHERA exposure models. Results of the HHERA were used to determine if remediation or additional risk management is required to be incorporated into the remedial design for the BHTEF or if natural attenuation is a technically and socially feasible remedial option for specific areas of the Project.

The findings from the Pilot Scale Testing Program and the final draft HHERA (GHD, February 2020) were used to refine the Qualified Remedial Options and determine the Alternative Means to be considered in the EIS.

2.2.1.2 Summary of Approaches and Alternative Means Considered

In developing the Alternative Means, NSLI took into account the overall vision of the Project that was developed through consultation and engagement with PLFN. Through the proposed Project, it is PLFN's desire and vision that Boat Harbour (known to PLFN as A'se'k) be returned to tidal estuary and allow the community to re-establish its relationship with the water and land of A'se'k. Further documentation on the establishment of the vision for Boat Harbour and engagement with PLFN on this topic is presented in Sections 5 and 6 of this EIS.

As documented in the RODD and noted above, approaches for each remedial component were broken down to Alternative Means based on technical expertise of the team, collaboration with subject matter experts, and research. Through the application of filters, Alternative Means that were not feasible were eliminated. Below is an overview of the approaches considered and those carried forward for evaluation as Alternative Means for each of the Project components.

2.2.1.2.1 Waste Management

Five approaches were initially identified for Waste Management including:

- Use of Existing Cell
- Develop New Cell
- Use New and Existing Cell
- Off-Site Disposal
- Treatment through incineration, thermal destruction and separation

Only four of the five approaches were carried forward in the option analysis as detailed below. Treatment through incineration, thermal destruction, and/or separation was not carried forward. The use of incineration as a method of waste management was not considered further based on potential impact to air emissions through incomplete destruction, public opposition to this technology on other sites within Nova Scotia, and that a facility of this nature has not been previously granted regulatory approvals within Nova Scotia. Following bench scale testing by a vendor and GHDs subsequent review of the results under a non-disclosure agreement, the use of thermal destruction and/or separation was not considered further as the technology was not proven, and the risk of performance could not be reasonably mitigated.

As such four approaches were carried forward for the management of waste generated as part of the remediation of the BHETF. It is noted that under each approach, the existing containment cell would be left in place. The four approaches reviewed are as follows:

A. Use Existing Containment Cell | This Approach consisted of the use of the existing containment cell to manage waste generated as part of remediation. The containment cell has received sludge originating from the BHETF under IA 94-032 since 1996. The disposal cell operates under a separate approval from the BHETF.

B. Develop New Containment Cell | This Approach consisted of the establishment of a new containment cell using the existing settling basins as the preferred containment cell location. This proposed location is ideal as it is an already disturbed area on provincial land and is currently accessible using the BHETF site access road (Simpsons Road).

C. Use Existing and New Containment Cell | This Approach combines aspects of the above two Approaches through use of the existing containment cell and development of a new containment cell within the existing settling basins. This Approach was developed to provide the flexibility to manage a potentially greater volume of waste that may be generated as a result of the remediation of BHETF.

D. Off-site Disposal | This Approach consisted of hauling the waste materials to a licensed off-site facility.

Approach A and D were carried forward for further evaluation. Approach B and C were eliminated during the first filtering step and were removed from further development and evaluation as a Feasible Concept. Development of a new on-site containment cell was common to both Approaches and was considered unlikely to be acceptable by stakeholders due to setback distances from adjacent properties and Boat Harbour; and due to visual appearance (i.e., mound height relative to surrounding grade in center of potentially usable land area).

Over the period April 2017 to present, it became apparent that the most significant environmental concern of the PLFN community members is the waste management aspect, using the existing containment cell, adjacent to Boat Harbour. The use of the containment cell on the BHETF site was the specific subject of a community meeting in PLFN in June 2018. Subsequently, PLFN Chief and Council leadership made a decision to hold four focus groups separately with Youth, Elders, Men, and Women to discuss this matter. The four focus group meetings were held separately in September and October 2018. In addition, a fifth focused meeting was held on October 30, 2018 to enable any PLFN community members who missed the focus group opportunities to be informed on the issue of waste management. These meetings were an opportunity for GHD and the NSLI Project team to present information on how containment cells are constructed, how they function, and how they are managed, maintained and monitored as well as to discuss the enhanced design and integrity of the containment cell adjacent to Boat Harbour.

2.2.1.2.2 Sediment Management (Dredging)

Three Approaches were identified for the sediment/sludge treatment as part of the BHRP implementation and carried forward to the option analysis:

A. Natural Attenuation | This Approach involved natural attenuation of contaminants, which is commonly used as a remedial option to address residual impacts to an ecosystem after the contaminant source has been removed or eliminated.

B. Removal | This Approach involved sludge removal from impacted areas and ex-situ sludge management. Removal may be completed in wet or dry conditions.

C. Manage in Place | This Approach involve in-situ remediation Approaches to address contamination in place without the removal of the sludge.

For remediation of the effluent ditches, settling basins, ASB, and BHSL Approach A and Approach C failed the first filter. Only, Approach B, complete removal of sludge passed the first filter and was deemed to be acceptable to stakeholders as reconnection of the community to A'se'k without recreational/traditional use which was deemed to be unacceptable.

For the estuary, Approach C, (Manage in Place) failed the first filter due to lack of acceptability as reconnection of the community to A'se'k needs to include the estuary. Although Approach C would provide an environment for recreation, public acceptance is unlikely. Given the wetland characteristics of the estuary, Approach A, natural attenuation was carried forward for the estuary, even though stakeholder acceptability is considered low. However over time, acceptance would likely increase as monitoring proved natural attenuation is occurring. Approach B, complete removal of sludge also passed the first filter and was deemed to be acceptable to stakeholders.

2.2.1.2.3 Wetland Management

Two Approaches were identified for the management of wetlands as part of the BHRP implementation and carried forward to the option analysis:

A. Natural Attenuation | This Approach involved natural attenuation of contaminants, which is commonly used as a viable remedial option to address residual impacts to an ecosystem after the contaminant source has been removed or eliminated.

B. Remediation | This Approach involved remediation of impacted sludge in the wetlands either through in-situ or ex-situ remediation Alternative Means. In-situ remediation refers to techniques to address contamination in place without the removal of the sludge (e.g., encapsulation or treatment); while ex-situ remediation involves direct removal of sludge from the wetlands.

Both Approach A and B passed the application of the first filter and were therefore carried for further evaluation.

2.2.1.2.4 Water Management

Two Approaches were identified for water management as part of the BHRP implementation and carried forward to the option analysis. These Approaches included:

A. On-site Management | This Approach involved on-site management using appropriate technology in a wastewater treatment system prior to discharge to a natural water body.

B. Off-site Management | This Approach involved off-site management consisting of a conveyance system to a wastewater treatment plant (WWTP), with or without pre-treatment.

For dewatering effluent and bulk water, Approach A passed the first filter and was carried forward for further evaluation. Approach B was deemed cost prohibitive and was not carried forward for further evaluation.

For leachate, both Approach A and B passed the application of the first filter and were both carried forward for further evaluation.

Following pilot scale testing, including gaining an understanding of the freshwater inflows to BHSL from groundwater recharge and surface water, it was determined that pre-treatment of dewatering effluent and bulk water could be readily achieved through natural attenuation.

2.2.1.2.5 Bridge at Highway 348

Two Approaches were identified for the Bridge at Highway 348 and carried forward to the option analysis:

A. Do Nothing | This Approach involves leaving the existing causeway in place.

B. Demolish and Replace Infrastructure | This Approach involved demolishing the existing causeway at Highway 348 and replacement of the causeway with a bridge.

Of the two Approaches considered, only Approach B was determined to be an Approach that warranted further evaluation. Approach A did not meet end use or functionality requirements (i.e., return to tidal conditions), and was also considered unlikely to receive acceptance from the public.

2.2.1.2.6 Infrastructure Decommissioning

2.2.1.2.6.1 Pipeline

Five Approaches were identified for decommissioning the pipeline as part of the overall infrastructure decommissioning to be conducted during BHRP implementation:

A. Do Nothing | This approach involves leaving the pipeline in place.

B. Clean, Inspect, and Abandon | This Approach involved cleaning the pipeline to remove accumulated solid residue and other liquids that might otherwise be released during decommissioning activities, or pose as an environmental risk/liability should the pipeline be abandoned in place, followed by an inspection of the pipeline to confirm its integrity followed by cutting and capping the pipeline to render it not usable in the future.

C. Clean and Fill | This Approach involved cleaning of the pipeline as noted in Approach B followed by filling of the pipeline to render it unusable in the future.

D. Complete Removal | This Approach involved cleaning of the pipeline as noted in Approach B followed by excavation, removal, and disposal of the pipeline.

E. Clean and Collapse | This Approach involved cleaning of the pipeline as noted in Approach B followed by excavation and crushing of the top of the pipeline, and backfilling with clean fill.

Of the five Approaches considered, only the Do Nothing alternative (Approach A) was removed from further consideration for the on-land pipeline as it failed due to long-term liability and potential environmental impact considerations due to potential failure/collapse. This Approach was also unlikely to meet anticipated landowner requirements.

Of the five Approaches considered, for the underwater pipeline both the Do Nothing (Approach A) and Complete Removal (Approach D) were removed from further consideration, as both failed to minimize long-term environmental impacts and were unlikely to meet regulatory requirements. Complete removal was considered to likely cause substantial disturbance to any established aquatic environments. All other Approaches were determined to warrant further evaluation and were therefore carried forward for further evaluation. It is noted that the Approach decision for the section of the pipeline between the East River and Highway 348 was delegated to PLFN as that specific section is adjacent to historic burial grounds. In January 2020, PLFN decided that the Approach for the pipeline adjacent to the historical burial grounds should be Approach D Complete Removal. (Refer to Section 5 for details surrounding PLFNs decision).

2.2.1.2.6.2 Treatment Buildings

Three Approaches were identified for decommissioning of the treatment buildings as part of the overall infrastructure decommissioning and carried forward to the option analysis:

A. Do Nothing | This involves leaving the buildings in place.

B. Demolish | This Approach involved the decommissioning and demolition of multiple BHETF buildings in an environmentally sound manner and in accordance with acceptable health and safety practices.

C. Repurpose | This Approach involved repurposing a building consistent with overall Site end use objectives.

The Do Nothing (Approach A) was removed from further consideration, as it failed to minimize long-term liability and was unlikely to meet anticipated decommissioning requirements. Both Approach B (Demolish) and Approach C (Repurpose) passed the first filter. Approach C was not carried as an Alternative Means, however if repurposing a building for beneficial transfer to PLFN is identified as a desirable alternative, then decommissioning and repurposing will be done in an environmentally sound manner and in accordance with acceptable health and safety practices.

2.2.1.2.6.3 Dam

Three Approaches were identified for decommissioning of the dam as part of the overall infrastructure decommissioning and carried forward to the option analysis:

A. Do Nothing | This involves leaving the dam in place.

B. Demolish | This Approach involved the decommissioning and demolition of the dam in an environmentally sound manner and in accordance with acceptable health and safety practices.

C. Repurpose | This Approach involved repurposing the dam consistent with overall Site end use objectives.

The Do Nothing (Approach A) and Approach C (Repurpose) failed the first filter as they did not meet the long-term requirements of returning Boat Harbour to a tidal estuary.

2.3 Alternative Means by Project Component

2.3.1 Waste Management

A component of this Project consists of the disposal of non-hazardous waste, hazardous waste, construction and demolition debris, and industrial waste generated from the proposed remediation of Boat Harbour and lands associated with the BHETF.

Description of the Alternative Means of Carrying Out the Undertaking for Waste Management

Alternative Means were developed incorporating the feasible components that passed the preliminary screening requirements. A brief description of each of the Alternative Means is provided in the subsections below.

Alternative Mean 1 – Use Existing Containment Cell

In 1994, an IA 94-032 was issued by NSE for the construction and operation of the containment cell. The containment cell operates under a separate approval from the BHETF, which operated under Approval (2011-076657-R03).[1] issued by NSE for operation of the Kraft Pulp Mill.

The 6.7 ha containment cell is located southeast of the ASB and has a total capacity of 220,000 m^3 (waste). The containment cell is located on provincially-owned lands and is surrounded by undeveloped mixed woodlands and First Nation reserve lands (including IR37 to the south, IR24G to the east, and IR24 (PLFN to the north, opposite BHSL). Access to the containment cell is via a single lane gravel roadway off the ASB perimeter road. The containment cell is secured by a perimeter fence with an access gate at the northwest corner.

Alternative Mean 1 involves using the existing containment cell and placing waste materials in excess of the current design capacity. It is noted that in the Operations and Maintenance Manual[2], the design capacity could be exceeded based on the physical properties of the waste materials and the recommended final elevations could be determined as part of the containment cell closure plan.

Under Alternative Mean 1, the containment cell would be modified to enhance the base liner system and leachate collection system to facilitate placement and dewatering of the sludge/sediment in a one-step operation.

The final containment cell cover contours would be designed to accommodate the anticipated range of final waste volumes, minimize precipitation infiltration through the cap, control the release of landfill gas, and accommodate the anticipated end use.

Once the containment cell is completed with final cover, the post-closure annual leachate generation rate is estimated to be less than 2,500 m^3 per year and decreasing over time based on using a flexible membrane liner cover and assuming approximately 1,200 mm of rainfall per year[3].

Leachate would be disposed of off-site at an NSE approved facility. Acceptance of the leachate at an NSE approved facility would be dependent on the strength and parameters in the leachate, as such leachate would need to be disposed of at an industrial facility approved to receive the waste for disposal or treated on-site. Leachate quality was characterized as part of pilot scale testing; and would require additional testing post-closure prior to off-site disposal.

---

1 The Kraft Pulp Mill's Industrial Approval (No. 2011-076657-A01) expired on January 30, 2020. As a result, Nova Scotia Minister of Environment issued a Ministerial Order on January 29, 2020 (MO-55774).

2 Nova Scotia Department of Transportation and Public Works Operational and Maintenance Manual, Boat Harbour Disposal Cell, Boat Harbour Treatment Facility, Boat Harbour, Nova Scotia (Jacques Whitford Environment Limited, September 1999).

3 Based on a review of Lyons Brook weather station data for 1981-2010.

Alternative Mean 2 – Employ Off-site Disposal

Alternative Mean 2 consists of trucking waste materials to an off-site facility located within 175 km of the Site. There are four provincial municipal landfills located within 175 km of the Site that were initially considered. However, it was determined through correspondence with NSE, that the Boat Harbour containment cell is the only facility currently approved to receive the sludge/sediment for disposal in Nova Scotia; and that new or existing facilities seeking approval to dispose of dioxin and furan impacted sediment would be required to undertake a provincial and likely federal EIA. The use of the landfill at the Kraft Pulp Mill, which currently receives waste from the settling basin was also considered. However, through discussions with NSE it was determined that the facility is not approved to receive waste from the remainder of the BHETF, nor does it have the capacity or area for expansion to receive the volume of sludge/sediment waste to be generated through remediation of BHETF.

It is anticipated that construction and demolition (C&D) debris would be disposed of at a C&D disposal site. There are three C&D disposal sites in relative (<75 km) close proximity to the Site.

Straight trailers (or similar) pulled by a tractor will be used to haul materials to an off-site disposal facility. All vehicles transporting contaminated materials would be cleaned as needed and inspected prior to leaving the Site to ensure loads are secured. Manifests would be completed to track the transportation and disposal at licensed provincial facilities.

Assuming a trailer capacity of approximately 35 tonnes (tonnes or metric tonnes [MT]) and based on the anticipated sludge volumes and density, it is estimated that approximately 18,200 loads would be required to transport the treated sludge material off-site should a facility be approved through the EIA process.

Evaluation of Alternative Means of Carrying Out the Undertaking for Waste Management

The Alternative Means were evaluated, compared, and ranked qualitatively to identify the Preferred Alternative. The evaluation process involved application of evaluation criteria and the identification and comparison of advantages/disadvantages for each Alternative Mean. Upon completion of the comparative evaluation process, the comparison of advantages and disadvantages supports selection of Alternative Mean 1 (on-site disposal using the existing containment cell) as the Preferred Alternative (Table 2.3-1 below).

Table 2.3-1 Comparative Evaluation of the Alternative Means for Waste Management

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Existing Containment Cell	Alternative Mean 2 Off-site Disposal	Rationale
Regulatory	A measure of the ability of the Alternative Mean to meet the safety requirements of the Project, including the protection of both the health and safety of both workers and the general public. In addition, this criterion also measures the anticipated approvability of the Alternative Mean.	Health & Safety	Ability to Protect Health and Safety of Public	• What is the relative risk level to public health and safety posed by the Alternative Mean? • To what extent can the potential risks be mitigated as part of the Alternative Mean?	🟢	🔴	An identical volume of waste material would need to be managed for both alternatives; however, the subsequent handling and potential transportation of waste material varies for each. Alternative Mean 2 has a higher level of risk to public health and safety due to the significant increase in truck traffic required to haul the waste material off-site, as compared to Alternative Mean 1. The potential risks to the public related to waste management are generally considered to be easily mitigable and may include stopping work during inclement weather, altering or restricting truck routes and travel times to avoid peak traffic areas and times. Due to the significant volume of transportation required to move the treated waste material, there is an inherent level of risk associated with Alternative Mean 2, despite the ability to implement mitigation measures. As a result, Alternative Mean 1 is the preferred method.
			Ability to Protect Health and Safety of Workers	• What is the relative risk level to worker health and safety posed by the Alternative Mean? • To what extent can the potential risks be mitigated as part of the Alternative Mean?	🟢	🔴	The level of risk to worker health and safety associated with constructing the containment cell modifications and final cover and placement of waste in a cell under Alternative Mean 1 was considered to be less than the risk associated with Alternative Mean 2, due to the significant volume of transportation required under Alternative Mean 2. The potential risks to workers related to waste management are generally considered to be easily mitigatable and may include stopping work during inclement weather, altering or restricting truck routes and travel times to avoid peak traffic areas and times. Due to the significant volume of transportation required to move the treated waste material, there is an inherent level of risk associated with Alternative Mean 2, despite the ability to implement mitigation measures. As a result, Alternative Mean 1 is the preferred method.
		Compliance	Ease of Obtaining Approvals	• Does the Alternative Mean go beyond the minimum requirements for federal/provincial approvability? • What is the relative public acceptability of the Alternative Mean?	🟢	🔴	NSLI and GHD consulted with NSE to determine which, if any, landfill in the Province of Nova Scotia could accept the waste. NSE confirmed that no landfill is currently approved to accept the waste given the anticipated levels of dioxins and furans. Since no landfill within 175 km is approved to accept the waste and the existing containment cell is already approved by NSE to accept the sludge waste, Alternative Mean 2 ranked lower than Alternative Mean 1 in terms of meeting minimum approvability requirements. Both Alternative Means were considered to have only a moderate level of public acceptance from PLFN, surrounding communities, and communities surrounding a potential receiving landfill site. As a result, both alternatives rank the same in relation to public acceptability.
				REGULATORY RANKING:	🟢	🔴	**ALTERNATIVE MEAN 1 IS PREFERRED FROM A REGULATORY PERSPECTIVE**

Table 2.3-1 Comparative Evaluation of the Alternative Means for Waste Management

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Existing Containment Cell	Alternative Mean 2 Off-site Disposal	Rationale
Technical	A measure of the Alternative Means ability to meet the functional requirements of the Project.	Technical	Technical Maturity	• What is the relative successful "track record" for implementing the Alternative Mean? • What is the relative availability of the source materials/equipment? • What is the relative availability of vendors/contractors for the Alternative Mean?	🟢	🔴	Both on-site disposal in the existing cell and off-site disposal are considered reliable and successful approaches to managing the waste generated by the Project. However, due to the significant volume of waste material and potentially high concentrations of dioxins and furans, there are no provincial municipal landfills that would be able to accept the sludge waste, without additional studies and approvals. Therefore, Alternative Mean 2 ranked lower than Alternative Mean 1 in terms of providing a reliable and experienced approach to managing waste. Similarly, the materials and equipment required to implement both Alternative Means are readily available, as are the vendors and contractors required to implement the remediation. Both of the alternatives rank the same in terms of resources and personnel readily available to implement remediation. As a result, Alternative Mean 1 is the preferred method.
			Compatibility with Current Site Features	• What is the relative compatibility of the Alternative Mean with Site size and configuration? • What is the relative compatibility of the Alternative Mean with Site geology? • What is the relative compatibility of the Alternative Mean with Site hydrogeology? • What is the relative compatibility of the Alternative Mean with Site access? • What is the relative compatibility of the Alternative Mean with Site hydrology?	🟢	🟢	The compatibility of Alternative Mean 1 and Alternative Mean 2 with current on-site features was identified as an item that needed to be addressed, but one that could be accomplished readily without challenges or constraints. While Alternative Mean 2 was expected to be less compatible with existing off-site features, there was no perceived difference between the compatibility of each Alternative Mean with on-site features. An assessment of the existing containment cell was completed and determined that it is not causing an adverse effect to the groundwater and surface water or the hydraulic regime. Site access improvements will be required but would be established along a similar alignment to current Site access. Both Alternative Means rank the same in regard to compatibility with on-site features.
			Compatibility with Existing Off-site Features	• What is the relative compatibility of the Alternative Mean with existing features and infrastructure surrounding the Site (e.g., points of access, roads, and power lines)? • Does the Alternative Mean cause significant changes to off-site conditions (e.g., traffic)? • Does the Alternative Mean require upgrades or significant changes to the existing off-site infrastructure (e.g., upgrades to roads, power supply, municipal infrastructure)?	🟢	🔴	Spring road load restrictions on secondary roads would limit off-site transport, making Alternative Mean 2 less compatible with existing off-site features. Historically, restrictions have been implemented between mid-March to mid-May but are also dependent on weather conditions and the types of vehicles being used. Potential changes or impacts to off-site conditions due to the anticipated increase in traffic volume under Alternative Mean 2 was considered to be a significant and challenging constraint. While there was no perceived difference between the two Alternative Means in terms of anticipated changes to existing power supply or other municipal infrastructure off-site, implementation of Alternative Mean 2 was expected to require significant upgrades and repairs to secondary highways surrounding the Site. As a result, Alternative Mean 1 is the preferred method.
			Reliability/ Effectiveness/ Durability	• What is the relative expected service life of the Alternative Mean components relative to the remediation and post-remediation maintenance period?	🟢	🔴	Alternative Mean 1 is not expected to fail within the remediation and post-remediation period. The relative maintenance requirements associated with Alternative Mean 1, including long-term containment cell operation and maintenance and leachate

Table 2.3-1 Comparative Evaluation of the Alternative Means for Waste Management

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Existing Containment Cell	Alternative Mean 2 Off-site Disposal	Rationale
				• What is the relative maintenance requirements of the Alternative Mean during the remediation and post-remediation maintenance period? • What is the likelihood the Alternative Mean will meet performance criteria or remediation objectives? • What is the relative impact of the Alternative Mean not meeting performance criteria or remediation objectives? • What is the relative ease of implementation of contingency measures during the remediation and post-remediation maintenance period?			treatment throughout the remediation and post-remediation period, were considered moderate. The likelihood and resulting impact of not meeting performance criteria or remediation objectives was considered low for Alternative Mean 1. The relative ease of implementing a contingency measure for Alternative Mean 1 is considered reasonable. In comparison, since there is currently no off-site landfill in the Province approved to receive the waste, an existing or new site would need to go through the provincial and potentially federal EIA process. The likelihood of receiving approval combined with the performance of the landfill, ability to implement contingency measures, and long-term maintenance requirements associated with Alternative Mean 2, are unknown, and therefore present a risk to the successful completion of the Project. In addition, ownership of a potentially new containment cell is unknown and could result in additional liability to the proponent. As a result, Alternative Mean 1 is the preferred method.
			Remedial Implementation Time	• Can the Alternative Mean be constructed and fully operational within established time frame? • Anticipated time frame to implement Alternative Mean?	● (green)	● (red)	The anticipated timeframe required to implement Alternative Mean 1 was considered to be less than 4 years. Depending on the study and approval process for an existing or new landfill to be approved and potentially constructed to accept the waste, Alternative Mean 2 will likely take between 3-5 years for approval, plus construction and the filling for an estimated timeframe of 8-10 years.
			Readily Monitored and Tested	• How readily can the Alternative Mean be monitored and tested during remediation phase? • How readily can the Alternative Mean be monitored and tested during post-remediation phase? • What is the relative amount of monitoring required to validate effectiveness?	● (green)	● (red)	During the remediation phase, routine monitoring requirements should be similar for both Alternative Means. Alternative Mean 2 would consider more monitoring to ensure that the waste meets the waste acceptance criteria for the landfill site. Additional monitoring and testing would be more readily implementable on-site under Alternative Mean 1, since the containment cell is already approved to receive the waste generated from the Site. Similarly, during the post-remediation phase, Alternative Mean 2 would be more difficult to monitor in an off-site location. Additional testing is unlikely to be required; however, these tasks would become the responsibility of the landfill operator at the off-site facility. Additional monitoring and testing would be more readily implementable on-site under Alternative Mean 1. Both Alternative Means were considered to require similar (i.e., moderate) amounts of monitoring to ensure effectiveness. As a result, Alternative Mean 1 is the preferred method.
			Minimal Waste Generation (e.g., dewatering effluent, dredged sediments, leachate)	• What is the ability of the Alternative Mean to minimize waste generation during remediation? • What is the ability of the Alternative Mean to minimize waste generation during the post-remediation maintenance phase?	● (red)	● (green)	During the remediation phase, both Alternative Means were considered to generate minimal amounts of additional waste through implementation. During the post-remediation phase, Alternative Mean 1 was considered to generate a moderate amount of waste (in comparison to Alternative Mean 2) due to the additional leachate generated from the on-site containment cell which would need to be managed. In comparison, any leachate generated under Alternative Mean 2 at an

Table 2.3-1 Comparative Evaluation of the Alternative Means for Waste Management

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Existing Containment Cell	Alternative Mean 2 Off-site Disposal	Rationale
				• What is the ability of the Alternative Mean to minimize dangerous goods generation?			off-site landfill would be the responsibility of the facility operator; therefore, minimal waste generation was associated with Alternative Mean 2. Both Alternative Means were considered to generate minimal (i.e., negligible) amounts of hazardous/dangerous goods through implementation during the remediation phase. As a result, Alternative Mean 2 is the preferred method.
				TECHNICAL RANKING:	🟢	🔴	**ALTERNATIVE MEAN 1 IS PREFERRED FROM A TECHNICAL PERSPECTIVE**
Environmental	A measure of the potential effects to the environment posed by the Alternative Means during remediation and post-remediation phases of the Project. In addition, this criterion considers the impact of weather events on the susceptibility and suitability of the Alternative Mean to severe weather events.	Environmental	Remediation Phase Effects	• During the remediation phase, to what extent is the Alternative Mean likely to cause an adverse effect on: Atmospheric Environment, Aquatic Environment, Geology and Groundwater, Terrestrial Environment	🟢	🔴	Very little separated the environmental impact scoring of each Alternative Mean during the remediation phase. Alternative Mean 2 was less favourable for impacts to air quality (for the protection of public health) due to increased vehicle emissions and dust emissions associated with a significant increase in traffic volume during the remediation phase. As a result, Alternative Mean 1 is the preferred method.
			Post-Remediation Phase Effects	• During the post-remediation phase, to what extent is the Alternative Mean likely to cause an adverse effect on: Atmospheric Environment, Aquatic Environment, Geology and Groundwater, Terrestrial Environment	🟢	🔴	Both Alternative Means are similar in terms of their post-remediation effects on Atmospheric Environment, Aquatic Environment, Geology and Groundwater, Terrestrial Environment. During the post-remediation phase, Alternative Mean 1 may be slightly less favourable due to the potential for aquatic/groundwater interactions, however the site setting for an off-site landfill is unknown. As a result, Alternative Mean 1 is the preferred method as no information is available for Alternative Mean 2.
			Weather Effects	• What is the potential impact of weather on the implementation of the Alternative Mean? • What is the potential impact of weather on the Alternative Mean during the post-remediation period? • What is the suitability of the Alternative Mean under severe weather events during remediation and post-remediation phase (e.g., 1:100 design event)?	🟢	🟢	Both Alternative Means were considered to be somewhat susceptible to poor weather conditions during the management of waste in the remediation phase. In particular, seasonal restrictions or limitations to off-site transport on secondary highways affected Alternative Mean 2, while inclement weather would hinder use of on-site access roads under both Alternative Means. During the post-remediation phase, both Alternative Means are considered to be somewhat susceptible to inclement weather due to the potential for interactions with the leachate treatment system. As part of detailed design, severe weather would be taken into consideration when designing the upgrades to the containment cell under Alternative Mean 1. Similarly, municipal landfills are designed to manage severe weather. As a result, Alternative Mean 1 and 2 are considered equal.
				ENVIRONMENTAL RANKING:	🟢	🔴	**ALTERNATIVE MEAN 1 IS PREFERRED FROM AN ENVIRONMENTAL PERSPECTIVE**
Social	The social criterion is a measure of the acceptability and compatibility of the Alternative Mean to the immediately affected surrounding community	Social	Community Acceptance	• How acceptable is the Alternative Mean to the surrounding communities during remediation phase? • How acceptable is the Alternative Mean to the surrounding communities during the post-remediation phase?	🟢	🔴	Both Alternative Means were considered to have only a moderate level of community acceptance during the remediation phase. While some members of the surrounding community may embrace the removal of contaminants from the Site, the anticipated short-term response from the surrounding communities may be one of resistance, and may include: a reluctance to transport, store, and manage a significant volume of waste within the community; opposition to store and manage

Table 2.3-1 Comparative Evaluation of the Alternative Means for Waste Management

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Existing Containment Cell	Alternative Mean 2 Off-site Disposal	Rationale
	during remediation and post-remediation phases of the Project. In addition, this criterion considers the potential socio-economic benefit to the surrounding community as a result of implementation of the Alternative Mean.			• Does the Alternative Mean impact the surroundings community during remediation phase (i.e., safety, visual, nuisance)? • Does the Alternative Mean impact the surroundings community during post-remediation phase (i.e., safety, visual, nuisance)?			waste in the existing on-site containment cell; and opposition to the significant increase in the volume of truck traffic. During the post-remediation phase, once the sludge waste has been transported off-site to a licensed provincial municipal landfill under Alternative Mean 2, it is anticipated that there would be a high level of community acceptance for the remediation of the BHETF[4]. During the post-remediation phase under Alternative Mean 1 it is anticipated that there would be only a moderate level of community acceptance (initially), as it would take time to demonstrate the closed containment cell does not pose a risk to human health or the environment. It should be noted that the existing containment cell would remain on-site should Alternative Mean 2 (off-site disposal) take place. During the remediation phase, implementation of Alternative Mean 2 was considered to have a moderately negative impact on the surrounding communities; the increased volume of truck traffic could potentially have an impact on community safety, and may also negatively impact ambient air quality (e.g., increased dust) and noise levels. Implementation of Alternative Mean 1 was considered to have no net effect (i.e., either positive or negative) or impact on the surrounding communities during the remediation phase. Finally, both Alternative Means were considered to have no net effect (i.e., either positive or negative) or impact on the surrounding communities during the post-remediation phase. As a result, Alternative Mean 1 is the preferred method.
			Community Benefit	• Does the Alternative Mean affect the socio-economic environment including direct and indirect economic benefit impacts and social impacts (i.e., human health and recreational enjoyment)?	🟢	🔴	The remediation of Boat Harbour and return to tidal conditions would have direct and indirect positive social impacts on the surrounding communities, from increased recreational use of Boat Harbour, to allowing the PLFN community to re-establish its relationship with the water and land of A'se'k. From an economic perspective, remediation of Boat Harbour may increase tourism in the area once Boat Harbour is returned to tidal conditions. Implementation of Alternative Mean 1 has the added benefit of potentially providing long-term employment to the PLFN community through performance of monitoring and operation and maintenance for the closed cell. No long-term economic benefits directly attributable to Alternative Mean 2 were identified. As a result, Alternative Mean 1 is the preferred method.
		SOCIAL RANKING:			🟢	🔴	**ALTERNATIVE MEAN 1 IS PREFERRED FROM A SOCIAL PERSPECTIVE**
Economic	The economic criterion is a measure of the relative costs associated with the	Economic	Remediation Capital Costs	• What is the capital cost of the Alternative Mean?	🟢	🔴	The capital cost of Alternative Mean 1 (existing containment cell) was estimated to be $6,400,000. The capital cost of Alternative Mean 2 (off-site disposal) was estimated to range between $28,510,000 and $85,080,000, depending on the tip fee

4 Community acceptance was focused on the communities adjacent to the Site and not the community in the vicinity of a potential receiving site

NOVA SCOTIA

Table 2.3-1 Comparative Evaluation of the Alternative Means for Waste Management

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Existing Containment Cell	Alternative Mean 2 Off-site Disposal	Rationale
	implementation of the Alternative Means. Consideration is given to costs for planning and implementation (i.e., capital costs) and for ongoing operation and maintenance costs.						for dewatered sludge/sediment ($25-$115 per MT) which is 4 to 13 times higher than Alternative Mean 1. As a result, Alternative Mean 1 is the preferred method.
			Post-Remediation Operations & Maintenance Costs	• What are the typical annual post-remediation operation and maintenance costs for the Alternative Mean?	Not Preferred	Preferred	Once the waste has been moved to a licensed provincial landfill under Alternative Mean 2, the anticipated operation and maintenance costs are $0, as these tasks would become the responsibility of the landfill operator. However, there is a potential that if a new facility is sought the proponent could be the owner and therefore responsible for long-term care of the facility. The anticipated operation and maintenance costs under Alternative Mean 1 are considerably greater, requiring post-closure management of the containment cell for approximately 25 years[5]. The operation and maintenance costs are estimated to range from $5,500,000 to $17,000,000 depending on the leachate disposal option implemented. As a result, Alternative Mean 2 is the preferred method.
				ECONOMIC RANKING:	Preferred	Preferred	**BOTH ALTERNATIVE MEANS ARE PREFERRED FROM AN ECONOMIC PERSPECTIVE**
				OVERALL RANKING:	Preferred	Not Preferred	**ALTERNATIVE MEAN 1 IS PREFERRED OVERALL**

● **PREFERRED** ● **NOT PREFERRED**

5 It is assumed that the material within the containment cell will generate leachate that has concentrations above direct discharge criteria for approximately 25 years, based on best practices. Further characterization of the waste once landfilled is needed to calculate the contaminating life span.

2.3.2 Dredging

Sediment management includes the removal of sludge and impacted sediment, dewatering of sludge/sediment, and treatment of sludge/sediment. Dredging is one method of removing sludge and impacted sediment.

Description of the Alternative Means of Carrying Out the Undertaking for Dredging

Alternative Means were developed incorporating the feasible components that passed the preliminary screening requirements. A brief description of each of the Alternative Means is provided in the subsections below.

It is noted that the use of Geotubes® or equivalent technology was found to be the most effective Alternative Mean for dewatering sludge based on Laboratory Treatability Study and was therefore carried forward as part of Alternative Means 1A and 2A. Similarly, the use of clay product (Liquasorb 2000™) was found to be the most effective Alternative Mean for stabilization of the sludge based on Bench Scale Testing and was therefore carried forward as part of Alternative Means 1B and 2B.

Alternative Mean 1A – Removal in the Wet with Geotube® or Equivalent Technology Dewatering

Removal in the wet can be achieved either through mechanical or hydraulic dredging. Mechanical dredging involves material removal using an excavator bucket or clamshell bucket from shore or from a barge. The material is loaded directly into a truck if at shore or if on the water into the barge and subsequently loaded into a truck for transport. The sludge may also be made into a slurry (sludge-water mixture) and transferred via a pipe to the desired location. Hydraulic dredging equipment is set up on a boat or barge and removes material in a sludge-water mixture (slurry), transferring it via pipe to the desired location.

Removal in the wet would be predominantly completed through hydraulic dredging due to the ease of material transfer (i.e., can be used to a minimum water depth of 0.8 to 1 m); however, limited mechanical dredging may be required to remove sludge in tight and shallow areas. The dredged sludge slurry would be subsequently pumped to a designated sludge management area.

The area (Boat Harbour, ASB, and estuary) would be sub-divided into remediation areas using silt curtains to segregate the areas and to control suspended sediments, with additional silt curtains used within each area, as beneficial, to better control suspended sediment movement. Dredging productivity (using two or more dredges) is anticipated to be 4,000 m^3 of in-place sludge removed per day for both hydraulic dredging and mechanical dredging (based on a 24-hour per day operation). Approximately 0.15 m of materials underlying the sludge (e.g., native marine clay in Boat Harbour) would likely be dredged based on the undulating bottom and accuracy of the dredging equipment. Following dredging, confirmatory sampling would be completed to confirm that remaining sediment meets the applicable remedial quality standards for all sediment contaminants of concern (COCs). As needed, clean up dredging passes and resampling would be completed.

Hydraulically dredged sludge slurry would be pumped through discharge lines to the sludge management area, located in the existing containment cell. Following modification to the base liner and leachate collection system in the containment cell, multiple Geotubes® or equivalent technology would be setup as permitted by space. As a Geotube® or equivalent technology dewaters, additional capacity is created to allow for placement of slurry (typically three pumping events per Geotube® or equivalent technology). Once the capacity of the Geotube® or equivalent technology is used, empty Geotubes® or equivalent technology would be stacked adjacent or on top (forming a pyramid shape). The number of Geotubes® or equivalent technology required to manage sludge/sediment generated during remediation is dependent on the size and configuration of Geotubes® or equivalent technology used, the final volume of sludge removed, and the dewatered volume of sludge.

Pilot scale testing was complete from August 2018 to July 2019. The results of the pilot scale testing confirm the following:

- The sludge/sediment can readily be hydraulically dredged. Enhanced grade controls are needed to minimize the amount of waste generated during dredging.
- Air quality downwind of the dredging operation and dewatering operation was not impacted due to operations.

Confirmatory sampling was used to determine the residual levels of contamination in the sediment resulting from underdredging and/or settlement of suspended sludge/sediment over dredged areas. Clean up passes, or second dredging passes, may be required in areas where sediment exceeds the remedial criteria (to be established using a risk-based approach).

Alternative Mean 1B – Removal in the Wet with Clay Stabilization.

Sludge removal activities would be the same as noted above for Alternative Mean 1A.

Hydraulically dredged sludge slurry, as noted in Alternative Mean 1A, would be pumped through discharge lines to the sludge management area located within the existing settling basins or other suitable area. Dredged slurry would be pumped to a shear mixer for the addition of Liquasorb 2000™ under optimal shear force mixing. Once mixed, the material would be pumped into a sludge management area, where excavators would be used to spread the material out for drying. Once the sludge has stabilized (e.g., solidified) (anticipated to occur over 1-3 days) the material would be loaded and hauled for disposal. As stabilization would increase the sludge volumes, the existing containment cell would need to be expanded to accommodate the treated sludge volume; or some treated sludge would need to be disposed of off-site.

Alternative Mean 2A – Removal in the Dry with Geotube® or Equivalent Technology Dewatering

Removal in the dry would involve dredging sludge/sediment from the settling basins, ASB, Boat Harbour, and estuary under dewatered conditions. Removal in the dry would involve bulk dewatering to achieve dry conditions, mechanical excavation, and transportation of dredged sludge/sediment for dewatering. For removal, in Boat Harbour, the BHSL would be sub-divided in smaller areas to facilitate bulk dewatering and removal of sludge. Isolation berms or coffer dams would be used to segregate the areas and to segregate the estuary from the Northumberland Strait. Within each area, smaller sub-areas would be created with smaller earthen separation berms or water inflated cofferdams, such as an aqua dam, to manage dewatering and maintain dry conditions in an active sub-area. Through pilot scale testing completed in 2018-2019 it was determined that removal in the dry is not a suitable Alternative Mean for Boat Harbour or the estuary as the underlying marine sediments are too soft to support construction equipment. Removal in the dry is suitable for the settling basins and likely the ASB. Removal in the dry would provide good visual control; to ensure all sludge has been removed. It is estimated that 0.15 m of materials underlying the sludge would be excavated along with the sludge based on undulating bottom and excavation accuracy. Excavated sludge would be placed in a hopper for mixing with water (as needed) to create a slurry such that it can be pumped to the Geotubes® or equivalent technology for dewatering as detailed in Alternative Mean 1A. Following excavation, confirmatory testing would be completed to confirm that the remaining sediment meets the remedial criteria.

Alternative Mean 2B – Removal in the Dry with Clay Stabilization

Sludge removal activities would be the same as detailed above for Alternative Mean 2A and clay stabilization would be the same as detailed for Alternative Mean 2B.

Evaluation of Alternative Means of Carrying Out the Undertaking for Dredging

The Alternative Means were evaluated, compared, and ranked qualitatively to identify the Preferred Alternative. The evaluation process involved application of evaluation criteria and the identification and comparison of advantages/disadvantages for each Alternative Mean. Upon completion of the comparative evaluation process, the comparison of advantages and disadvantages supports selection of Alternative Mean 1A as the preferred Alternative Mean for the treatment of sediment from the BHSL and the estuary (see Table 2.3-2). It is noted that BHSL contains the greatest quantity of sludge/sediment to be remediated from the BHETF. During pilot scale testing it was determined that removal in the dry was not possible in BHSL due to the soft underlying marine sediment. This is reflected in the evaluation; however, the below evaluation does support removal in the dry for areas that are not accessible by hydraulic dredging methods and for the effluent ditches, settling basins and potentially the ASB.

Table 2.3-2 Comparative Evaluation of the Alternative Means for Dredging

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1A Wet and Dewatering	Alternative Mean 1B Wet and Stabilization	Alternative Mean 2A Dry and Dewatering	Alternative Mean 2B Dry and Stabilization	Rationale
Regulatory	A measure of the ability of the Alternative Mean to meet the safety requirements of the Project, including the protection of the health and safety of both workers and the general public. In addition, this criterion also measures the anticipated approvability of the Alternative Mean.	Health & Safety	Ability to Protect Health and Safety of Public	• What is the relative risk level to public health and safety posed by the Alternative Mean? • To what extent can the potential risks be mitigated as part of the Alternative Mean?	🟢	🟢	🔴	🔴	Under each of the four Alternative Means, sludge would be removed from the effluent ditches, settling basins, ASB, Boat Harbour, and the estuary, however, the handling and transportation of waste material varies for each. There would be some risk due to air quality and odour for all Alternative Means, however the concern would be greater for removal in the dry since sludge would be exposed near the property line prior to pumping, whereas material removed in the wet would be directly pumped. As a result, Alternative Mean 1A and 1B are the preferred methods over 2A and 2B.
			Ability to Protect Health and Safety of Workers	• What is the relative risk level to worker health and safety posed by the Alternative Mean? • To what extent can the potential risks be mitigated as part of the Alternative Mean?	🟢	🟢	🔴	🔴	Under each of the four Alternative Means, sludge would be removed from the effluent ditches, settling basins, ASB, Boat Harbour, and the estuary, however, the handling and transportation of waste material varies for each. There would be some risk due to air quality and odour for all Alternative Means, however the concern would be greater for removal in the dry since sludge would be exposed prior to pumping, whereas material removed in the wet would be directly pumped. As a result, Alternative Mean 1A and 1B are the preferred methods over 2A and 2B.
		Compliance	Ease of Obtaining Approvals	• Does the Alternative Mean go beyond the minimum requirements for federal/provincial approvability? • What is the relative public acceptability of the Alternative Mean?	🔴	🔴	🟢	🟢	It is expected that all Alternative Means would be readily approvable, and that significant monitoring and testing would be required to verify compliance. Remedial criteria will be developed using a risk-based approach that is protective of ecological and human health and a comprehensive confirmatory sampling program will be required to confirm the remedial criteria is met. Based on GHD's Phase 2 ESA results, it is expected that once the sludge is removed, sediment criteria would readily be met since the contamination is contained in the sludge layer and not the underlying sediment of the harbour bottom. Confirmatory sampling would be completed for all options. As a result, Alternative Mean 2A and 2B are the preferred methods over Alternative Mean 1A and 1B.
				REGULATORY RANKING:	🟢	🟢	🔴	🔴	**ALTERNATIVE MEANS 1A AND 1B ARE PREFFERED FROM A REGULATORY PERSPECTIVE**

Table 2.3-2 Comparative Evaluation of the Alternative Means for Dredging

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1A Wet and Dewatering	Alternative Mean 1B Wet and Stabilization	Alternative Mean 2A Dry and Dewatering	Alternative Mean 2B Dry and Stabilization	Rationale
Technical	A measure of the Alternative Mean's ability to meet the functional requirements of the Project.	Technical	Technical Maturity	• What is the relative successful "track record" for implementing the Alternative Mean? • What is the relative availability of the source materials/equipment? • What is the relative availability of vendors/contractors for the Alternative Mean?	🟢	🔴	🔴	🔴	Clay stabilization (Alternative Mean 1B and Alternative Mean 2B) is less proven than Geotube® or equivalent technology dewatering (Alternative Mean 1A and Alternative Mean 2A) for sediment management and treatment. With regard to sediment removal, hydraulic dredging and pumping equipment, as well as excavators and low ground pressure equipment are all readily available. Removal in the dry (Alternative Mean 2A and Alternative Mean 2B) however, would require significant amounts of material for temporary berm construction, which could be difficult to obtain on such a large scale and would require stabilization of the underlying marine sediment as pilot scale testing confirmed that the underlying marine sediment cannot support construction equipment. The clay required for stabilization (Alternative Mean 1B and Alternative Mean 2B) may be difficult to obtain in large quantities, and there are limited vendors who could provide the product required (other products tested were not successful at stabilizing the sediment). Geotubes® or equivalent technology, on the other hand, are easily attainable. There are many local contractors available to complete removal in the dry, whereas there would be less dredging and pumping contractors available to complete removal in the wet. At this time, it is understood that the clay mixing process for stabilization is specialized and is typically completed by a sole contractor, using the tested product. As a result, Alternative Mean 1A is the preferred method over Alternative Mean 1B, 2A, and 2B.
			Compatibility with Current Site Features	• What is the relative compatibility of the Alternative Mean with Site size and configuration? • What is the relative compatibility of the Alternative Mean with Site geology? • What is the relative compatibility of the Alternative Mean with Site hydrogeology? • What is the relative compatibility of the Alternative Mean with Site access? • What is the relative compatibility of the Alternative Mean with Site hydrology?	🟢	🟢	🔴	🔴	The compatibility of Alternative Mean 1A and Alternative Mean 1B (removal in the wet) with current on-site features was identified as an item that needed to be addressed, but one that could be accomplished readily without challenges or constraints. Removal in the dry (Alternative Mean 2A and Alternative Mean 2B) would be a challenge with current Site size and configuration due to the large amount of berms and haul roads to be constructed to get equipment and sludge around the Site. Removal in the dry was deemed not suitable for Boat Harbour and the estuary, with the exception of areas that could be reached from the shore, due to soft underlying marine sediment. During pilot scale testing it was confirmed that the soft underlying marine sediment is not capable of supporting construction equipment. Removal in the dry was deemed suitable for the perimeter areas of Boat Harbour and the estuary for areas that could be reached from shore as well as the effluent ditches, settling basins and potentially the ASB, where a firm bottom is present. The dewatering requirements to maintain dry conditions and the amplified impact of a storm event on dry conditions also provide construction challenges. As a result, Alternative Mean 1A and 1B are the preferred methods over Alternative Mean 2A and 2B.

Table 2.3-2 Comparative Evaluation of the Alternative Means for Dredging

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1A Wet and Dewatering	Alternative Mean 1B Wet and Stabilization	Alternative Mean 2A Dry and Dewatering	Alternative Mean 2B Dry and Stabilization	Rationale
			Compatibility with Existing Off-site Features	• What is the relative compatibility of the Alternative Mean with existing features and infrastructure surrounding the Site (e.g., points of access, roads, power lines)? • Does the Alternative Mean cause significant changes to off-site conditions (e.g., traffic)? • Does the Alternative Mean require upgrades or significant changes to the existing off-site infrastructure (e.g., upgrades to roads, power supply, municipal infrastructure)?	🟢	🔴	🔴	🔴	Remedial options completed in the dry (Alternative Mean 2A and Alternative Mean 2B) would require importing a large amount of off-site material for temporary berm construction. Similarly, remedial options involving clay stabilization (Alternative Mean 1B and Alternative Mean 2B) would require substantial amounts of off-site clay product. Restrictions due to spring load restrictions on secondary roads would limit material deliveries to the Site, making Alternative Mean 2A and Alternative Mean 2B (and partially Alternative Mean 1B) less compatible with existing off-site features. Historically, load restrictions have been implemented between mid-March to mid-May, but restrictions are dependent on weather conditions and the types of vehicles being used. Material deliveries would result in increased traffic, noise, dust, and wear and tear on off-site roads which would be apparent in Alternative Mean 2A, 2B and 1B. No potential changes or impacts to off-site conditions were associated with Alternative Mean 1A. While there was no perceived difference between the Alternative Means in anticipated changes to existing power supply or other municipal infrastructure off-site, implementation of Alternative Mean 1B, Alternative Mean 2A, and Alternative Mean 2B were expected to necessitate minor repairs to secondary highways surrounding the Site. As a result, Alternative Mean 1A is the preferred method over Alternative Mean 1B, 2A, and 2B.
			Reliability/ Effectiveness/ Durability	• What is the relative expected service life of the Alternative Mean components relative to the remediation and post-remediation maintenance period? • What is the relative maintenance requirements of the Alternative Mean during the remediation and post-remediation maintenance period? • What is the likelihood the Alternative Mean will meet performance criteria or remediation objectives? • What is the relative impact of the Alternative Mean not meeting performance criteria or remediation objectives?	🔴	🔴	🟢	🟢	The components of each Alternative Mean were not expected to fail within the remediation and post-remediation period. Maintenance requirements for all options are focused on during remediation, as no major maintenance is expected to be involved post-remediation. The relative maintenance requirements associated with Alternative Mean 2A and Alternative Mean 2B (removal in the dry), including bulk dewatering, water management and treatment, were considered moderate. By comparison, there were less maintenance requirements associated with Alternative Mean 1A and Alternative Mean 1B (removal in the wet), though there would still be potential for dredge breakdowns and associated maintenance. There is a high likelihood that remediation completed in the dry (Alternative Mean 2A and Alternative Mean 2B) would achieve sediment criteria due to the high control of removal and visual confirmation. Comparatively, criteria should be met once sediment is removed in wet conditions (Alternative Mean 1A and Alternative Mean 1B), however there would be some uncertainty due to the lack of visual confirmation. Confirmatory sampling would be used to verify satisfactory removal. The likelihood and resulting impact of Alternative Mean 2A and Alternative Mean 2B (removal in the dry) not meeting performance criteria or remediation objectives was considered low, as any isolated residual contaminated sediment could be readily identified and removed. The impact of residual contamination for remediation in the

Table 2.3-2 Comparative Evaluation of the Alternative Means for Dredging

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1A Wet and Dewatering	Alternative Mean 1B Wet and Stabilization	Alternative Mean 2A Dry and Dewatering	Alternative Mean 2B Dry and Stabilization	Rationale
				• What is the relative ease of implementation of contingency measures during the remediation and post-remediation maintenance period?					wet (Alternative Mean 1A and Alternative Mean 1B) would be more substantial, as clean-up passes with a hydraulic dredge would not be as targeted as removal of residual sludge in the dry. Should remaining hotspots need to be addressed following initial sludge removal in the dry, this additional effort would be easily implemented if the area is still dewatered. Comparatively, this task would be more difficult in the wet due to lack of visual confirmation during removal, and inability to accurately delineate discrete hotspots in the wet. Contingencies could be implemented with relative ease but would require more effort in the wet than in the dry. As a result, Alternative Mean 2A and 2B are the preferred methods over Alternative Mean 1A and 1B.
			Remedial Implementation Time	• Can the Alternative Mean be constructed and fully operational within established time frame? • Anticipated time frame to implement Alternative Mean?	● (green)	● (red)	● (red)	● (red)	Removal in the wet can be implemented relatively quickly, as it is easy to scale up the operation with the addition of more equipment. This solution may be slightly slower when combined with clay stabilization versus Geotubes® or equivalent technology, due to the extra steps of handling and hauling. Removal in the dry would take longer due to increased weather sensitivity and the time required for temporary berm construction. Again, the clay stabilization process is expected to add to the timeframe as well. The anticipated timeframe for Alternative Mean 1A and Alternative Mean 1B is less than 4 years, while Alternative Mean 2A and Alternative Mean 2B are both expected to be implemented in 4-7 years. As a result, Alternative Mean 1A is the preferred method over Alternative Mean 1B, 2A, and 2B.
			Readily Monitored and Tested	• How readily can the Alternative Mean be monitored and tested during remediation phase? • How readily can the Alternative Mean be monitored and tested during post-remediation phase? • What is the relative amount of monitoring required to validate effectiveness?	● (red)	● (red)	● (green)	● (green)	During the remediation phase, remediation performance can be readily monitored and tested for all Alternative Means through confirmatory sampling in effluent ditches, settling basins, ASB, Boat Harbour, and the estuary following sludge removal and through material testing of dewatered/stabilized sediment. Post-remediation monitoring of sediment quality would be limited to confirm remediation, however given the use of risk-based remediation criteria, monitoring of sediment will likely be required. Alternative Means involving removal in the wet (Alternative Mean 1A and Alternative Mean 1B) were considered to require slightly more monitoring (confirmatory sampling) during remediation to ensure effectiveness, due to the lack of visual confirmation compared to in the dry. As a result, Alternative Mean 2A and 2B are the preferred methods over Alternative Mean 1A and 1B.

Table 2.3-2 Comparative Evaluation of the Alternative Means for Dredging

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1A Wet and Dewatering	Alternative Mean 1B Wet and Stabilization	Alternative Mean 2A Dry and Dewatering	Alternative Mean 2B Dry and Stabilization	Rationale
			Minimal Waste Generation (e.g., dewatering effluent, dredged sediments, leachate)	• What is the ability of the Alternative Mean to minimize waste generation during remediation? • What is the ability of the Alternative Mean to minimize waste generation during the post-remediation maintenance phase? • What is the ability of the Alternative Mean to minimize dangerous goods generation?	🟢	🔴	🟢	🔴	During the remediation phase, all Alternative Means would generate waste as sediment is removed from effluent ditches, settling basins, ASB, Boat Harbour, and the estuary. The Alternative Means utilizing Geotube® or equivalent technology dewatering for treatment (Alternative Mean 1A and Alternative Mean 2A) would reduce the volume of sludge through dewatering, whereas clay stabilization for Alternative Mean 1B and Alternative Mean 2B would bulk the material and increase the volume of sludge to be managed. Furthermore, Alternative 2A and 2B would result in an increase in waste generated from temporary berm construction material. None of the waste generated (impacted sludge) is expected to be classified as dangerous goods. All Alternative Means would effectively remove all impacted sediment during remediation, resulting in no further waste generation post-remediation. As a result, Alternative Mean 1A and 2A are the preferred methods over Alternative Mean 1B and 2B.
				TECHNICAL RANKING:	🟢	🔴	🔴	🔴	**ALTERNATIVE MEAN 1A IS PREFERRED FROM A TECHNICAL PERSPECTIVE**
Environmental	A measure of the potential effects to the environment posed by the Alternative Means during remediation and post-remediation phases of the Project. In addition, this criterion considers the impact of weather events on the susceptibility and suitability of the Alternative Mean to severe weather events.	Environmental	Remediation Phase Effects	• During the remediation phase, to what extent is the Alternative Mean likely to cause an adverse effect on: Atmospheric Environment; Aquatic Environment; Geology and Groundwater; Terrestrial Environment	🟢	🔴	🔴	🔴	During remediation, the risk of air quality effects on workers would be greater for Alternative Mean 1B and Alternative Mean 2B involving clay stabilization, as there would be additional material handling compared to Alternative Mean 1A and Alternative Mean 2A. The public would also be exposed under Alternative Mean 2A and Alternative Mean 2B where sediment is removed in the dry and exposed at the surface near the property boundary. For the aquatic environment, geology and groundwater, and terrestrial environment all Alternative Means were considered to have similar and minor effects. Boat Harbour is not currently considered to be high value habitat due to its use as part of the BHETF. Any short-term disruption would result in long-term benefit. As a result, Alternative Mean 1A is the preferred method over Alternative Mean 1B, 2A, and 2B.
			Post-remediation Phase Effects	• During the post-remediation phase, to what extent is the Alternative Mean likely to cause an adverse effect on: Atmospheric Environment; Aquatic Environment; Geology and Groundwater; Terrestrial Environment	🟢	🟢	🟢	🟢	All impacted sediment would be removed, and areas would have met sediment cleanup criteria. Environmental impacts at this stage would be a positive improvement to the conditions prior to remediation.
			Weather Effects	• What is the potential impact of weather on the implementation of the Alternative Mean? • What is the potential impact of weather on the Alternative	🟢	🟢	🔴	🔴	During remediation, poor weather or large storm events will impact construction and potentially cause delays. Remediation in the dry is much more susceptible to precipitation events compared to in the wet, since dewatering and maintaining dry conditions is a major component of Alternative Mean 2A and Alternative Mean 2B. There would be no potential impacts due to weather post-remediation since all of the related works associated with sediment management would be complete. While

Table 2.3-2 Comparative Evaluation of the Alternative Means for Dredging

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1A Wet and Dewatering	Alternative Mean 1B Wet and Stabilization	Alternative Mean 2A Dry and Dewatering	Alternative Mean 2B Dry and Stabilization	Rationale
				Mean during the post-remediation period? • What is the suitability of the Alternative Mean under severe weather events during remediation and post-remediation phase (e.g., 1:100 design event)?					Alternative Mean 2A and Alternative Mean 2B are susceptible to poor weather, these Alternative Means are still suitable solutions since although they may take longer, they can still be completed successfully. As a result, Alternative Mean 1A and 1B are the preferred methods over Alternative Mean 2A and 2B.
				ENVIRONMENTAL RANKING:	🟢	🔴	🔴	🔴	**ALTERNATIVE MEAN 1A IS PREFERRED FROM AN ENVIRONMENTAL PERSPECTIVE**
Social	The social criterion is a measure of the acceptability and compatibility of the Alternative Mean to the immediately affected surrounding community during remediation and post-remediation phases of the Project. In addition, this criterion considers the potential socio-economic benefit to the surrounding community as a result of implementation of the Alternative Mean.	Social	Community Acceptance	• How acceptable is the Alternative Mean to the surrounding communities during remediation phase? • How acceptable is the Alternative Mean to the surrounding communities during the post-remediation phase? • Does the Alternative Mean impact the surroundings community during remediation phase (i.e., safety, visual, nuisance)? • Does the Alternative Mean impact the surroundings community during post-remediation phase (i.e., safety, visual, nuisance)?	🟢	🟢	🔴	🔴	All Alternative Means were considered to have only a moderate level of community acceptance during the remediation phase. While some members of the surrounding community may embrace the removal of contaminants and return of Boat Harbour to tidal conditions, the anticipated short-term response from the surrounding communities may be one of reluctance. The public may have concerns with the long timeframe and potentially increased odour issues during removal in the dry. During the post-remediation phase, once BHETF components have been cleaned up through the removal of impacted sediment, it is anticipated that there would be a high level of community acceptance for the remediation of Boat Harbour and return to tidal conditions. During the remediation phase, implementation of Alternative Mean 1A and Alternative Mean 1B (removal in the wet) was considered to have no net effect (i.e., positive or negative) on the surrounding communities. Implementation of Alternative Mean 2A and Alternative Mean 2B (removal in the dry) would have a moderately negative impact on the surrounding communities; the increased volume of truck traffic could potentially have an impact on community safety, and may also negatively impact ambient air quality (e.g., increased dust) and noise levels. This remedial option is expected to take longer to implement and would involve exposure of sludge near the property boundary. All Alternative Means were considered to have positive net effect on the surrounding communities during the post-remediation phase due to the completion of full remediation and sludge removal. As a result, Alternative Mean 1A and 1B are the preferred methods over Alternative Mean 2A and 2B.
			Community Benefit	• Does the Alternative Mean affect the socio-economic environment including direct and indirect economic benefit impacts and social impacts (human health and recreational enjoyment)	🟢	🟢	🟢	🟢	The remediation of Boat Harbour and return to tidal conditions would have direct and indirect positive social impacts on the surrounding communities, from increased recreational use of Boat Harbour, to allowing the PLFN community to re-establish its relationship with the water and land of A'se'k. From an economic perspective, remediation of Boat Harbour may increase tourism in the area once the harbour is returned to tidal conditions.

Table 2.3-2 Comparative Evaluation of the Alternative Means for Dredging

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1A Wet and Dewatering	Alternative Mean 1B Wet and Stabilization	Alternative Mean 2A Dry and Dewatering	Alternative Mean 2B Dry and Stabilization	Rationale
				SOCIAL RANKING:	🟢	🟢	🔴	🔴	**ALTERNATIVE MEANS 1A AND 1B ARE PREFERRED FROM A SOCIAL PERSPECTIVE**
Economic	The economic criterion is a measure of the relative costs associated with the implementation of the Alternative Means. Consideration is given to costs for planning and implementation (i.e., capital costs) and for ongoing operation and maintenance costs.	Economic	Remediation Capital Costs	• What is the capital cost of the Alternative Mean?	🟢	🔴	🔴	🔴	The capital cost of Alternative Mean 1A was estimated to be $89,090,000 and was the lowest cost of all the Alternative Means being considered. The capital cost of Alternative Mean 1B was estimated to be $117,590,000, which is approximately 1.3 times higher than Alternative Mean 1A. The capital cost of Alternative Mean 2A was estimated to be $113,190,000, which is approximately 1.3 times higher than Alternative Mean 1A. The capital cost of Alternative Mean 2B was estimated to be $160,570,000, which is approximately 1.8 times higher than Alternative Mean 1A. It is noted that the sediment disposal costs associated with implementing the Alternative Means have not been incorporated in these estimates, as these costs have already been included with the Alternative Means developed under Waste Management component. As a result, Alternative Mean 1A is the preferred method over Alternative Mean 1B, 2A, and 2B.
			Post-Remediation Operations & Maintenance Costs	• What are the typical annual post-remediation operation and maintenance costs for the Alternative Mean?	🟢	🟢	🟢	🟢	Once the impacted sediment has been removed from effluent ditches, settling basins, ASB, Boat Harbour, and the estuary, and subsequently treated, there would be no post-remediation operation and maintenance activities and therefore no cost associated with sediment management.
				ECONOMIC RANKING:	🟢	🔴	🔴	🔴	**ALTERNATIVE MEAN 1A IS PREFERRED FROM A ECONOMIC PERSPECTIVE**
				OVERALL RANKING	🟢	🔴	🔴	🔴	**ALTERNATIVE MEAN 1A IS PREFERRED OVERALL**

🟢 **PREFERRED** 🔴 **NOT PREFERRED**

2.3.3 Wetland Management

Wetlands are a diverse group of natural ecosystems that range from salt marshes to prairie potholes to riparian forests and forested swamps. The wetlands associated with the Site have been classified as marsh and swamp wetlands or a combination of the two wetland types. Wetlands serve as nursery areas for many valuable recreational fish species as well as habitat for numerous plant and wildlife species including federally and provincially listed species at risk. Wetlands are often rich in nutrients and organic matter and are among the most productive ecosystems as they form the base of complex communities, producing the biomass that forms the base of complex food webs.

Description of the Alternative Means of Carrying Out the Undertaking for Wetland Management

Alternative Means were developed incorporating the feasible components that passed the preliminary screening requirements. A brief description of each of the Alternative Means is provided in the subsections below. At the time of completion of the RODD, the intent was that the wetlands would remain as freshwater wetlands. However, in consultation with PLFN and the Project goal of returning as much of Boat Harbour as practical to conditions prior to the development and use of the land and waters for the BHETF, the wetlands will be reconnected to Boat Harbour with tidal influence.

Alternative Mean 1 – Natural Attenuation

Alternative Mean 1 involves natural attenuation, which is commonly used as a viable remedial option to address residual impacts to an ecosystem after the contaminant source has been removed or eliminated. Following the elimination of the mill effluent and the implementation of the planned remediation of other areas of the Site, natural attenuation processes would begin on-site.

In addition to natural attenuation of COCs in wetlands, a human health/ecological risk assessment (HHERA) has been completed in order to estimate the nature and probability of adverse health effects to humans or ecological receptors that may be exposed to chemicals in contaminated environmental media (including sediment), now or in the future. The risk assessment included an analysis of theoretical models such as bioavailability model in conjunction with field investigation. Sampling of biological tissue such as plants (including fruits and berries), fish, birds, and/or small mammals was completed in support of the HHERA. Appendix A includes a copy of the HHERA.

The HHERA included the development of a risk management plan, which addresses the findings of the HHERA. Since several of the COCs associated with the Site are potentially bio-accumulative (i.e., dioxins and furans, PCBs, mercury), the HHERA identified hotspots in the wetland areas that require active remediation or risk management measures.

Active remediation of select areas will include full remediation through ex-situ removal and treatment (as discussed under Alternative Mean 2 below).

A post-remediation monitoring program of up to 5 years in duration would be implemented to monitor the Site and confirm the effectiveness of the natural attenuation, where applied.

Alternative Mean 2 – Ex-Situ Remediation

Alternative Mean 2 consists of the complete removal of the approximately 263,000 m^3 of contaminated sludge/sediment and root mass present in the former effluent discharge area and former Settling Ponds 1, 2, and 3.

The wetlands water level would be lowered, as needed, and impacted sediments would be removed through dredging, using the Alternative 1A dredging in the wet and Geotube® or equivalent technology dewatering. Dredging using Alternative 2A may also be applied for areas that can be reached from the land with lowered water level.

Construction of access roads into the wetlands to facilitate dewatering and removal activities would be required. Dredging would remove wetland vegetation and root mass as well as sludge. Where practical, vegetation would be segregated, tested and used as a soil amendment, (if it has been determined to be non-impacted).

The implementation of Alternative Mean 2 would require careful consideration as to not negatively impact existing wildlife. During dewatering activities, a wildlife removal plan may be required to trap and relocate fish or other aquatic wildlife species. The requirement to conduct a fish removal program would be determined in consultation with Department of Fisheries and Oceans (DFO) and NSE. Secondly, to mitigate potential impacts to waterfowl and other migratory birds as well as breeding or spawning aquatic wildlife such as anurans, the construction activities may be limited to late summer or early winter months. These seasonal periods are typically not considered sensitive spawning/breeding/nesting periods.

Alternative Mean 2 would effectively reduce or eliminate the potential for unacceptable risk to ecological receptors by removing the exposure pathway, however, it would cause significant short-term damage to the existing habitat. Following the removal of impacted sediment and infilling and regrading to match the existing hydraulic regime, Alternative Mean 2 would involve restoration of the construction areas including the planting or seeding of native aquatic and terrestrial vegetation. It is important that native species be seeded or planted that are tolerant of the hydrological regimes that would be established following remedial activities.

Evaluation of Alternative Means of Carrying Out the Undertaking for Wetland Management

The Alternative Means were evaluated, compared, and ranked qualitatively to identify the Preferred Alternative. The evaluation process involved application of evaluation criteria, and the identification and comparison of advantages/disadvantages for each Alternative Mean. Upon completion of the comparative evaluation process, Alternative Mean 1 (Natural Attenuation) was deemed preferable to Alternative Mean 2 (Ex-Situ Remediation). The complete comparative evaluation is provided in Table 2.3-3. As previously noted, an HHERA was completed as part of the BHRP. The findings indicate that portions of the wetlands and the estuary are impacted above the risk-based criteria established in the HHERA, and therefore will need to undergo ex-situ remediation discussed under Alternative Mean 2. Areas where the concentrations are below the risk-based criteria will be managed though natural attenuation, as the Preferred Alternative Mean.

Additional sampling will be completed in 2020 to further characterize the wetlands and refine the areas that require remediation.

Table 2.3-3 Comparative Evaluation of the Alternative Means for Wetland Management

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Natural Attenuation	Alternative Mean 2 Ex-situ Remediation	Rationale
Regulatory	A measure of the ability of the Alternative Mean to meet the safety requirements of the Project, including the protection of the health and safety of both workers and the general public. In addition, this criterion also measures the anticipated approvability of the Alternative Mean.	Health & Safety	Ability to Protect Health and Safety of Public	• What is the relative risk level to public health and safety posed by the Alternative Mean? • To what extent can the potential risks be mitigated as part of the Alternative Mean?	🔴	🟢	The level of risk associated with public health and safety was considered to be very low for both Alternative Means. Under Alternative Mean 2, only short-term risks were identified during the removal activities, such as increased vehicle emissions and dust, and potential exposure to air emissions and odors resulting from removal of contaminated sediment. However, the likelihood of exposure or risk to public health and safety was considered low since removal activities are concentrated in the middle of the Site. In comparison, long-term risks were associated with Alternative Mean 1 due to contamination being left in place, but the risk to public health and safety was minimal since there were no direct exposure pathways and risk management measures would be in place. The potential risks to public health and safety during wetland management were generally considered to be easily mitigatable. However, Alternative Mean 2 was more favourable than Alternative Mean 1 since exposure to identified on-site risks during remediation would occur over a shorter period of time and mitigation measures could be implemented (e.g., use of an odour dispersion mister combined with perimeter air monitoring). As a result, Alternative Mean 2 is the preferred method over Alternative Mean 1.
			Ability to Protect Health and Safety of Workers	• What is the relative risk level to worker health and safety posed by the Alternative Mean? • To what extent can the potential risks be mitigated as part of the Alternative Mean?	🟢	🟢	Alternative Mean 2 requires the use of earthmoving equipment, management of impacted sediment, and lowering water level of the impacted wetlands. These removal activities create a direct exposure pathway to COCs and included several potential risks for workers such as work near open water, and typical health and safety risks associated with general construction (i.e., working at heights, use of heavy equipment, slips/trips/falls). By comparison, Alternative Mean 1 requires less intrusive fieldwork on-site, and less interaction or exposure to COCs. Based on the results of the HHERA, approximately 258,000 m^3 of impacted sludge and 71,000 m^3 of sediment would require additional risk management measures due to the level of contamination. One risk management measure is to complete ex-situ remediation of the "hot spots". The potential risks to worker health and safety during wetland management are quite common, and generally considered to be easily mitigatable for both Alternative Means. For Alternative Mean 1 and 2, the implementation of proper site planning and controls, standard safety methods on a construction site, and use of PPE would mitigate the anticipated risks by adapting to the specific conditions on-site.
		Compliance	Ease of Obtaining Approvals	• Does the Alternative Mean go beyond the minimum requirements for federal/provincial approvability? • What is the relative public acceptability of the Alternative Mean?	🟢	🔴	Both Alternative Means were considered to have a generally high level of compliance for ease of approvability. Under Alternative Mean 2, the timeframe needed to completely restore the wetlands following ex-situ remediation activities is very long, and implementation of a compensation plan may be required to ensure approvability. Both Alternative Means were considered to have only a moderate level of public acceptance from PLFN and the surrounding communities. It is anticipated that both Alternative Means would face the same level of public scrutiny. Under Alternative Mean 1, uncertainty regarding the level of impact to existing flora and fauna in the wetland would remain throughout the natural attenuation process. In comparison, the public perception of the intrusive works necessary under Alternative Mean 2 (causing the temporary destruction of functional wetlands) would be negative, despite the fact that the wetlands would eventually regain ecological functions.

Table 2.3-3 Comparative Evaluation of the Alternative Means for Wetland Management

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Natural Attenuation	Alternative Mean 2 Ex-situ Remediation	Rationale
							As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2.
				REGULATORY RANKING:	🟢	🟢	**ALTERNATIVE MEAN 1 IS PREFERRED FROM A REGULATORY PERSPECTIVE**
Technical	A measure of the Alternative Mean's ability to meet the functional requirements of the Project.	Technical	Technical Maturity	• What is the relative successful "track record" for implementing the Alternative Mean? • What is the relative availability of the source materials/equipment? • What is the relative availability of vendors/contractors for the Alternative Mean?	🟢	🟢	Both Alternative Means were considered reliable and successful approaches for wetland management. Similarly, the materials and equipment required to implement both Alternative Means were considered readily available, as were the vendors and contractors required to implement the remediation. Despite the fact that Alternative Mean 1 is based on widely-accepted scientific methodology and approach, uncertainty remains because the time for natural attenuation to occur is uncertain. However, as demonstrated through completion of the HHERA, risk management measures are required to address the "hot spots". Risk management measures may include ex-situ remediation, isolation or capping, all of which are proven. As a result, Alternative Mean 1 and Alternative Mean 2 have proven and successful track records.
			Compatibility with Current Site Features	• What is the relative compatibility of the Alternative Mean with Site size and configuration? • What is the relative compatibility of the Alternative Mean with Site geology? • What is the relative compatibility of the Alternative Mean with Site hydrogeology? • What is the relative compatibility of the Alternative Mean with Site access? • What is the relative compatibility of the Alternative Mean with Site hydrology?	🟢	🔴	The compatibility of Alternative Mean 1 with current on-site features was identified as an item that needed to be addressed, but one that could be accomplished readily without challenges or constraints for all five sub-indicators. Site compatibility was one of the strengths of Alternative Mean 1, largely due to significantly less intrusive work as compared to Alternative Mean 2. Under Alternative Mean 2, the compatibility with current on-site features was also identified as an item that needed to be addressed, but one that could be accomplished readily without challenges or constraints. As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2.
			Compatibility with Existing Off-site Features	• What is the relative compatibility of the Alternative Mean with existing features, and infrastructure surrounding the Site (e.g., points of access, roads, power lines)? • Does the Alternative Mean cause significant changes to off-site conditions (e.g., traffic)? • Does the Alternative Mean require upgrades or significant changes to the existing off-site infrastructure (e.g., upgrades to roads, power supply, municipal infrastructure)?	🟢	🔴	The compatibility of Alternative Mean 1 and Alternative Mean 2 with current off-site features was identified as an item that needed to be addressed, but one that could be accomplished readily without challenges or constraints for most sub-indicators. Alternative Mean 2 would have a greater impact on off-site conditions (i.e., traffic) due to general construction for mobilizing and demobilizing equipment. As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2.

Table 2.3-3 Comparative Evaluation of the Alternative Means for Wetland Management

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Natural Attenuation	Alternative Mean 2 Ex-situ Remediation	Rationale
			Reliability/ Effectiveness/ Durability	• What is the relative expected service life of the Alternative Mean components relative to the remediation and post-remediation maintenance period? • What is the relative maintenance requirements of the Alternative Mean during the remediation and post-remediation maintenance period? • What is the likelihood the Alternative Mean will meet performance criteria or remediation objectives? • What is the relative impact of the Alternative Mean not meeting performance criteria or remediation objectives? • What is the relative ease of implementation of contingency measures during the remediation and post-remediation maintenance period?	🔴	🟢	The components of each Alternative Mean were not expected to fail within the remediation and post-remediation periods, and the relative maintenance requirements during the remediation and post-remediation periods were considered low. Under Alternative Mean 2, performance criteria and remediation objectives were expected to be met readily due to the complete removal of impacted sediments and the confirmatory sampling program implemented during remediation. In comparison, under Alternative Mean 1 performance criteria and remediation objectives were considered only likely to be met, due to the potential uncertainty of complete effectiveness of natural attenuation processes on-site, and the risk management measures implemented. As a result, Alternative Mean 2 is the preferred method over Alternative Mean 1.
			Remedial Implementation Time	• Can the Alternative Mean be constructed and fully operational within established time frame? • Anticipated time frame to implement Alternative Mean?	🟢	🟢	The anticipated timeframe required to implement Alternative Mean 1 and Alternative Mean 2 was considered to be less than 4 years.
			Readily Monitored and Tested	• How readily can the Alternative Mean be monitored and tested during remediation phase? • How readily can the Alternative Mean be monitored and tested during post-remediation phase? • What is the relative amount of monitoring required to validate effectiveness?	🔴	🟢	During the remediation phase, Alternative Mean 2 was identified as easier to monitor while Alternative Mean 1 needs average monitoring and testing effort. The monitoring program for Alternative Mean 2 consists of confirmatory sampling of sediment, while the Alternative Mean 1 monitoring program includes significant sampling of sediment, invertebrates, pore water, and biological tissue. During the post-remediation phase, both Alternative Means were considered readily monitored and tested. As a result, Alternative Mean 2 is the preferred method over Alternative Mean 1.
			Minimal Waste Generation (e.g., dewatering effluent, dredged sediments, leachate)	• What is the ability of the Alternative Mean to minimize waste generation during remediation? • What is the ability of the Alternative Mean to minimize waste generation during the post-remediation maintenance phase?	🟢	🔴	During the remediation phase, Alternative Mean 2 would generate a relatively high amount of waste through the removal of impacted sediment. In comparison, Alternative Mean 1 was considered to generate a significantly smaller amount of waste; depending on the results of the risk assessment, there may be individual hot-spots that would be addressed with ex-situ remediation during the implementation of natural attenuation. During the post-remediation phase, both Alternative Means were considered to generate a minimal amount of waste. However, Alternative Mean 1 was less favourable due to the

Table 2.3-3 Comparative Evaluation of the Alternative Means for Wetland Management

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Natural Attenuation	Alternative Mean 2 Ex-situ Remediation	Rationale
				• What is the ability of the Alternative Mean to minimize dangerous goods generation?			potential post-remediation activities required if wetland areas do not meet performance criteria and remediation objectives. Both Alternative Means were expected to generate minimal (i.e., negligible) amounts of hazardous/dangerous goods. As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2.
				TECHNICAL RANKING:	🟢	🔴	**ALTERNATIVE MEAN 1 IS PREFERRED FROM A TECHNICAL PERSPECTIVE**
Environmental	A measure of the potential effects to the environment posed by the Alternative Means during remediation and post-remediation phases of the Project. In addition, this criterion considers the impact of weather events on the susceptibility and suitability of the Alternative Mean to severe weather events.	Environmental	Remediation Phase Effects	• During the remediation phase, to what extent is the Alternative Mean likely to cause an adverse effect on: Atmospheric Environment, Aquatic Environment, Geology and Groundwater, Terrestrial Environment	🟢	🔴	During the remediation phase, Alternative Mean 2 was identified to have a higher potential environmental impact than Alternative Mean 1 due to an increased amount of intrusive work required on-site. However, through the HHERA it was determined that some areas are not suitable for natural attenuation and will require ex-situ remediation. As such the potential effects on groundwater, and surface water quality, as well as fish communities and habitats, benthic invertebrate communities, etc. is similar for both Alternative Means. Very little separated the atmospheric environmental impact scoring. Moderate adverse effects were identified for air quality under Alternative Mean 2 for workers due to exposed sludge (i.e., under dewatered conditions) and increased vehicle emissions and dust emissions associated with earthmoving equipment. However, impacts to air quality for the public would be limited as emissions would be concentrated in the middle of the Site and would not likely migrate off-site. Alternative Mean 2 would cause destruction of habitat due to intrusive activities (e.g., dewatering, sediment removal, road construction). In addition, Alternative Mean 2 could potentially cause impact to groundwater, surface water, and soil quality and cause some impact to the terrestrial environment in the vicinity of the impacted wetlands. As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2.
			Post-remediation Phase Effects	• During the post-remediation phase, to what extent is the Alternative Mean likely to cause an adverse effect on: Atmospheric Environment, Aquatic Environment, Geology and Groundwater, Terrestrial Environment	🔴	🟢	During the post-remediation phase, both Alternative Means were considered to cause moderate adverse effects to the aquatic and terrestrial environments. Under Alternative Mean 1, the potential impacts resulted from the contamination left in place and associated with potential intrusive work required depending on the findings of the risk assessment. Under Alternative Mean 2, the aquatic and terrestrial environments would be impacted due to intrusive work and be moderately effected post-remediation as the wetlands re-establishes. As a result, Alternative Mean 2 is the preferred method over Alternative Mean 1.
			Weather Effects	• What is the potential impact of weather on the implementation of the Alternative Mean? • What is the potential impact of weather on the Alternative Mean during the post-remediation period? • What is the suitability of the Alternative Mean under severe weather events during remediation and post-remediation phase (e.g., 1:100 design event)?	🟢	🔴	Under Alternative Mean 1, on-site condition would almost remain steady and therefore weather conditions would not affect the implementation, post-remediation, and the suitability (i.e., during extreme weather events) of Alternative Mean 1. Alternative Mean 2 was identified as moderately susceptible to inclement weather for all three sub-indicators. Under Alternative Mean 2, severe weather events could affect the excavation and restoration work schedule during the remediation phase. As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2.

Table 2.3-3 Comparative Evaluation of the Alternative Means for Wetland Management

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Natural Attenuation	Alternative Mean 2 Ex-situ Remediation	Rationale
				ENVIRONMENTAL RANKING:	🟢	🔴	**ALTERNATIVE MEAN 1 IS PREFERRED FROM AN ENVIRONMENTAL PERSPECTIVE**
Social	The social criterion is a measure of the acceptability and compatibility of the Alternative Mean to the immediately affected surrounding community during remediation and post-remediation phases of the Project. In addition, this criterion considers the potential socio-economic benefit to the surrounding community as a result of implementation of the Alternative Mean.	Social	Community Acceptance	• How acceptable is the Alternative Mean to the surrounding communities during remediation phase? • How acceptable is the Alternative Mean to the surrounding communities during the post-remediation phase? • Does the Alternative Mean impact the surroundings community during remediation phase (i.e., safety, visual, nuisance)? • Does the Alternative Mean impact the surroundings community during post-remediation phase (i.e., safety, visual, nuisance)?	🔴	🟢	Under Alternative Mean 2 the wetlands would be fully remediated; however, it would likely take up to 25 years to regain full ecological function as compared to current conditions. While some members of the surrounding community may embrace the direct removal of contaminants by an intrusive method, others may perceive this approach as the destruction of natural habitat. Under the more passive approach of Alternative Mean 1, contaminants are being kept in place and, as a result, post-remediation monitoring requirements would prevent full use of Boat Harbour until natural attenuation processes have been confirmed effective. This approach is likely to receive minimal community acceptance, despite the fact that the wetlands would remain largely intact. During the remediation phase, both alternative means were considered to have no effect on the surrounding communities from a safety or nuisance perspective. Since the remediation would be conducted in the middle of the Site, there are no potential receptors nearby to be affected, and impacts due to noise or vehicle traffic would be minimal. During the post-remediation phase, members of the surrounding community may have a low risk tolerance, and may not be comfortable with contamination left in place even if the risk assessment has determined that current concentrations of COCs in wetland areas do not pose an unacceptable risk to ecological receptors or human health. Through formal consultation with PLFN, it was requested that the natural attenuation be considered as a means to preserve the land, water, and wetland function. As noted earlier, an HHERA was completed. As a result, Alternative Mean 2 is the preferred method over Alternative Mean 1.
			Community Benefit	• Does the Alternative Mean affect the socio-economic environment including direct and indirect economic benefit impacts and social impacts (human health and recreational enjoyment)	🔴	🟢	The remediation of Boat Harbour and return to tidal conditions would have direct and indirect positive social impacts on the surrounding communities, from increased recreational use of Boat Harbour, to allowing the PLFN community to re-establish its relationship with the water, and land of A'se'k. From an economic perspective, remediation of Boat Harbour may also increase tourism in the area once the harbour is returned to tidal conditions. Implementation of Alternative Mean 2 would provide more positive social impacts by enabling use of the wetlands immediately following remediation. This would provide recreational and human health benefits for PLFN and the surrounding community, and may potentially provide traditional benefits for PLFN. However, there are no direct economic benefits associated with Alternative Mean 2, and the wetland functionally would be impaired and may take up to 25 years to fully recover. Under Alternative Mean 1, the post-remediation monitoring requirements may benefit the community through potential involvement in monitoring activities (minimum 5 years). However, post-remediation monitoring requirements would also prevent full use of the wetlands until natural attenuation processes have been confirmed effective. This approach significantly delays any human health or recreational benefits resulting from the remediation of the wetlands. As a result, Alternative Mean 2 is the preferred method over Alternative Mean 1.

NOVA SCOTIA

Table 2.3-3 Comparative Evaluation of the Alternative Means for Wetland Management

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Natural Attenuation	Alternative Mean 2 Ex-situ Remediation	Rationale
				SOCIAL RANKING:	Not Preferred	Preferred	**ALTERNATIVE MEAN 2 IS PREFERRED FROM A SOCIAL PERSPECTIVE**
Economic	The economic criterion is a measure of the relative costs associated with the implementation of the Alternative Means. Consideration is given to costs for planning and implementation (i.e., capital costs) and for ongoing operation and maintenance costs.	Economic	Remediation Capital Costs	• What is the capital cost of the Alternative Mean?	Preferred	Not Preferred	The capital cost of Alternative Mean 1 was estimated to be $17,420,000 and was the lowest cost of the two Alternative Means being considered. Following the identification of portions of wetlands not suitable for natural attenuation as part of the final draft HHERA, this cost was estimated to be $32,080,000. The capital cost of Alternative Mean 2 was estimated to be $41,590,000, which is approximately 1.3 times higher than Alternative Mean 1. As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2.
			Post-Remediation Operations & Maintenance Costs	• What are the typical annual post-remediation operation and maintenance costs for the Alternative Mean?	Not Preferred	Preferred	Under both Alternative Means, the impacted sediment would be removed. Under Alternative Mean 2, no further work would be required after remediation, however, under Alternative Mean 1 intensive monitoring requirements associated with natural attenuation would be necessary. As a result, Alternative Mean 2 is the preferred method over Alternative Mean 1.
				ECONOMIC RANKING:	Preferred	Preferred	**ALTERNATIVE MEANS 1 AND 2 ARE PREFERRED FROM AN ECONOMIC PERSPECTIVE**
				OVERALL RANKING:	Preferred	Not Preferred	**ALTERNATIVE MEAN 1 IS PREFERRED OVERALL**

PREFERRED (green) **NOT PREFERRED** (red)

2.3.4 Water Management

2.3.4.1 Bulk Water Management

This section presents the Alternative Means developed for the management and treatment of bulk water. Bulk water refers to impacted surface water that will need to be managed prior to, during or post sludge/sediment removal, and includes dewatering effluent returned to BHSL. Dewatering effluent is water generated from dewatering sludge/sediment using the Geotubes® or equivalent technology as part of sediment remediation until the BHSL is fully remediated. The overall volume of bulk water to be managed to complete remediation in the dry is approximately 3,500,000 m^3 for initial dewatering, with 1,200,000 m^3 for ongoing dewatering to maintain dry conditions. For removal in the wet, the volume of bulk dewatering requiring treatment is estimated at 5,700,000 m^3; plus groundwater and surface water recharge into the BHSL during remediation, estimated at an average of 28,000 m^3 per day. The bulk water in the BHSL is characterized with elevated concentrations of total petroleum hydrocarbons (TPH), cyanide, and metals.

Description of the Alternative Means of Carrying Out the Undertaking for Bulk Water Management

As previously mentioned in Section 2.2.1.2.4, the one Alternative Mean was developed incorporating the feasible components that passed the preliminary screening requirements and needs following pilot scale testing. A brief description of the Alternative Mean is provided below.

Alternative Mean 1 – Natural Attenuation

Impacted water from all system components will be conveyed to the BHSL. The BHSL continuously receives surface water flow from the collection area surrounding Boat Harbour as well as continuous inflows from groundwater. The compound flow of surface water drainage and groundwater infiltration into the BHSL is estimated to range from 7,200 m^3/day (low) to 64,000 m^3/day (peak) with an average of 28,000 m^3/day. Thus, the BHSL will be continuously flushed with water of quality equal to natural background condition in the area of Boat Harbour. Since the termination of operations at the Kraft Pulp Mill, it is expected that the quality of water within Boat Harbour will progressively improve due to natural attenuation influences. Additional flow verification and water quality testing is proposed to validate projected water quality in the BHSL. As there was only one feasible Alternative Mean that was fully developed for management and treatment of BHETF bulk water, a comparative evaluation was not required.

2.3.4.2 Leachate Management

This section presents the Alternative Means developed for the management of leachate generated from the use of the on-site containment cell for long-term disposal of the waste. Under post-closure conditions (i.e., post capping the landfill with a low permeable final cover), the anticipated leachate generation rate from the containment cell is expected to be 2,500 m^3 per year and decreasing over time.

NOVA SCOTIA

Description of the Alternative Means of Carrying Out the Undertaking for Leachate Treatment

Alternative Means were developed incorporating the feasible components that passed the preliminary screening requirements. A brief description of each of the Alternative Means is provided in the subsections below.

Alternative Mean 1 – On-site Management

A four-step treatment process would be installed. The main treatment steps or unit processes (coagulation, sedimentation, filtration, and adsorption) as detailed below.

Treatment Step 1 – Coagulation/flocculation | The role of this treatment step is to increase the pH of the water in order to reduce the solubility of dissolved metals by formation of insoluble precipitates and to facilitate flocculation for enhanced settling via polymer addition.

Treatment Step 2 - Sedimentation | The sedimentation step will be designed to settle floc and separate the clear effluent from the waste chemical sludge resulting from Step 1.

Treatment Steps 3 and 4 - Filtration and Adsorption | The filtration step (Step 3) will be designed to remove the remaining fine flocs and coagulated particles, which are not removed in the sedimentation step. The filtration step is a pre-treatment step to protect the downstream granular activated carbon (GAC) media by removing suspended particles and minimizing the backwash requirement of the GAC column. The adsorption step (Step 4) will be designed to remove dissolved constituents, specifically the organic compounds.

This process was tested as part of the Pilot Scale Testing Program. Further details on the system tested and the results are presented in the Pilot Scale Testing Report.

It is expected that these four treatment steps would reduce the concentration of all COCs below potential discharge criteria, and the effluent could be released to the estuary near Point D.

Solids generated through the leachate treatment process would be managed and returned to the containment cell until such time as the containment cell is closed. Following closure of the containment cell residual solids will be managed through dewatering and off-site disposal at a facility approved to receive the waste. Residual solids from the process are expected to be minimal.

Alternative Mean 2 – Off-site Disposal

This Alternative Mean involves collection of leachate in a storage tank (with capacity to store the volume of leachate generated over approximately 3 days) and disposal at an off-site NSE approved facility for disposal by tanker truck. In addition to the storage tank, a larger emergency storage tank was considered in case of higher flow rates or other unpredictable circumstances to provide extra capacity to prevent unauthorized discharges to Boat Harbour.

Leachate would drain from the containment cell to the storage tanks. A truck loading station would facilitate the loading of leachate into a tanker truck. The tanker truck would then transport and dispose of leachate at an off-site NSE approved facility for disposal. It has been assumed that all off-site disposal would be within 175 km of the Site. Leachate quality sampling may be required prior to transportation, depending on the pre-screening requirements of the selected off-site disposal facility.

Evaluation of Alternative Means of Carrying Out the Undertaking for Leachate Management

The Alternative Means were evaluated, compared, and ranked using a "Reasoned Argument" approach to identify the Preferred Alternative. The evaluation process involved application of evaluation criteria and the identification and comparison of advantages/disadvantages for each Alternative Mean. Upon completion of the comparative evaluation process, Alternative Mean 2 (off-site disposal) was deemed preferable to Alternative Mean 1 (on-site management using advanced treatment). The complete comparative evaluation is provided in Table 2.3-4.

Due to the iterative nature of the EIA process, it was subsequently determined that a combined approach to leachate management is the preferred option. This is as a result of refinement to the design of the containment cell and incorporating modelling of leachate generation over both the short-term (i.e., during construction and operation) and the long-term (i.e., during closure/post-closure). Therefore, both on-site and off-site leachate management will be utilized. A summary of the short-term and long-term leachate management Alternative Means is provided after Table 2.3-4.

Table 2.3-4 Comparative Evaluation of the Alternative Means for Leachate Management

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 On-site Advanced	Alternative Mean 2 Off-site Disposal	Rationale
Regulatory	A measure of the ability of the Alternative Mean to meet the safety requirements of the Project, including the protection of the health and safety of both workers and the general public. In addition, this criterion also measures the anticipated approvability of the Alternative Mean.	Health & Safety	Ability to Protect Health and Safety of Public	• What is the relative risk level to public health and safety posed by the Alternative Mean? • To what extent can the potential risks be mitigated as part of the Alternative Mean?	🟢	🟢	There was deemed to be no risk to public health and safety under either of the Alternative Means during remediation and post-remediation phases.
			Ability to Protect Health and Safety of Workers	• What is the relative risk level to worker health and safety posed by the Alternative Mean? • To what extent can the potential risks be mitigated as part of the Alternative Mean?	🔴	🟢	The inherent level of risk to worker health and safety associated with leachate management was generally considered to be quite low. In both cases there would be some health and safety risks associated with general construction (i.e., use of heavy equipment, slips/trips/falls, and potential contact with leachate). The risks were considered slightly higher for Alternative Mean 1 working in a leachate treatment plant on an ongoing basis (in terms of potential air quality issues and leachate contact) compared to leachate trucking. The risks associated with both Alternative Means were considered to be easily mitigated with proper planning and controls and use of personal protective equipment. Alternative Mean 1 risk may be relatively less mitigatable than Alternative Mean 2 if changes or repairs to leachate treatment system are required. As a result, Alternative Mean 2 is the preferred method over Alternative Mean 1.
		Compliance	Ease of Obtaining Approvals	• Does the Alternative Mean go beyond the minimum requirements for federal/provincial approvability? • What is the relative public acceptability of the Alternative Mean?	🔴	🟢	For Alternative Mean 2, it is anticipated that the leachate would be accepted for off-site disposal, however, depending on the strength and parameters of concern in the leachate, options for location of off-site treatment disposal may be limited. The relative approvability of an on-site leachate treatment system (Alternative Mean 1) may vary depending on the discharge location. Both Alternative Means were considered to have only a moderate level of public acceptance from the PLFN and surrounding communities. Under Alternative Mean 1, the public may not want a treatment facility remaining and discharging to Boat Harbour. Under Alternative Mean 2, the public may not want the leachate being sent to their municipal NSE approved facility for disposal. As a result, Alternative Mean 2 is the preferred method over Alternative Mean 1.
				REGULATORY RANKING:	🔴	🟢	**ALTERNATIVE MEAN 2 IS PREFERRED FROM REGULATORY PERSPECTIVE**
Technical	A measure of the Alternative Mean's ability to meet the functional requirements of the Project.	Technical	Technical Maturity	• What is the relative successful "track record" for implementing the Alternative Mean? • What is the relative availability of the source materials/equipment? • What is the relative availability of vendors/contractors for the Alternative Mean?	🔴	🟢	Both leachate management methodologies were considered reliable approaches with extensive track records of successful applications. The materials, equipment, and contractors required to implement Alternative Mean 2 (i.e., for off-loading station construction and trucking) were considered easily acquired within the Province. Materials and equipment required for Alternative Mean 1 (i.e., for leachate treatment facility construction and operation) were considered less accessible than those required for Alternative Mean 2 since they would be more specialized. Similarly, the on-site leachate treatment facility would require a specialized licensed operator, which may not be available locally. As a result, Alternative Mean 2 is the preferred method over Alternative Mean 1.

NOVA SCOTIA

Table 2.3-4 Comparative Evaluation of the Alternative Means for Leachate Management

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 On-site Advanced	Alternative Mean 2 Off-site Disposal	Rationale
			Compatibility with Current Site Features	• What is the relative compatibility of the Alternative Mean with Site size and configuration? • What is the relative compatibility of the Alternative Mean with Site geology? • What is the relative compatibility of the Alternative Mean with Site hydrogeology? • What is the relative compatibility of the Alternative Mean with Site access? • What is the relative compatibility of the Alternative Mean with Site hydrology?	🔴	🟢	The compatibility of Alternative Mean 1 with the Site (size and configuration) was identified as an item that needed to be addressed, but one that could be accomplished readily. An area would need to be dedicated for the on-site leachate treatment facility, but this should not be an issue due to the Site size and access. The compatibility of Alternative Mean 1 with the rest of the current on-site features was identified as an item that needed to be addressed, but one that could be accomplished readily without challenges or constraints. The compatibility of Alternative Mean 2 with current on-site features was identified as an item that needed to be addressed, but one that could be accomplished readily without challenges or constraints. As a result, Alternative Mean 2 is the preferred method over Alternative Mean 1.
			Compatibility with Existing Off-site Features	• What is the relative compatibility of the Alternative Mean with existing features and infrastructure surrounding the Site (e.g., points of access, roads, power lines)? • Does the Alternative Mean cause significant changes to off-site conditions (e.g., traffic)? • Does the Alternative Mean require upgrades or significant changes to the existing off-site infrastructure (e.g., upgrades to roads, power supply, municipal infrastructure)?	🟢	🟢	The compatibility of Alternative Mean 1 and 2 with existing off-site features was identified as an item that needed to be addressed, but one that could be accomplished readily. Both Alternative Means would require an upgraded and realigned service road to the containment cell, new power service, and site preparation of construction of the Alternative Mean. Alternative Mean 1 would require a discharge of treated leachate to the natural environment, while Alternative Mean 2 involves some off-site traffic for leachate hauling, the volume is relatively small (2,500 m^3 per year and decreasing over time).
			Reliability/ Effectiveness/ Durability	• What is the relative expected service life of the Alternative Mean components relative to the remediation and post-remediation maintenance period? • What is the relative maintenance requirements of the Alternative Mean during the remediation and post-remediation maintenance period? • What is the likelihood the Alternative Mean will meet performance criteria or remediation objectives? • What is the relative impact of the Alternative Mean not meeting performance criteria or remediation objectives?	🟢	🔴	Alternative Mean 2 is not expected to fail within the remediation and post-remediation period since leachate would be managed off-site and it is expected there would always be a location willing to accept the leachate. It is anticipated that some maintenance would be required for both Alternative Means, however, an on-site leachate treatment facility would require more maintenance activities (Alternative Mean 1) than a truck loading station (Alternative Mean 2) due to the greater complexity of components. It is likely that Alternative Mean 1 would meet performance criteria (i.e., leachate treatment objectives) since the on-site leachate treatment system would be designed to treat the Site-specific leachate (with contingencies) and its process could be modified as required if leachate characteristics change slightly. It is expected that leachate would be readily accepted by off-site facilities, however, there is a greater relative risk that some NSE approved disposal facilities may not be able to accept the leachate based on the actual quality results. In the event that leachate quality is worse than expected and does not meet performance criteria, the process at the on-site leachate treatment facility (Alternative

Table 2.3-4 Comparative Evaluation of the Alternative Means for Leachate Management

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 On-site Advanced	Alternative Mean 2 Off-site Disposal	Rationale
				• What is the relative ease of implementation of contingency measures during the remediation and post-remediation maintenance period?			Mean 1) could be modified as required. For off-site disposal, however, the leachate could be rejected if it does not meet the performance criteria. The relative ease of implementing a contingency measure during the post-remediation period was considered relatively easy for both Alternative Means. The contingency for Alternative Mean 2 would involve shipping the leachate to another facility that would accept the leachate; while this may result in a higher cost, it would be easily accomplished. Contingencies for Alternative Mean 1 would be slightly more involved to alter the leachate treatment process, as needed. As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2.
			Remedial Implementation Time	• Can the Alternative Mean be constructed and fully operational within established time frame? • Anticipated time frame to implement Alternative Mean?	🔴	🟢	The anticipated timeframe required to construct a truck loading station is substantially shorter than that to construct a leachate treatment facility. Both Alternative Means were expected to be implemented in well under 4 years. As a result, Alternative Mean 2 is the preferred method over Alternative Mean 1.
			Readily Monitored and Tested	• How readily can the Alternative Mean be monitored and tested during remediation phase? • How readily can the Alternative Mean be monitored and tested during post-remediation phase? • What is the relative amount of monitoring required to validate effectiveness?	🟢	🟢	During the remediation phase, routine monitoring requirements were considered to be roughly the same (i.e., readily monitored and testable) for both Alternative Means. Operational checks can be completed during construction to ensure systems are properly installed and leachate samples would be collected to monitor quality in both scenarios to ensure suitability of proposed leachate management strategies. This would remain the case during the post-remediation phase, when system checks may be completed, and leachate sampling would be completed to verify compliance with criteria. Both Alternative Means were considered to require similar (i.e., minimal) amounts of monitoring to validate effectiveness, though there would be ongoing leachate quality sampling required for both.
			Minimal Waste Generation (e.g., dewatering effluent, dredged sediments, leachate)	• What is the ability of the Alternative Mean to minimize waste generation during remediation? • What is the ability of the Alternative Mean to minimize waste generation during the post-remediation maintenance phase? • What is the ability of the Alternative Mean to minimize dangerous goods generation?	🟢	🟢	During the remediation phase (i.e., construction), both Alternative Means were considered to generate minimal amounts of additional waste through implementation. During the post-remediation phase (i.e., operational phase), both Alternative Means were considered to generate moderate amounts of additional waste. The on-site leachate treatment facility would produce waste through the use of disposable materials for the treatment process (e.g., filters), while for off-site disposal the leachate represents a waste to be managed. Both Alternative Means were considered to generate minimal amounts of hazardous/dangerous goods through implementation during the remediation phase.
				TECHNICAL RANKING:	🔴	🟢	**ALTERNATIVE MEAN 2 IS PREFERRED FROM TECHNICAL PERSPECTIVE**
Environmental	A measure of the potential effects to the environment posed by the Alternative Means during remediation	Environmental	Remediation Phase Effects	• During the remediation phase, to what extent is the Alternative Mean likely to cause an adverse effect on: Atmospheric Environment, Aquatic Environment,	🟢	🟢	During remediation (i.e., construction), there may be some risk of air quality effects on workers due to construction activities and potential leachate exposure. For aquatic environment, geology and groundwater, and terrestrial environment, all Alternative Means were considered to have similar and minor effects.

Table 2.3-4 Comparative Evaluation of the Alternative Means for Leachate Management

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 On-site Advanced	Alternative Mean 2 Off-site Disposal	Rationale
	and post-remediation phases of the Project. In addition, this criterion considers the impact of weather events on the susceptibility and suitability of the Alternative Mean to severe weather events.			Geology and Groundwater, Terrestrial Environment			
			post-remediation phase effects	• During the post-remediation phase, to what extent is the alternative mean likely to cause an adverse effect on: atmospheric environment, aquatic environment, geology and groundwater, terrestrial environment	🔴	🟢	Similar to during remediation there may be some risk of air quality effects on workers during operations activities (from either equipment or potential leachate exposure). The risk of air quality effects to the public would be very minor, though the trucking operations for off-site disposal would generate some emissions. Both Alternative Means were considered to have similar and minor effects. However, for aquatic environment depending on leachate discharge location, Alternative Mean 1 could have relatively more of an impact the aquatic environment compared to Alternative Mean 2. As a result, Alternative Mean 2 is the preferred method over Alternative Mean 1.
			Weather Effects	• What is the potential impact of weather on the implementation of the Alternative Mean? • What is the potential impact of weather on the Alternative Mean during the post-remediation period? • What is the suitability of the Alternative Mean under severe weather events during remediation and post-remediation phase (e.g., 1:100 design event)?	🔴	🟢	Weather was considered to have little effect on both Alternative Means outside of typical weather-related construction delays during the remediation (or construction) phase. During the post-remediation phase (operation and maintenance phase), poor weather conditions were considered to have minimal effects on hauling leachate off-site. Poor weather could have moderate effects on an on-site leachate treatment facility if the facility were to experience a power outage. Both Alternative Means were considered suitable under severe weather events (i.e., 1:100 year design storm). There may be some effects from severe weather (e.g., power outages, work stoppages, increased leachate generation, etc.). As a result, Alternative Mean 2 is the preferred method over Alternative Mean 1.
				ENVIRONMENTAL RANKING:	🔴	🟢	**ALTERNATIVE MEAN 2 IS PREFERRED FROM AN ENVIRONMENTAL PERSPECTIVE**
Social	The social criterion is a measure of the acceptability and compatibility of the Alternative Mean to the immediately affected surrounding community during remediation and post-remediation phases of the Project. In addition, this criterion considers the potential socio-economic benefit to the surrounding community as a result of implementation of the Alternative Mean.	Social	Community Acceptance	• How acceptable is the Alternative Mean to the surrounding communities during remediation phase? • How acceptable is the Alternative Mean to the surrounding communities during the post-remediation phase? • Does the Alternative Mean impact the surroundings community during remediation phase (i.e., safety, visual, nuisance)? • Does the Alternative Mean impact the surroundings community during post-remediation phase (i.e., safety, visual, nuisance)?	🟢	🟢	Both Alternative Means were considered to have a high level of community acceptance during the remediation phase. It is not expected that the public would have an issue with construction of either leachate management solution, since it would be one component of a larger construction project. During the post-remediation (or operational) phase, both Alternative Means were expected to receive only a moderate amount of community support. Though the leachate would be managed, the public may not support having the remaining leachate treatment or conveyance infrastructure on-site. They may be resistant to discharging effluent from the on-site leachate treatment facility to Boat Harbour, and similarly to sending leachate to a NSE approved facility for disposal. During the construction phase, implementation of both Alternative Means were considered to have no effect (i.e., positive or negative) on the surrounding community. Finally, both Alternative Means were considered to have a slightly negative effect on PLFN and the surrounding community due to the leachate management operation remaining post-remediation.

Table 2.3-4 Comparative Evaluation of the Alternative Means for Leachate Management

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 On-site Advanced	Alternative Mean 2 Off-site Disposal	Rationale
			Community Benefit	• Does the Alternative Mean affect the socio-economic environment including direct and indirect economic benefit impacts and social impacts (human health and recreational enjoyment)	Preferred	Preferred	Both leachate management Alternative Means would have direct and indirect positive social impacts on the surrounding communities. Leachate management activities would provide a public safeguard against any leachate impacts. Both Alternative Means could provide local employment opportunities; an on-site leachate treatment facility operator would be required, or truck drivers and maintenance staff for the off-site disposal option.
				SOCIAL RANKING:	Preferred	Preferred	**ALTERNATIVE MEANS 1 AND 2 ARE PREFERRED FROM A SOCIAL PERSPECTIVE**
Economic	The economic criterion is a measure of the relative costs associated with the implementation of the Alternative Means. Consideration is given to costs for planning and implementation (i.e., capital costs) and for ongoing operation and maintenance costs.	Economic	Remediation Capital Costs	• What is the capital cost of the Alternative Mean?	Not Preferred	Preferred	The capital cost of Alternative Mean 2 was estimated to be $430,000, and was the lowest cost of the two Alternative Means being considered. The capital cost of Alternative Mean 1 was estimated to be $2,770,000, which is approximately 6.44 times higher than Alternative Mean 2. As a result, Alternative Mean 2 is the preferred method over Alternative Mean 1.
			Post-Remediation Operations & Maintenance Costs	• What are the typical annual post-remediation operation and maintenance costs for the Alternative Mean?	Not Preferred	Preferred	The operation and maintenance cost of Alternative Mean 2 was estimated to range from $2,000,000 to $13,500,000 depending on whether a municipal or industrial NSE approved facility for disposal would accept the leachate (respectively). As it is anticipated that a municipal NSE approved facility for disposal would be able to accept the leachate, Alternative Mean 2 was considered to be the lowest cost of the two Alternative Means being considered. The operation and maintenance cost of Alternative Mean 1 was estimated to be $6,300,000, which is approximately 3.15 times higher than Alternative Mean 2 (for a municipal NSE approved facility for disposal). As a result, Alternative Mean 2 is the preferred method over Alternative Mean 1.
				ECONOMIC RANKING:	Not Preferred	Preferred	**ALTERNATIVE MEAN 2 IS PREFERRED FROM AN ECONOMIC PERSPECTIVE**
				OVERALL RANKING:	Not Preferred	Preferred	**ALTERNATIVE MEAN 2 IS PREFERRED OVERALL**

● (green) **PREFERRED** ● (red) **NOT PREFERRED**

As previously mentioned, modelling of future leachate levels has created the need for a combined approach to leachate management, which includes both on-site treatment and off-site disposal. Immediately following cessation of dredging operations, an interim period of time will occur between completion of dredging (when the containment cell is uncovered) through progressive and final cover/closure of the containment cell. During this interim period, the waste within the containment cell will continue to release water as the solids thicken and consolidate. The waste may be covered with an interim cover to reduce the amount of precipitation that comes in contact with the waste. All water that comes in contact with the waste will be managed as leachate. During the interim period, leachate will be directed from the containment cell to a buried holding tank (forming part of the long-term leachate management system described below) prior to being conveyed to a temporary leachate treatment system. Treated effluent from the temporary leachate treatment system that meets the discharge criteria will be conveyed to the discharge point of the BHSL at the estuary. Temporary leachate treatment will be employed until the containment cell is completely covered and management of leachate under the long-term leachate management system becomes viable. It is expected that temporary leachate treatment will be required for approximately 1-2 years following cessation of dredging operations, and for a few months following placement of final cover and closure of the containment cell.

With the above in mind, the interim or temporary leachate treatment facility (TLTF) for the short-term will include four main treatment steps or unit processes (coagulation, sedimentation, filtration, and adsorption). This process was tested as part of the Pilot Scale Testing Program. Further details on the system tested and the results are presented in the Pilot Scale Testing Report (GHD, December 2019).

During post-closure, leachate collected within the containment cell will be directed (pumped) to a 40 m^3 buried holding tank. Stored leachate will be pumped from the holding tank to tanker trucks (ranging in size from approximately 10 to 40 m^3. Loading of the trucks for off-site disposal will be achieved by two (lead lag) self priming leachate loading pumps (approximately 13 Litres per second [L/s], each). The leachate loading station will include a load out billing station for verification of the volumes and hauler removing leachate from the Site. The leachate loading pumps and associated electrical/control hardware associated with the leachate loading station will be configured in a pump house located adjacent to the buried leachate holding tank. Upgrades to access roads in the vicinity of the containment cell will permit truck access to the leachate loading station. Leachate will be disposed of at an off-site municipal or industrial wastewater treatment facility licensed to receive the wastewater.

2.3.5 Bridge at Highway 348

A causeway along Highway 348 crosses Boat Harbour at the downstream end. The causeway is constructed with three 1500 millimetre (mm) diameter concrete culverts and two 3600 x 3000 mm concrete box culverts connecting Boat Harbour to the downstream dam. A water main running from the PLFN well field to the PLFN community is buried within the causeway.

In order to return Boat Harbour to tidal conditions and to allow for small boat access to the harbour, the causeway would be removed and replaced with a bridge.

Returning Boat Harbour to a tidal state and providing navigation would generally require the following construction activities:

- Removal of the existing causeway and all culverts to accommodate new bridge span
- Construction of a temporary by-pass causeway
- Construction of a new bridge along Highway 348
- Removal of the temporary by-pass causeway
- Re-routing the existing water main along the new bridge

The new bridge structure would be approximately 34 m long single-span structure, maximizing the flow beneath the span through elimination of a center pier. The bridge would have a sidewalk on both sides, and a decorative concrete and metal rail barrier to meet the necessary requirements for pedestrians and architectural enhancements. The bridge design would incorporate a new support system for the water main, including galvanized steel brackets equally spaced at approximately 1.8 to 2.4 m across the bridge.

The temporary by-pass causeway and double sidewalk were requested by PLFN. Details surrounding PLFNs request is provided in Section 5. Architectural enhancements would be informed by discussions with PLFN prior to construction.

Description of the Alternative Means of Carrying Out the Undertaking for the Bridge at Highway 348

Alternative Means were developed incorporating the feasible components that passed the preliminary screening requirements. A brief description of each of the Alternative Means is provided in the subsections below.

Alternative Mean 1 – Concrete Girder Bridge

Alternative Mean 1 involves the construction of a precast concrete bulb tee girder superstructure for the bridge. Precast bulb tee girders are a cost-effective solution for a 34 m span, provided a reasonable structure depth, and is comparable to the historical bridge. For this span length, a concrete superstructure is typically preferred by Nova Scotia Transportation and Infrastructure Renewal (NSTIR) as they are a durable structure with low long-term maintenance costs and easily meet the 75 year design life criteria outlined in the Canadian Highway Bridge Design Code (CHBDC).

Alternative Mean 2 – Steel Girder Bridge

Alternative Mean 2 involves the construction of a steel girder superstructure for the bridge. A steel superstructure can consist of either steel plate girders or steel box beams. Steel girders have the benefit of potential longer spans and shallower depths, but for shorter span structures such as this bridge, they are typically more costly to construct and maintain compared to concrete girders.

Evaluation of Alternative Means of Carrying Out the Undertaking for the Bridge at Highway 348

The Alternative Means were evaluated, compared, and ranked qualitatively to identify the Preferred Alternative. The evaluation process involved application of evaluation criteria and the identification and comparison of advantages/disadvantages for each Alternative Mean. Upon completion of the comparative evaluation process, Alternative Mean 1 (concrete girder bridge) was deemed preferable to Alternative Mean 2 (steel girder bridge). The complete comparative evaluation is provided in Table 2.3-5.

Table 2.3-5 Comparative Evaluation of the Alternative Means for the Bridge at Highway 348

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Concrete Girder Bridge	Alternative Mean 2 Steel Girder Bridge	Rationale
Regulatory	A measure of the ability of the Alternative Mean to meet the safety requirements of the Project, including the protection of the health and safety of both workers and the general public. In addition, this criterion also measures the anticipated approvability of the Alternative Mean.	Health & Safety	Ability to Protect Health and Safety of Public	• What is the relative risk level to public health and safety posed by the Alternative Mean? • To what extent can the potential risks be mitigated as part of the Alternative Mean?	●	●	Under both Alternative Means, the relative risk to public health and safety upon completion of the bridge was considered to be very low, but not negligible. The only perceived risk was the presence of rip rap or armour stone along the embankments, which would potentially represent a slip/trip/fall hazard. As both Alternative Means would include a designated sidewalk on both sides of the bridge, there would be no need for pedestrians to walk along the embankments. The potential risks to public health and safety during and following construction of the bridge at Highway 348 are generally considered to be easily mitigatable, and may include barricades, re-routing of traffic (i.e., detours), and signage.
			Ability to Protect Health and Safety of Workers	• What is the relative risk level to worker health and safety posed by the Alternative Mean? • To what extent can the potential risks be mitigated as part of the Alternative Mean?	●	●	Under both Alternative Means, the inherent level of risk to worker health and safety associated with constructing a Bridge at Highway 348 was considered to be low. Typical health and safety risks associated with general construction (i.e., working at heights, use of heavy equipment, and slips/trips/falls) are common hazards and were considered to be easily mitigated with proper training and Site planning and controls.
		Compliance	Ease of Obtaining Approvals	• Does the Alternative Mean go beyond the minimum requirements for federal/provincial approvability? • What is the relative public acceptability of the Alternative Mean?	●	●	Both Alternative Means were considered to have a high level of compliance, going beyond the minimum requirements for ease of federal/provincial approvability. Both Alternative Means were able to meet functional requirements for navigable channel size, design load, and hydraulic capacity, making the Alternative Means readily approvable in accordance with the CHBDC and the applicable *Navigable Waters Bridges Regulations*. Similarly, both Alternative Means were considered to have high levels of public acceptance from the PLFN and surrounding communities. Both options facilitate a return to tidal conditions and no change to traffic flow (with the exception during construction). Regardless of the construction materials selected (i.e., concrete vs. steel girders), it is expected that the Bridge at Highway 348 would be welcomed by PLFN and surrounding communities.
				REGULATORY RANKING:	●	●	**ALTERNATIVE MEAN 1 AND 2 ARE PREFERRED FROM A REGULATORY PERSPECTIVE**
Technical	A measure of the Alternative Mean's ability to meet the functional requirements of the Project.	Technical	Technical Maturity	• What is the relative successful "track record" for implementing the Alternative Mean? • What is the relative availability of the source materials/equipment? • What is the relative availability of vendors/contractors for the Alternative Mean?	●	●	Both bridge construction methodologies were considered reliable approaches with extensive track records of successful applications. Similarly, the materials and equipment required to implement both Alternative Means were considered easily acquired within the Province, as were the vendors and contractors required to implement the construction. While there are limited concrete girder manufacturers in Nova Scotia (compared to several/multiple steel suppliers), all materials required for construction of Alternative Mean 1 and Alternative Mean 2 were considered easily acquirable.

Table 2.3-5 Comparative Evaluation of the Alternative Means for the Bridge at Highway 348

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Concrete Girder Bridge	Alternative Mean 2 Steel Girder Bridge	Rationale
			Compatibility with Current Site Features	• What is the relative compatibility of the Alternative Mean with Site size and configuration? • What is the relative compatibility of the Alternative Mean with Site geology? • What is the relative compatibility of the Alternative Mean with Site hydrogeology? • What is the relative compatibility of the Alternative Mean with Site access? • What is the relative compatibility of the Alternative Mean with Site hydrology?	🟢	🟢	The compatibility of Alternative Mean 1 and Alternative Mean 2 with Site size and configuration was identified as an item that needed to be addressed, and was considered an average constraint regardless of the construction material. There was no perceived differences between the compatibility of either Alternative Mean with all other on-site features (i.e., site geology, hydrogeology, access, and hydrology).
			Compatibility with Existing Off-site Features	• What is the relative compatibility of the Alternative Mean with existing features and infrastructure surrounding the Site (e.g., points of access, roads, power lines)? • Does the Alternative Mean cause significant changes to off-site conditions (e.g., traffic)? • Does the Alternative Mean require upgrades or significant changes to the existing off-site infrastructure (e.g., upgrades to roads, power supply, municipal infrastructure)?	🟢	🟢	Regardless of the construction materials selected, there was no perceived difference between the compatibility of either Alternative Mean with existing off-site features. Both Alternative Means required grade adjustment and resurfacing to the approach ramps. Compatibility of the Alternative Means with existing off-site features was considered to be a modest constraint to be addressed, with minimal impact to off-site conditions (e.g., traffic) or infrastructure (e.g., points of access, roads, and power lines) associated with either Alternative Mean.
			Reliability/ Effectiveness/ Durability	• What is the relative expected service life of the Alternative Mean components relative to the remediation and post-remediation maintenance period? • What is the relative maintenance requirements of the Alternative Mean during the remediation and post-remediation maintenance period? • What is the likelihood the Alternative Mean will meet performance criteria or remediation objectives? • What is the relative impact of the Alternative Mean not meeting performance criteria or remediation objectives?	🟢	🔴	The components of each Alternative Mean were not expected to fail, but would show signs of fatigue/wear and tear within the remediation, and post-remediation period. The relative maintenance requirements associated with each Alternative Mean was considered throughout the anticipated 75-year lifespan of the bridge at Highway 348. Under Alternative Mean 2, the steel components of the bridge would be subject to corrosion, and would require cleaning and/or painting after a period of approximately 40 years. All other maintenance requirements for both Alternative Means were anticipated to be routine (e.g., cleaning, and minor repair). Both Alternative Means were considered to have a high likelihood of compliance, meeting functional requirements (i.e., navigable channel size, design load, and hydraulic capacity) and performance requirements readily. The resulting impact of the Alternative Means not meeting performance criteria was considered moderate. The relative ease of implementing a contingency measure during the post-remediation period was considered moderately difficult for both Alternative Means, despite the fact that the likelihood of contingency measures being required was considered remote.

Table 2.3-5 Comparative Evaluation of the Alternative Means for the Bridge at Highway 348

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Concrete Girder Bridge	Alternative Mean 2 Steel Girder Bridge	Rationale
				• What is the relative ease of implementation of contingency measures during the remediation and post-remediation maintenance period?			As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2.
			Remedial Implementation Time	• Can the Alternative Mean be constructed and fully operational within established time frame? • Anticipated time frame to implement Alternative Mean?	🟢	🟢	The anticipated timeframe required to construct the bridge at Highway 348 under Alternative Mean 1 and Alternative Mean 2 was considered to be approximately 4 months. This estimate included import of fill material and re-grading to adjust the super elevation on the approaches connecting Highway 348. Both Alternative Means are expected to be implemented in less than 4 years.
			Readily Monitored and Tested	• How readily can the Alternative Mean be monitored and tested during remediation phase? • How readily can the Alternative Mean be monitored and tested during post-remediation phase? • What is the relative amount of monitoring required to validate effectiveness?	🟢	🟢	The duration of the remediation and post-remediation phases of the BHRP have no impact on the monitoring and testing of the Bridge at Highway 348; general inspection, operation, and maintenance requirements for both Alternative Means would be the same throughout, and is readily accomplished. Both Alternative Means were considered to require similar (i.e., above average or moderate) amounts of monitoring to validate proper construction and effectiveness, including full time inspection during construction of footings, foundations, and concrete pours, etc.
			Minimal Waste Generation (e.g., dewatering effluent, dredged sediments, leachate)	• What is the ability of the Alternative Mean to minimize waste generation during remediation? • What is the ability of the Alternative Mean to minimize waste generation during the post-remediation maintenance phase? • What is the ability of the Alternative Mean to minimize dangerous goods generation?	🟢	🟢	During the remediation phase, both Alternative Means were considered to generate moderate amounts of general construction, and demolition debris. Removal of fill excavated during the process of opening up the channel for construction was not considered, as this volume of material was considered to be the same for both Alternative Means. During the post-remediation/maintenance phase, neither Alternative Mean was expected to generate any amount of waste. Both Alternative Means were expected to generate minimal (i.e., negligible) amounts of hazardous/dangerous goods throughout construction and post-construction phases.
				TECHNICAL RANKING:	🟢	🔴	**ALTERNATIVE MEAN 1 IS PREFERRED FROM A TECHNICAL PERSPECTIVE**
Environmental	A measure of the potential effects to the environment posed by the Alternative Means during remediation and post-remediation phases of the Project. In addition, this criterion considers the impact of weather events on the susceptibility and	Environmental	Remediation Phase Effects	• During the remediation phase, to what extent is the Alternative Mean likely to cause an adverse effect on: Atmospheric Environment, Aquatic Environment, Geology and Groundwater, Terrestrial Environment	🟢	🟢	No environmental impacts to atmosphere, groundwater quality, and soil quality were anticipated during the construction phase. As the bridge is anticipated to be constructed prior to the removal of the dam, minimal risk to the aquatic environment is anticipated due to excavation within water for construction of footings. Similarly, minimal/modest environmental impacts to terrestrial environment were anticipated during construction due to heavy equipment, clean fill stockpiles, and laydown areas.
			Post-remediation Phase Effects	• During the post-remediation phase, to what extent is the Alternative Mean likely to cause an adverse effect on: Atmospheric Environment, Aquatic Environment, Geology and Groundwater, Terrestrial Environment	🟢	🟢	During the post-construction phase, no impacts to atmospheric, aquatic, or geologic/terrestrial environmental quality were associated with either Alternative Mean.

Table 2.3-5 Comparative Evaluation of the Alternative Means for the Bridge at Highway 348

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Concrete Girder Bridge	Alternative Mean 2 Steel Girder Bridge	Rationale
	suitability of the Alternative Mean to severe weather events.		Weather Effects	• What is the potential impact of weather on the implementation of the Alternative Mean? • What is the potential impact of weather on the Alternative Mean during the post-remediation period? • What is the suitability of the Alternative Mean under severe weather events during remediation and post-remediation phase (e.g., 1:100 design event)?	🟢	🟢	Both Alternative Means were considered to be somewhat susceptible to poor weather conditions during construction. However, the differing construction materials used (i.e., concrete vs. steel) did not have an impact on the susceptibility of the Alternative Means to inclement weather as both girders systems are manufactured off-site. During the post-remediation phase (following construction of the bridge at Highway 348), both Alternative Means were considered to be not susceptible to poor weather conditions. Similarly, both Alternative Means would be designed and constructed in accordance with CHBDC and applicable *Navigable Water Bridges Regulations*, ensuring that the bridges would not fail under severe weather events (i.e., 1:100 year design event) during the remediation and post-remediation phase.
				ENVIRONMENTAL RANKING:	🟢	🟢	**ALTERNATIVE MEAN 1 AND 2 ARE PREFERRED FROM AN ENVIRONMENTAL PERSPECTIVE**
Social	The social criterion is a measure of the acceptability and compatibility of the Alternative Mean to the immediately affected surrounding community during remediation and post-remediation phases of the Project. In addition, this criterion considers the potential socio-economic benefit to the surrounding community as a result of implementation of the Alternative Mean.	Social	Community Acceptance	• How acceptable is the Alternative Mean to the surrounding communities during remediation phase? • How acceptable is the Alternative Mean to the surrounding communities during the post-remediation phase? • Does the Alternative Mean impact the surroundings community during remediation phase (i.e., safety, visual, nuisance)? • Does the Alternative Mean impact the surroundings community during post-remediation phase (i.e., safety, visual, nuisance)?	🟢	🟢	Both Alternative Means were considered to have only a moderate level of community acceptance during the remediation phase. While some members of the surrounding community may embrace getting a new bridge, the anticipated short-term response from the surrounding communities may be one of opposition, as the lane reductions during the anticipated 4-month construction period would inconvenience some. During the post-remediation phase, once the Bridge at Highway 348 has been constructed, it was anticipated that there would be a high level of community acceptance for the new bridge and associated return to tidal conditions under both Alternative Means. During the remediation phase, construction of the Bridge at Highway 348 was considered to have a negative impact on the surrounding communities; the lane reductions during construction present an inconvenience to the surrounding communities, and would limit/prohibit pedestrian traffic in the area. Finally, both Alternative Means were considered to have positive effect or impact on the surrounding communities during the post-remediation phase.
			Community Benefit	• Does the Alternative Mean affect the socio-economic environment including direct and indirect economic benefit impacts and social impacts (human health and recreational enjoyment)	🟢	🟢	Construction of the Bridge at Highway 348 and return to tidal conditions would have direct and indirect positive social impacts on the surrounding communities, from increased recreational use of Boat Harbour, to allowing the PLFN community to re-establish its relationship with the water and land of A'se'k. From an economic perspective, construction of the Bridge at Highway 348 may increase tourism in the area once the harbour is returned to tidal conditions. No other economic benefits directly attributable to either Alternative Mean were identified.
				SOCIAL RANKING:	🟢	🟢	**ALTERNATIVE MEAN 1 AND 2 ARE PREFERRED FROM A SOCIAL PERSPECTIVE**
Economic	The economic criterion is a measure of the relative costs associated with the implementation of the	Economic	Remediation Capital Costs	• What is the capital cost of the Alternative Mean?	🟢	🔴	The capital cost of Alternative Mean 1 (concrete girder bridge) was estimated to be $2,980,000, and was the lowest cost of the two Alternative Means being considered. The capital cost of Alternative Mean 2 (steel girder bridge) was estimated to be $3,160,000, which is approximately 6 percent higher than Alternative Mean 1. As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2.

Table 2.3-5 Comparative Evaluation of the Alternative Means for the Bridge at Highway 348

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Concrete Girder Bridge	Alternative Mean 2 Steel Girder Bridge	Rationale
	Alternative Means. Consideration is given to costs for planning and implementation (i.e., capital costs) and for ongoing operation and maintenance costs.		Post-Remediation Operations & Maintenance Costs	• What are the typical annual post-remediation operation and maintenance costs for the Alternative Mean?			Considering the relative maintenance requirements associated with each Alternative Mean throughout the anticipated 75-year lifespan of the Bridge at Highway 348, under Alternative Mean 2 the steel components of the bridge would be subject to corrosion, and would require cleaning and/or painting after a period of approximately 40 years. All other maintenance requirements for both Alternative Means were anticipated to be routine (e.g., cleaning, minor repair). Therefore, the estimated operation and maintenance costs for Alternative Mean 2 ($280,000) were higher than Alternative Mean 1 ($150,000). As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2.
				ECONOMIC RANKING:	Preferred	Not Preferred	**ALTERNATIVE MEAN 1 IS PREFERRED FROM AN ECONOMIC PERSPECTIVE**
				OVERALL RANKING:	Preferred	Not Preferred	**ALTERNATIVE MEAN 1 IS PREFERRED OVERALL**

Green dot: **PREFERRED** Red dot: **NOT PREFERRED**

2.3.6 Infrastructure Decommissioning

The following sections describe the Alternative Means for the infrastructure required to be decommissioned as part of the Project.

Key infrastructure components that would need to be decommissioned include:

- Pipeline | The pipeline includes approximately 2,305 m of 0.915 m diameter fiberglass reinforced plastic pipe (RPP) buried on land; and approximately 1,220 m of 1.1 m diameter high density polyethylene (HDPE) pipe buried at the bottom of the East River.
- Treatment Buildings | There are ten buildings and several small structures that formed part of the BHETF. Buildings are typically slab on grade construction or trailer based. Structures include inlet/outlet weirs, retaining walls, and maintenance holes, etc.
- Dam | The dam is located north of Highway 348 causeway and is designed to allow the levels in the BHSL to be controlled while blocking the tidal inflow. The dam is approximately 25 m wide and is connected to the banks of the estuary with earthen berms.

2.3.6.1 Pipeline Decommissioning – On Land

Description of the Alternative Means of Pipeline Decommissioning – On Land

Alternative Means were developed incorporating the feasible components that passed the preliminary screening requirements. A brief description of each of the Alternative Means is provided in the subsections below.

Alternative Mean 1 – Inspect and Abandon in Place

Alternative Mean 1 consists of performing an inspection and abandonment of the pipeline in place.

The purpose of inspecting the pipeline would be to ensure that the pipeline has been adequately cleaned and that the integrity of the pipeline is sufficient to minimize differential settlement or ground subsidence due to the pipe collapsing. Corrective action could include potential filling or complete removal of segments of the pipeline should imminent collapse be identified through inspection activities. Acceptable inspection approaches include manual visual inspection, PIG inspection, and video inspection.

Abandonment would consist of leaving the inspected pipeline in place. The ends of the pipeline would be plugged with an appropriate cap (e.g., concrete plug). Similarly, pipeline ends at each manhole would be cut and plugged with an appropriate cap (e.g., concrete plug). Each manhole would be cut approximately 1 metre below grade (mbg) and backfilled (both remaining void space and disturbed area). Disturbed areas would be graded to match existing hard surfaces and to achieve positive drainage.

Alternative Mean 2 – Fill and Abandon in Place

Alternative Mean 2 consists of filling the annulus such that the internal void space in the pipeline is solidified, and abandonment of the pipeline in place.

The purpose of filling the pipeline would be to solidify the annulus of the pipe such that any remaining process residues are immobilized and to prevent ground subsidence due to the pipe collapsing. Prior to commencing the filling process, an inspection would be performed, as per Alternative Mean 1.

The filling process would involve using mechanical equipment to mix and pump cellular concrete fill into the pipeline, followed by allowing the fill to solidify/set. Expandable foam is also a viable alternative to fill the pipeline.

Abandonment would consist of leaving the filled pipeline in place. The ends of the pipeline would be plugged with an appropriate cap (e.g., concrete plug). Similarly, pipeline ends at each manhole would be cut and plugged with an appropriate cap (e.g., concrete plug). Each manhole would be cut approximately 1 mbg and backfilled (both remaining void space and disturbed area). Disturbed areas would be graded to match existing hard surfaces and to achieve positive drainage.

Alternative Mean 3 – Complete Removal

Alternative Mean 3 consists of complete removal by excavating cover material and removal using mechanical equipment such as excavators or cranes (as needed). It is noted that a section of the pipeline between the East River and Highway 348 is near a PLFN burial ground. Complete removal of this section would require acceptance from PLFN and would require archeological monitoring.

Removal would include excavating the cover material to expose the pipeline such that it can be removed. The cover material would be removed using conventional excavation equipment. Large excavators with buckets would be used to excavate a trench and expose the pipeline. An excavator equipped with a ripper tooth would be used, as needed, to break strong in-situ material.

The excavated material would be stockpiled near the trench and would be reused for backfilling provided there are no soil contamination issues. It is anticipated that approximately a 30 m pipeline section would be exposed at one time followed by pipe removal and backfilling. The pipeline would be removed using mechanical equipment by first cutting the pipeline (e.g., excavator with a shear attachment) followed by removal (e.g., excavator or mobile crane). All manholes would also be removed. Manholes would be removed in sections using mechanical equipment (e.g., excavator or mobile crane).

If high rates of groundwater infiltration are observed, the water table would be lowered using pumps. The water collected from dewatering would be tested and then disposed at an appropriate on- or off-site treatment facility. Trenches would be continuously backfilled as the pipe is removed to limit the length of open excavations. Efforts would be made to limit excavations left open at the end of each day. Disturbed areas would be backfilled and graded to match existing hard surfaces and to achieve positive drainage.

Evaluation of Alternative Means of Carrying Out the Pipeline Decommissioning – On Land

Overall, the comparison of advantages and disadvantages generally supports selection of Alternative Mean 1 (abandon) as the preferred Alternative Mean for decommissioning of the on-land portion of the pipeline. The complete comparative evaluation is provided in Table 2.3-6.

A portion of the pipeline on-land near Indian Cross Point, passes adjacent to an unmarked Mi’kmaq burial ground. In order to determine PLFN's preferred alternative for decommissioning of the pipeline in this archeologically sensitive area, NSLI, together with PLFN completed a ground penetrating radar survey in the area to determine the presence or likely presence of graves. Using the findings of the ground penetrating survey and through Community meetings and surveys, PLFN has advised NSLI that the pipeline from the shoreline of East River at Indian Cross point to the west property line of Highway 348 should undergo complete removal. Details surrounding PLFN's decision are discussed in Section 5.

In consultation with NSTIR it has been decided that the pipeline under Highway 348 should be filled and abandoned in place.

Table 2.3-6 Comparative Evaluation of the Alternative Means for the Pipe Decommissioning – On Land

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Inspect and Abandon	Alternative Mean 2 Fill and Abandon	Alternative Mean 3 Complete Removal	Rationale
Regulatory	A measure of the ability of the Alternative Mean to meet the safety requirements of the Project, including the protection of the health and safety of both workers and the general public. In addition, this criterion also measures the anticipated approvability of the Alternative Mean.	Health & Safety	Ability to Protect Health and Safety of Public	• What is the relative risk level to public health and safety posed by the Alternative Mean? • To what extent can the potential risks be mitigated as part of the Alternative Mean?	🔴	🟢	🟢	By simply abandoning the on-land portion of the pipeline in place (following inspection) under Alternative Mean 1, there was potential for the pipeline to collapse. Under a worse-case scenario, pipeline collapse could potentially cause a sinkhole or surface depression to occur. Therefore, Alternative Mean 1 was considered to represent a low risk to public health and safety, while Alternative Mean 2 (fill) and Alternative Mean 3 (remove) were both considered to represent no risk to public health during remediation and post-remediation phases. The potential risks to public during decommissioning of the on-land portion of the pipeline were generally considered to be easily mitigated, with the exception of Alternative Mean 1. Following abandonment of the pipeline, moderate changes to Alternative Mean 1 would be required to mitigate the potential risks to public associated with pipeline collapse, including isolating or partial filling of pipeline segments. As a result, Alternative Mean 2 and 3 are preferred over Alternative Mean 1.
			Ability to Protect Health and Safety of Workers	• What is the relative risk level to worker health and safety posed by the Alternative Mean? • To what extent can the potential risks be mitigated as part of the Alternative Mean?	🟢	🟢	🔴	Alternative Mean 3 required a significantly greater level of effort to physically remove the pipeline during decommissioning, and as a result was considered to represent a low level of risk to worker health and safety. In contrast, under Alternative Mean 1 and Alternative Mean 2, the relative risk level to worker safety was considered to be much less since the pipeline was being abandoned in place for both Alternative Means, and therefore required significantly less effort. The inherent level of risk to worker health and safety associated with decommissioning of the on-land portion of the pipeline was generally considered to be low, and easily mitigated. Typical health and safety risks associated with general construction (e.g., working at heights, use of heavy equipment, and slips/trips/falls, etc.) are quite common, and were considered to be easily mitigated with proper site planning and controls, use of personal protective equipment (PPE), and implementation of proper protective systems during trenching and excavation. As a result, Alternative Mean 1 and 2 are preferred over Alternative Mean 3.
		Compliance	Ease of Obtaining Approvals	• Does the Alternative Mean go beyond the minimum requirements for federal/provincial approvability? • What is the relative public acceptability of the Alternative Mean?	🟢	🟢	🟢	All three Alternative Means were considered to have a high level of compliance, going beyond the minimum requirements for ease of federal/provincial approvability. While there are few applicable criteria that apply to decommissioning of the on-land portion of the pipe, demolition activities may require a permit for portions under public roadways. Disposal of construction waste material from pipeline decommissioning activities would be disposed of in the on-Site containment cell or at an off-Site landfill licensed to accept construction and demolition waste. All three Alternative Means were considered to have only a moderate level of public acceptance from the PLFN and surrounding communities. Under Alternative Mean 3, complete removal of the pipeline would inconvenience the general public for the removal of the portion under Highway 348. While there is much more disturbance along the pipeline corridor under Alternative Mean 3, the surrounding community would likely be more content to have the pipeline (and all associated

Table 2.3-6 Comparative Evaluation of the Alternative Means for the Pipe Decommissioning – On Land

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Inspect and Abandon	Alternative Mean 2 Fill and Abandon	Alternative Mean 3 Complete Removal	Rationale
								impacts) removed entirely. Under Alternative Mean 1 and Alternative Mean 2, the public may fear residual contamination would be left in place with the abandoned pipeline, or that the pipeline may get subsequently re-used for another purpose. It is worth noting that the majority of land along the pipeline corridor is generally wide open and located within an easement. The easement would remain in place under Alternative Mean 1 and 2, but could be removed under Alternative Mean 3. For the pipeline adjacent the PLFN burial ground; complete removal of this section would require acceptance from PLFN and would require archaeological monitoring.
				REGULATORY RANKING:	🔴	🟢	🔴	**ALTERNATIVE MEAN 2 IS PREFERRED FROM A REGULATORY PERSPECTIVE**
Technical	A measure of the Alternative Mean's ability to meet the functional requirements of the Project.	Technical	Technical Maturity	• What is the relative successful "track record" for implementing the Alternative Mean? • What is the relative availability of the source materials/equipment? • What is the relative availability of vendors/contractors for the Alternative Mean?	🟢	🟢	🟢	All three pipeline decommissioning methodologies were considered reliable approaches with extensive track records of successful applications. The materials and equipment required to implement the Alternative Means were considered easily acquired within the Province. Similarly, the vendors and contractors required to implement the decommissioning activities were considered readily available within the province.
			Compatibility with Current Site Features	• What is the relative compatibility of the Alternative Mean with Site size and configuration? • What is the relative compatibility of the Alternative Mean with Site geology? • What is the relative compatibility of the Alternative Mean with Site hydrogeology? • What is the relative compatibility of the Alternative Mean with Site access? • What is the relative compatibility of the Alternative Mean with Site hydrology?	🟢	🔴	🔴	The compatibility of Alternative Mean 1 with the Site (size and configuration) was identified as an item that needed to be addressed, but one that could be accomplished readily. The inspection and abandonment associated with Alternative Mean 1 was considered the least intrusive, causing minimal disturbance at the Site. The compatibility of Alternative Mean 2 with the Site was identified as an item that needed to be addressed, and was an average constraint. The filling, and abandonment associated with Alternative Mean 2 was considered somewhat intrusive, causing moderate disturbance at the Site. Finally, the compatibility of Alternative Mean 3 was considered a challenging constraint, with the complete pipe removal causing the most disturbance to Site features and noting the potential for space limitations for staging decommissioning activities. The compatibility of Alternative Mean 1 with Site geology was identified as an item that needed to be addressed, but one that could be accomplished readily. Alternative Mean 2 and Alternative Mean 3 were considered to be less compatible with Site geology – disturbances were required at several access points during filling of the pipeline under Alternative Mean 2, and significant disturbance was required along the entire pipeline corridor with the removal under Alternative Mean 3. The compatibility of Alternative Mean 1 with Site hydrogeology was identified as an item that needed to be addressed, but one that could be accomplished readily. Alternative Mean 2 and Alternative Mean 3 were considered to be less compatible with Site hydrogeology, especially along the sections adjacent to East River of Pictou. It is noted that groundwater quality along the pipeline corridor has not been characterized due to access restrictions while the pipeline is in operation. Scoring

Table 2.3-6 Comparative Evaluation of the Alternative Means for the Pipe Decommissioning – On Land

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Inspect and Abandon	Alternative Mean 2 Fill and Abandon	Alternative Mean 3 Complete Removal	Rationale
								for Alternative Mean 2 and Alternative Mean 3 is based the assumption that groundwater quality along the pipeline corridor is not impacted. The compatibility of Alternative Mean 1 with Site access was identified as an item that needed to be addressed, but one that could be accomplished readily. Alternative Mean 2 and Alternative Mean 3 were considered to be less compatible with Site access, especially along sections where the pipeline crosses the existing single lane access road. In particular for Alternative Mean 3, the anticipated 2-4 m deep excavation required to remove the pipeline presents a significant challenge to maintain Site access. Finally, the compatibility of Alternative Mean 1 with Site hydrology was identified as an item that needed to be addressed, but one that could be accomplished readily. Alternative Mean 2 and Alternative Mean 3 were considered to be less compatible with Site hydrology due to potential localized impacts to runoff, infiltration, and streamflow. As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2 and Alternative Mean 3.
			Compatibility with Existing Off-site Features	• What is the relative compatibility of the Alternative Mean with existing features and infrastructure surrounding the Site (e.g., points of access, roads, power lines)? • Does the Alternative Mean cause significant changes to off-site conditions (e.g., traffic)? • Does the Alternative Mean require upgrades or significant changes to the existing off-site infrastructure (e.g., upgrades to roads, power supply, municipal infrastructure)?	🟢	🔴	🔴	Restrictions due to spring load restrictions on secondary roads would limit off-site transport, making Alternative Mean 3 less compatible with existing off-site features due to construction traffic (e.g., importing fill for restoration). Historically, load restrictions are implemented between mid-March to mid-May, but load restrictions are also dependent on weather conditions and the types of vehicles being used. Potential changes or impacts to off-site conditions due to the anticipated increase in traffic volume, noise, dust (during summer months), wear and tear (e.g., deterioration) under Alternative Mean 3 was considered to be an average constraint. No potential changes or impacts to off-site conditions were associated with Alternative Mean 1 and minor changes with Alternative Mean 2. There was no perceived difference between the three Alternative Means in anticipated changes to existing power supply or other municipal infrastructure off-site, as no upgrades are currently required for implementation of these Alternative Means. As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2 and Alternative Mean 3.
			Reliability/ Effectiveness/ Durability	• What is the relative expected service life of the Alternative Mean components relative to the remediation and post-remediation maintenance period? • What is the relative maintenance requirements of the Alternative Mean during the remediation and post-remediation maintenance period?	🔴	🔴	🟢	The components of Alternative Mean 2 and Alternative Mean 3 were not expected to fail within the remediation and post-remediation period Alternative Mean 1 presents the small likelihood that the abandoned pipeline may collapse in place during the post-remediation period. The relative maintenance requirements associated with Alternative Mean 2 and Alternative Mean 3 were considered low, as no inspection or testing is anticipated during the post-remediation maintenance period. By comparison, periodic walks/inspections along the former pipeline corridor may be required following implementation of Alternative Mean 1 to monitor for potential pipe collapse.

Table 2.3-6 Comparative Evaluation of the Alternative Means for the Pipe Decommissioning – On Land

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Inspect and Abandon	Alternative Mean 2 Fill and Abandon	Alternative Mean 3 Complete Removal	Rationale
				• What is the likelihood the Alternative Mean will meet performance criteria or remediation objectives? • What is the relative impact of the Alternative Mean not meeting performance criteria or remediation objectives? • What is the relative ease of implementation of contingency measures during the remediation and post-remediation maintenance period?				In the event that existing soils around the pipeline are impacted, there is a slight/modest risk that remediation objectives associated with Alternative Mean 1 and Alternative Mean 2 would not be met as marginally impacted soils may be left in place. Under Alternative Mean 3, the level of risk associated with remediation objectives not being met was considered to be lower, since impacted soils (surrounding the pipeline) would be removed along with the pipeline itself as part of decommissioning activities. In the event that marginally impacted soils surrounding the pipeline were left in place under Alternative Mean 1 and Alternative Mean 2, the resulting impact was considered to be slight or modest. Under Alternative Mean 3, the relative impact associated with remediation objectives not being met was considered to be lower, since impacted soils would be removed along with the pipeline itself as part of decommissioning activities. The relative ease of implementing a contingency measure during the post-remediation period was considered straight forward for all Alternative Means. As a result, Alternative Mean 3 is the preferred method over Alternative Mean 1 and Alternative Mean 2.
			Remedial Implementation Time	• Can the Alternative Mean be constructed and fully operational within established time frame? • Anticipated time frame to implement Alternative Mean?	● (green)	● (red)	● (red)	The anticipated timeframe required to decommission the pipeline under Alternative Mean 3 was considered to be approximately 6-months (i.e., a single construction season) for complete removal and reinstatement; this timeframe is significantly longer than the time required to implement Alternative Mean 1 and Alternative Mean 2. Alternative Mean 1 had the shortest relative timeframe for implementation. Alternative Mean 2 had a slightly longer timeframe for implementation, while Alternative Mean 3 had the longest timeframe for construction. All three Alternative Means were expected to be implemented in well under 4 years. As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2 and Alternative Mean 3.
			Readily Monitored and Tested	• How readily can the Alternative Mean be monitored and tested during remediation phase? • How readily can the Alternative Mean be monitored and tested during post-remediation phase? • What is the relative amount of monitoring required to validate effectiveness?	● (red)	● (green)	● (green)	During the remediation phase, routine monitoring requirements were considered to be roughly the same (i.e., readily monitored and testable) for all Alternative Means. For all three Alternative Means, inspection would be either through in-situ (e.g., camera) or ex-situ (i.e., visual in the case of complete removal) means. Similarly, during the post-remediation phase, there are no anticipated monitoring requirements for Alternative Mean 2 and Alternative Mean 3 following pipeline decommissioning activities. Alternative Mean 1 (abandon) would require some post-remediation inspection for subsidence. Finally, all three Alternative Means were considered to require similar (i.e., minimal) amounts of monitoring to ensure effectiveness. As a result, Alternative Mean 2 and 3 are preferred method over Alternative Mean 1.
			Minimal Waste Generation (e.g., dewatering	• What is the ability of the Alternative Mean to minimize waste generation during remediation?	● (green)	● (green)	● (red)	During the remediation phase, both Alternative Mean 1 and Alternative Mean 2 were considered to generate minimal amounts of additional waste through implementation. By comparison, Alternative Mean 3 was expected to generate a

Table 2.3-6 Comparative Evaluation of the Alternative Means for the Pipe Decommissioning – On Land

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Inspect and Abandon	Alternative Mean 2 Fill and Abandon	Alternative Mean 3 Complete Removal	Rationale
			effluent, dredged sediments, leachate)	• What is the ability of the Alternative Mean to minimize waste generation during the post-remediation maintenance phase? • What is the ability of the Alternative Mean to minimize dangerous goods generation?				moderate amount of waste, primarily consisting of pipe and construction/demolition debris to be removed as part of decommissioning activities. During the post-remediation phase, all three Alternative Means were considered to generate minimal amounts of additional waste following decommissioning activities. All three Alternative Means were considered to generate negligible amounts of hazardous/dangerous goods during the remediation phase. As a result, Alternative Mean 1 and Alternative Mean 2 are preferred method over Alternative Mean 3.
				TECHNICAL RANKING:	🟢	🔴	🔴	**ALTERNATIVE MEAN 1 IS PREFERRED FROM A TECHNICAL PERSPECTIVE**
Environmental	A measure of the potential effects to the environment posed by the Alternative Means during remediation and post-remediation phases of the Project. In addition, this criterion considers the impact of weather events on the susceptibility and suitability of the Alternative Mean to severe weather events.	Environmental	Remediation Phase Effects	• During the remediation phase, to what extent is the Alternative Mean likely to cause an adverse effect on: Atmospheric Environment, Aquatic Environment, Geology and Groundwater, Terrestrial Environment	🟢	🔴	🔴	Alternative Mean 3 presented potential impacts to the aquatic environment (e.g., water quality, habitat, fish and benthic communities, etc.) resulting from pipeline removal activities near the East River. Alternative Mean 2 and 3 presented potential impacts to terrestrial environment (e.g., vegetation, and habitat, etc.) resulting from soil disturbances required to create access points or complete pipeline removal during decommissioning activities. All three Alternative Means presented no potential impact to atmospheric environment or geology and groundwater. As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2 and Alternative Mean 3.
			Post-remediation Phase Effects	• During the post-remediation phase, to what extent is the Alternative Mean likely to cause an adverse effect on: Atmospheric Environment, Aquatic Environment, Geology and Groundwater, Terrestrial Environment	🟢	🟢	🔴	All three Alternative Means indicated that little or no environmental interaction was anticipated, and no resulting adverse effects were expected following pipeline decommissioning activities. It should be noted though, that some tree removal may be required for complete removal.
			Weather Effects	• What is the potential impact of weather on the implementation of the Alternative Mean? • What is the potential impact of weather on the Alternative Mean during the post-remediation period? • What is the suitability of the Alternative Mean under severe weather events during remediation and post-remediation phase (e.g., 1:100 design event)?	🟢	🔴	🔴	Both Alternative Mean 1 and Alternative Mean 2 were considered to be not susceptible to poor weather conditions during implementation of pipeline decommissioning activities on land, primarily because these Alternative Means require significantly less intrusive work and would be implemented under a much shorter time frame. Alternative Mean 3 was considered to be moderately susceptible to inclement weather due to the six month implementation timeframe and amount of intrusive/open excavation work required during decommissioning. During the post-remediation phase (following pipeline decommissioning activities), all three Alternative Means were considered to be not susceptible to poor weather conditions. Alternative Mean 1 was considered suitable under severe weather events (i.e., 1:100 year design storm), as the Alternative Mean would not fail under a catastrophic event. Alternative Mean 2 was considered slightly more susceptible to a severe weather event during the remediation/implementation phase due to the increased implementation time and excavation required. Alternative Mean 3 was

NOVA SCOTIA

Table 2.3-6 Comparative Evaluation of the Alternative Means for the Pipe Decommissioning – On Land

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Inspect and Abandon	Alternative Mean 2 Fill and Abandon	Alternative Mean 3 Complete Removal	Rationale
								considered most susceptible to a severe weather event during the remediation/implementation phase due to the significantly increased implementation time and amount of open excavation required. As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2 and Alternative Mean 3.
				ENVIRONMENTAL RANKING:	🟢	🔴	🔴	**ALTERNATIVE MEAN 1 IS PREFERRED FROM AN ENVIRONMENTAL PERSPECTIVE**
Social	The social criterion is a measure of the acceptability and compatibility of the Alternative Mean to the immediately affected surrounding community during remediation and post-remediation phases of the Project. In addition, this criterion considers the potential socio-economic benefit to the surrounding community as a result of implementation of the Alternative Mean.	Social	Community Acceptance	• How acceptable is the Alternative Mean to the surrounding communities during remediation phase? • How acceptable is the Alternative Mean to the surrounding communities during the post-remediation phase? • Does the Alternative Mean impact the surroundings community during remediation phase (i.e., safety, visual, nuisance)? • Does the Alternative Mean impact the surroundings community during post-remediation phase (i.e., safety, visual, nuisance)?	🟢	🔴	🟢	All three Alternative Means were considered to have only a moderate level of community acceptance during the remediation phase. Under Alternative Mean 3, complete removal of the pipeline would inconvenience the public during the removal of the pipeline under Highway 348. While there is much more disturbance along the pipeline corridor under Alternative Mean 3, the surrounding community would likely be more content to have the pipeline (and all associated impacts) removed entirely. Under Alternative Mean 1 and Alternative Mean 2, the public may be concerned that residual contamination would be left in place with the abandoned pipeline, or that the pipeline may get subsequently re-used for another purpose. During the post-remediation phase, it was anticipated that there would be a high level of community acceptance for the complete pipeline removal under Alternative Mean 3. In comparison, abandonment of the pipeline under Alternative Mean 1 and Alternative Mean 2 would likely receive less community support during the post-remediation phase, as there may be concerns of residual contamination in place. During the remediation phase, implementation of Alternative Mean 1 was considered to have no effect (i.e., positive or negative) on the surrounding community. Similarly, implementation of Alternative Mean 2 was considered to have a slightly negative effect on the surrounding community due to minor inconvenience/nuisance during pipeline filling activities prior to abandonment. Finally, implementation of Alternative Mean 3 was considered to have a definite negative impact on the surrounding communities due to the disruption and inconvenience caused by pipeline removal, in particular at the Highway 348 crossing. Finally, all three Alternative Means were considered to have no net effect (i.e., either positive or negative) or impact on the surrounding communities during the post-remediation phase. However, for certain portions of the pipeline, completed removal was preferred from PLFN's perspective. As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2 and Alternative Mean 3, with the exception of PLFN's desire to remove the pipeline at Indian Cross Point, based on their feedback and input.

Table 2.3-6 Comparative Evaluation of the Alternative Means for the Pipe Decommissioning – On Land

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Inspect and Abandon	Alternative Mean 2 Fill and Abandon	Alternative Mean 3 Complete Removal	Rationale
			Community Benefit	• Does the Alternative Mean affect the socio-economic environment including direct and indirect economic benefit impacts and social impacts (human health and recreational enjoyment)	🟢	🟢	🟢	Decommissioning of the on-land portion of the pipeline was considered to have no direct or indirect positive social impacts on the surrounding communities. From an economic perspective, no economic benefits directly attributable to pipeline decommissioning Alternative Means were identified.
				SOCIAL RANKING:	🟢	🔴	🟢	**ALTERNATIVE MEAN 1 IS PREFERRED FROM A SOCIAL PERSPECTIVE. ALTERNATIVE 3 IS PREFERRED FOR A PORTION OF THE PIPELINE BASED ON PLFN INPUT**
Economic	The economic criterion is a measure of the relative costs associated with the implementation of the Alternative Means. Consideration is given to costs for planning and implementation (i.e., capital costs) and for ongoing operation and maintenance costs.	Economic	Remediation Capital Costs	• What is the capital cost of the Alternative Mean?	🟢	🔴	🔴	The capital cost of Alternative Mean 1 was estimated to be $170,000, and was the lowest cost of the three Alternative Means being considered. The capital cost of Alternative Mean 2 was estimated to be $1,520,000, which is approximately 8.9 times higher than Alternative Mean 1. Similarly, the capital cost of Alternative Mean 3 was estimated to be $630,000, which is approximately 3.7 times higher than Alternative Mean 1. As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2 and Alternative Mean 3.
			Post-Remediation Operations & Maintenance Costs	• What are the typical annual post-remediation operation and maintenance costs for the Alternative Mean?	🔴	🟢	🟢	The relative post-remediation operation and maintenance requirements associated with Alternative Mean 2 and Alternative Mean 3 were considered low/negligible, as no inspection or testing is anticipated during the post-remediation maintenance period. By comparison, periodic inspections along the pipeline corridor would be required following implementation of Alternative Mean 1 to monitor for pipe collapse. As a result, Alternative Mean 2 and Alternative Mean 3 are the preferred methods over Alternative Mean 1.
				ECONOMIC RANKING:	🟢	🔴	🔴	**ALTERNATIVE MEAN 1 IS PREFERRED FROM AN ECONOMIC PERSPECTIVE**
				OVERALL RANKING:	🟢	🔴	🔴	**ALTERNATIVE MEAN 1 IS PREFERRED OVERALL***

🟢 **PREFERRED** 🔴 **NOT PREFERRED**

*It is noted that while Alternative Mean 1 is the Preferred Method, during subsequent discussions with PLFN, it was determined that removal of the pipeline at Indian Cross Point was preferred for that particular section.

2.3.6.2 Pipeline Decommissioning – Under Water

Description of the Alternative Means of Carrying Out the Undertaking for the Pipeline Decommissioning – Under Water

Alternative Means were developed incorporating the feasible components that passed the preliminary screening requirements. A brief description of each of the Alternative Means is provided in the subsections below.

Alternative Mean 1 –Inspect and Abandon in Place

Alternative Mean 1 consists of performing an inspection of the pipeline and abandonment of the pipeline in place.

The purpose of inspecting the pipeline would be to ensure that the pipeline has been adequately cleaned. Acceptable inspection approaches include manual visual inspection, PIG inspection, and video inspection.

Abandonment would consist of leaving the inspected pipeline in place. The ends of the pipeline would be cut at the nearest manhole and plugged with an appropriate cap (e.g., concrete plug).

Alternative Mean 2 – Fill and Abandon in Place

Alternative Mean 2 consists of filling the annulus such that the internal void space in the pipeline is solidified, and abandonment of the pipeline in place. Filling operations would be completed in sequence with pipeline decommissioning activities for both the land and water portions as described for the portion of the pipeline on land.

Evaluation of Alternative Means of Carrying Out the Pipe Decommissioning – Under Water

Overall, the comparison of advantages and disadvantages generally supports selection of Alternative Mean 1 as the preferred Alternative Mean for decommissioning of the underwater portion of the pipeline. The complete comparative evaluation is provided in Table 2.3-7.

Table 2.3-7 Comparative Evaluation of the Alternative Means for the Pipe Decommissioning – Under Water

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Inspect and Abandon	Alternative Mean 2 Fill and Abandon	Rationale
Regulatory	A measure of the ability of the Alternative Mean to meet the safety requirements of the Project, including the protection of the health and safety of both workers, and the general public. In addition, this criterion also measures the anticipated approvability of the Alternative Mean.	Health & Safety	Ability to Protect Health and Safety of Public	• What is the relative risk level to public health and safety posed by the Alternative Mean? • To what extent can the potential risks be mitigated as part of the Alternative Mean?	● (green)	● (green)	By simply abandoning the underwater portion of the pipeline in place (following inspection) under Alternative Mean 1, there is potential for the pipeline to collapse. However, due to its location, pipe abandonment did not represent any risk to public health and safety. Alternative Mean 2 was also considered to present no risk to public health during remediation and post-remediation phases. The potential risks to public during decommissioning of the underwater portion of the pipeline were generally considered to be easily mitigated. Similarly, post-remediation/implementation identifies no potential risks to public health and safety.
			Ability to Protect Health and Safety of Workers	• What is the relative risk level to worker health and safety posed by the Alternative Mean? • To what extent can the potential risks be mitigated as part of the Alternative Mean?	● (green)	● (green)	The inherent level of risk to worker health and safety associated with decommissioning of the underwater portion of the pipeline was generally considered to be quite low, and easily mitigated. Typical health and safety risks associated with general construction (i.e., use of heavy equipment, pressurized equipment, and slips/trips/falls, etc.) are quite common, and were considered to be easily mitigated with proper site planning and controls and use of PPE. There is no additional risk for decommissioning the pipeline sections under water.
		Compliance	Ease of Obtaining Approvals	• Does the Alternative Mean go beyond the minimum requirements for federal/provincial approvability? • What is the relative public acceptability of the Alternative Mean?	● (green)	● (green)	Both Alternative Means were considered to have a high level of compliance, going beyond the minimum requirements for ease of federal/provincial approvability. While there are few applicable criteria that apply to decommissioning of the underwater portion of the pipe, decommissioning activities would be conducted in accordance with requirements specified in the *Nova Scotia Watercourse Alterations Standard*, and would be subject to conditions identified in *Canadian Navigable Waters Protection Act*. Both Alternative Means were considered to have only a moderate level of public acceptance from the PLFN and surrounding communities. Under Alternative Mean 1 and Alternative Mean 2, the public may fear residual contamination would be left in place with the abandoned pipeline, or that the pipeline may get used for another purpose. Conversely, the surrounding community may be more content knowing that the pipeline has been filled.
				REGULATORY RANKING:	● (green)	● (green)	**ALTERNATIVE MEANS 1 AND 2 ARE PREFERRED FROM A REGULATORY PERSPECTIVE**
Technical	A measure of the Alternative Mean's ability to meet the functional requirements of the Project.	Technical	Technical Maturity	• What is the relative successful "track record" for implementing the Alternative Mean? • What is the relative availability of the source materials/equipment? • What is the relative availability of vendors/contractors for the Alternative Mean?	● (green)	● (green)	Both pipe decommissioning methodologies were considered reliable approaches with extensive track records of successful applications. The materials and equipment required to implement the Alternative Means were considered easily acquired within the Province. Similarly, the vendors and contractors required to implement the decommissioning activities were considered readily available locally within the Province.
			Compatibility with Current Site Features	• What is the relative compatibility of the Alternative Mean with Site size and configuration? • What is the relative compatibility of the Alternative Mean with Site geology?	● (green)	● (red)	The compatibility of Alternative Mean 1 with the Site (size and configuration) was identified as an item that needed to be addressed, but one that could be accomplished readily. The inspection, and abandonment associated with Alternative Mean 1 was considered the least intrusive, causing minimal disturbance at the Site. The compatibility of Alternative Mean 2 with the Site was identified as an item that needed to be addressed, and was an average

Table 2.3-7 Comparative Evaluation of the Alternative Means for the Pipe Decommissioning – Under Water

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Inspect and Abandon	Alternative Mean 2 Fill and Abandon	Rationale
				• What is the relative compatibility of the Alternative Mean with Site hydrogeology? • What is the relative compatibility of the Alternative Mean with Site access? • What is the relative compatibility of the Alternative Mean with Site hydrology?			constraint. The filling, and abandonment associated with Alternative Mean 2 was considered somewhat intrusive, causing moderate disturbances at access points. The compatibility of Alternative Mean 1 with Site geology was identified as an item that needed to be addressed, but one that could be accomplished readily. Alternative Mean 2 was considered to be less compatible with Site geology – disturbances were required at access points during filling of the pipeline under Alternative Mean 2. The compatibility of Alternative Mean 1 with Site hydrogeology was identified as an item that needed to be addressed, but one that could be accomplished readily. Alternative Mean 2 was considered to be less compatible with Site hydrogeology due to the placement of cellular concrete fill throughout the underwater sections of pipeline. The compatibility of Alternative Mean 1 with Site access was identified as an item that needed to be addressed, but one that could be accomplished readily. Alternative Mean 2 was considered to be less compatible with Site access, as much of the decommissioning work would be initiated from points only accessible from the existing single lane access road. Finally, the compatibility of Alternative Mean 1 with Site hydrology was identified as an item that needed to be addressed, but one that could be accomplished readily. Alternative Mean 2 was considered to be less compatible with Site hydrology due to potential localized impacts to runoff, infiltration, and streamflow during the filling activities. As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2.
			Compatibility with Existing Off-site Features	• What is the relative compatibility of the Alternative Mean with existing features and infrastructure surrounding the Site (e.g., points of access, roads, power lines)? • Does the Alternative Mean cause significant changes to off-site conditions (e.g., traffic)? • Does the Alternative Mean require upgrades or significant changes to the existing off-site infrastructure (e.g., upgrades to roads, power supply, municipal infrastructure)?	🟢	🔴	Restrictions due to spring load restrictions on secondary roads would hinder off-site transport, making Alternative Mean 2 slightly less compatible with existing off-site features due to the amount of cellular concrete (also called foamed concrete) to be imported from off-site. Historically, load restrictions have been implemented between mid-March to mid-May, but restrictions are dependent on weather conditions and the types of vehicles being used. Potential changes or impacts to off-site conditions due to the slight increase in traffic volume under Alternative Mean 2 was considered to be a minor constraint that could be easily addressed. The resulting increase in noise, dust (during summer months), wear and tear (e.g., deterioration) on surrounding roads, and impact on traffic volume were considered minimal. No potential changes or impacts to off-site conditions were associated with Alternative Mean 1. There was no perceived difference between the two Alternative Means in anticipated changes to existing power supply or other municipal infrastructure off-site, as no upgrades are currently required for implementation of these Alternative Means. As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2.
			Reliability/ Effectiveness/ Durability	• What is the relative expected service life of the Alternative Mean components relative to the remediation and post-remediation maintenance period? • What is the relative maintenance requirements of the Alternative Mean	🟢	🟢	The components of Alternative Mean 1 and Alternative Mean 2 were not expected to fail within the remediation and post-remediation period. While there was a small likelihood that the abandoned pipeline under Alternative Mean 1 may collapse in place during the post-remediation period, this was not considered a design failure of the Alternative Mean; the pipeline is situated at such a depth that there is no risk for the public to encounter it, and therefore does not pose any risk if it collapses in place.

Table 2.3-7 Comparative Evaluation of the Alternative Means for the Pipe Decommissioning – Under Water

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Inspect and Abandon	Alternative Mean 2 Fill and Abandon	Rationale
				during the remediation and post-remediation maintenance period? • What is the likelihood the Alternative Mean will meet performance criteria or remediation objectives? • What is the relative impact of the Alternative Mean not meeting performance criteria or remediation objectives? • What is the relative ease of implementation of contingency measures during the remediation and post-remediation maintenance period?			The relative maintenance requirements associated with Alternative Mean 1 and Alternative Mean 2 were considered low, as no inspection or testing was anticipated during the post-remediation maintenance period; and the level of effort required to inspect the pipeline during decommissioning was the same for both Alternative Means. In the event that existing sediment around the underwater sections of the pipeline is impacted, there is a slight/modest risk that remediation objectives associated with Alternative Mean 1 and Alternative Mean 2 would not be met, as marginally impacted sediment may be left in place. Scoring for this sub-indicator was made under the assumption that soil surrounding the pipeline is not impacted. In the event that marginally impacted soil surrounding the pipeline was left in place under Alternative Mean 1 and Alternative Mean 2, the resulting impact from not meeting remediation objective was considered to be low as there is no potential receptor for the buried soil. The relative ease of implementing a contingency measure during the post-remediation period was considered relatively easy for both Alternative Means.
			Remedial Implementation Time	• Can the Alternative Mean be constructed and fully operational within established time frame? • Anticipated time frame to implement Alternative Mean?	🟢	🟢	Both Alternative Means are expected to be implemented in well under 4 years, as such both Alternative Means are equal.
			Readily Monitored and Tested	• How readily can the Alternative Mean be monitored and tested during remediation phase? • How readily can the Alternative Mean be monitored and tested during post-remediation phase? • What is the relative amount of monitoring required to validate effectiveness?	🟢	🟢	During the remediation phase, routine monitoring requirements were considered to be similar (i.e., readily monitored and testable) for both Alternative Means. Similarly, during the post-remediation phase, monitoring requirements were considered to be roughly the same (i.e., readily monitored and testable) for both Alternative Means following pipeline decommissioning activities, since no post-remediation inspections would be required for either Alternative Mean. Finally, both Alternative Means were considered to require similar (i.e., minimal) amounts of monitoring to validate effectiveness.
			Minimal Waste Generation (e.g., dewatering effluent, dredged sediments, leachate)	• What is the ability of the Alternative Mean to minimize waste generation during remediation? • What is the ability of the Alternative Mean to minimize waste generation during the post-remediation maintenance phase? • What is the ability of the Alternative Mean to minimize dangerous goods generation?	🟢	🟢	During the remediation phase, both Alternative Mean 1 and Alternative Mean 2 were considered to generate minimal amounts of additional waste throughout implementation. Similarly, during the post-remediation phase, both Alternative Means were considered to generate minimal amounts of waste following decommissioning activities. Both Alternative Means were considered to generate negligible amounts of hazardous/dangerous goods through implementation during the remediation phase.
				TECHNICAL RANKING:	🟢	🔴	**ALTERNATIVE MEAN 1 IS PREFERRED FROM A TECHNICAL PERSPECTIVE**
Environmental	A measure of the potential effects to the	Environmental	Remediation Phase Effects	• During the remediation phase, to what extent is the Alternative Mean likely to	🟢	🔴	Very little separated the environmental impact scoring of each Alternative Mean during the remediation phase. Alternative Mean 2 presented potential to the terrestrial environment

Table 2.3-7 Comparative Evaluation of the Alternative Means for the Pipe Decommissioning – Under Water

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Inspect and Abandon	Alternative Mean 2 Fill and Abandon	Rationale
	environment posed by the Alternative Means during remediation and post-remediation phases of the Project. In addition, this criterion considers the impact of weather events on the susceptibility and suitability of the Alternative Mean to severe weather events.			cause an adverse effect on: Atmospheric Environment, Aquatic Environment, Geology and Groundwater, Terrestrial Environment			(e.g., vegetation and habitat) resulting from the additional equipment and pumper trucks required to complete pipeline filling activities. These filing activities were not required under Alternative Mean 1. Little or no environmental interaction was anticipated, and no resulting adverse effects were expected following pipeline decommissioning activities. As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2.
			Post-remediation Phase Effects	• During the post-remediation phase, to what extent is the Alternative Mean likely to cause an adverse effect on: Atmospheric Environment, Aquatic Environment, Geology and Groundwater, Terrestrial Environment	🟢	🟢	Very little separated the environmental impact scoring of each Alternative Mean during the post-remediation phase. Little or no environmental interaction was anticipated for both Alternative Means, and no resulting adverse effects were expected following pipeline decommissioning activities.
			Weather Effects	• What is the potential impact of weather on the implementation of the Alternative Mean? • What is the potential impact of weather on the Alternative Mean during the post-remediation period? • What is the suitability of the Alternative Mean under severe weather events during remediation and post-remediation phase (e.g., 1:100 design event)?	🟢	🔴	Both Alternative Mean 1 and Alternative Mean 2 were considered to be not impacted by poor weather conditions during implementation of underwater pipeline decommissioning activities, primarily because these Alternative Means required minimal intrusive work and were implemented under a relatively short time frame. During the post-remediation phase (following pipeline decommissioning activities), both Alternative Means were not considered to be susceptible to poor weather conditions. Alternative Mean 1 was considered suitable under severe weather events (i.e., 1:100 year design storm), as the Alternative Mean would not fail under a catastrophic event. Alternative Mean 2 was considered slightly more susceptible to a severe weather event during the remediation/implementation phase due to the slightly increased implementation time required for pipeline filling activities. As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2.
				ENVIRONMENTAL RANKING:	🟢	🔴	**ALTERNATIVE MEAN 1 IS PREFERRED FROM AN ENVIRONMENTAL PERSPECTIVE**
Social	The social criterion is a measure of the acceptability and compatibility of the Alternative Mean to the immediately affected surrounding community during remediation and post-remediation phases of the Project. In addition, this criterion considers the potential socio-economic benefit to the surrounding community as a result	Social	Community Acceptance	• How acceptable is the Alternative Mean to the surrounding communities during remediation phase? • How acceptable is the Alternative Mean to the surrounding communities during the post-remediation phase? • Does the Alternative Mean impact the surroundings community during remediation phase (i.e., safety, visual, nuisance)? • Does the Alternative Mean impact the surroundings community during post-remediation phase (i.e., safety, visual, nuisance)?	🟢	🔴	Both Alternative Means were considered to have only a moderate level of community acceptance during the remediation phase. Under Alternative Mean 1 and Alternative Mean 2, the public may be concerned that residual contamination would be left in place with the abandoned pipeline, or that the pipeline may get used for another purpose. Conversely, PLFN and the surrounding community may be more content knowing that the pipeline has been filled. During the post-remediation phase, abandonment of the pipeline under Alternative Mean 1 and Alternative Mean 2 would likely receive a moderate amount of community support, however there may still be lingering concerns of residual contamination remaining in place. During the remediation phase, implementation of Alternative Mean 1 was considered to have no effect (i.e., positive or negative) on the surrounding community. Similarly, implementation of Alternative Mean 2 was considered to have a slightly negative effect on PLFN and the surrounding community due to minor inconvenience/nuisance during pipeline filling activities prior to abandonment. Finally, both Alternative Means were considered to have no net effect (i.e., either positive or negative) or impact on the surrounding communities during the post-remediation phase.

Table 2.3-7 Comparative Evaluation of the Alternative Means for the Pipe Decommissioning – Under Water

Component	Criteria Description	Criteria	Indicator	Key Questions	Alternative Mean 1 Inspect and Abandon	Alternative Mean 2 Fill and Abandon	Rationale
	of implementation of the Alternative Mean.						As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2.
			Community Benefit	• Does the Alternative Mean affect the socio-economic environment including direct and indirect economic benefit impacts and social impacts (human health and recreational enjoyment)?	🟢	🟢	Decommissioning of the underwater portion of the pipeline was considered to have no direct or indirect positive social impacts on the surrounding communities. From an economic perspective, no economic benefits directly attributable to pipeline decommissioning Alternative Means were identified.
				SOCIAL RANKING:	🟢	🔴	**ALTERNATIVE MEAN 1 IS PREFERRED FROM A SOCIAL PERSPECTIVE**
Economic	The economic criterion is a measure of the relative costs associated with the implementation of the Alternative Means. Consideration is given to costs for planning and implementation (i.e., capital costs) and for ongoing operation and maintenance costs.	Economic	Remediation Capital Costs	• What is the capital cost of the Alternative Mean?	🟢	🔴	The capital cost of Alternative Mean 1 was estimated to be $90,000, and was the lowest cost of the two Alternative Means being considered. The capital cost of Alternative Mean 2 was estimated to be $1,080,000, which is approximately 12 times higher than Alternative Mean 1. As a result, Alternative Mean 1 is the preferred method over Alternative Mean 2.
			Post-Remediation Operations & Maintenance Costs	• What are the typical annual post-remediation operation and maintenance costs for the Alternative Mean?	🟢	🟢	The relative post-remediation operation and maintenance requirements associated with Alternative Mean 1 and Alternative Mean 2 were considered low/negligible, as no inspection or testing is anticipated during the post-remediation maintenance period.
				ECONOMIC RANKING:	🟢	🔴	**ALTERNATIVE MEAN 1 IS PREFERRED FROM AN ECONOMIC PERSPECTIVE**
				OVERALL RANKING:	🟢	🔴	**ALTERNATIVE MEAN 1 IS PREFERRED OVERALL**

🟢 **PREFERRED** 🔴 **NOT PREFERRED**

2.3.6.3 Treatment Buildings

There are multiple small buildings and structures located throughout the Site that were used in support of the BHETF. The list below provides an inventory of the buildings and structures under consideration for decommissioning/demolition or repurposing as part of the Project:

- Press Building
- Mobile Building Adjacent to Press Building
- Storage Shed
- Air Monitoring Shelter
- Electrical Building
- Mobile Building belonging to CTS Electrical
- Silo
- Electrical Building for Silo
- Point A Building
- Point C Buildings

Description of the Alternative Means of Carrying Out the Undertaking for the Treatment Buildings

One Alternative Mean was developed incorporating the feasible components that passed the preliminary screening requirements. A brief description of each of the Alternative Means is provided in the subsections below. It is noted that a modification and repurposing of a Site building is considered possible, however, has not been evaluated at this stage as detailed end use Project requirements have not been identified. The repurposing of buildings will occur on an as-identified basis during the operation and decommissioning phase of the Project.

Alternative Mean 1 – Decommissioning and Demolition

Alternative Mean 1 consists of decommissioning and demolishing of each building/structure and transporting waste materials for disposal or recycling.

Prior to demolition, any hazardous materials would be abated, and a chemical sweep and cleaning would be completed. All residual product would be containerized and packaged, transported, and disposed of in accordance with provincial and federal regulations. Any non-hazardous waste would be collected and disposed or recycled. Building surfaces would be cleaned, as needed, to remove any residues. Electrical connections would be de-energized and disconnected. Similarly, any buried services would be decommissioned, as needed.

Demolition would commence once each building has been decommissioned and has been released for demolition. Demolition would require the use of an excavator, with a standard bucket or potentially mechanical shears for cutting large structural elements and collapsing the structure for cleanup. For larger structures, such as the silo, demolition would be done with a more methodical process using a crane and taking the structure apart in pieces. Footings and foundations would be removed to a depth of 0.9 m below finished grade.

As there was only one Alternative Mean that was fully developed, the evaluation and weighting matrix was not applied. Alternative Mean 1 – Decommissioning and Demolishing of the treatment buildings was selected as the preferred Alternative Mean.

2.3.6.4 Dam

The dam is used to regulate the water level in the BHETF and is located north of the bridge at Highway 384. The dam is a flat concrete slab structure with retaining walls supporting the earth embankments at both ends with the bottom elevation of the slab being approximately equivalent to extreme low tide. The water levels are controlled by an adjustable weir/stop log arrangement within the dam structure.

Description of the Alternative Means of Carrying Out the Dam

One Alternative Mean was developed incorporating the feasible components that passed the preliminary screening requirements. A brief description of the Alternative Mean is provided in the subsections below.

Alternative Mean 1 – Decommissioning and Demolition of Dam

Alternative Mean 1 involves the demolition of the dam structure and the rehabilitation of the estuary embankment slopes. The demolition of the dam structure would consist of using mechanical equipment to break the concrete structure into smaller components excavated and dumped into a dump truck for on-site or off-site disposal. The smaller elements of the structure would be demolished by hand, such as the timber screens and fences.

Prior to demolition, any hazardous materials should be abated. In addition, any electrical connections should be fully de-energized.

One of the major items for consideration are the requirements for erosion control during and after construction. Demolition would commence once the remediation is complete and Boat Harbour is ready to be reinstated back to tidal conditions. The use of silt booms installed in the water upstream and downstream of the dam would be used to control the migration of silt generated as a result of the dam removal. Once the dam structure is removed the channel would be dredged to match the channel shape and depth as the bridge (that would be installed to replace the causeway), to ensure the hydraulics are maintained throughout the channel.

As there was only one Alternative Mean that was fully developed, the evaluation and weighting matrix was not applied. Alternative Mean 1 – Decommissioning and Demolition of the Dam was selected as the preferred Alternative Mean.

2.3.7 Remediation Infrastructure

With the exception of energy supply, feasible Alternative Means are available for the majority of the required remediation infrastructure. A description of ancillary infrastructure required for the remediation is provided in subsequent sections.

2.3.7.1 Water Supply

The proposed bridge will be designed to accommodate the provision of potable water supply to PLFN, in accordance with potable water guidelines (*Atlantic Canada Guidelines for Drinking Water Supply Systems*). Temporary water supply service will be required during causeway removal and bridge construction activities. Upon completion of bridge construction, permanent water supply services will be reinstated. Permanent water supply services will be conveyed suspended from the bridge, and will require continual electric power source/supply for heat tracing.

The potable water wells on-site associated with the BHETF would be decommissioned.

2.3.7.2 Site Access

The Site has an existing access road (Simpsons Road) that extends from Pictou Landing Road/Highway 348 to the berm separating the ASB from the BHSL. Given the presence of this well-established site access road, no alternative site access roads would be explored for the Project.

Similarly, the existing perimeter road adjacent to the twin settling basins were deemed to be sufficient for the Project and no alternatives are being explored.

Access to the containment cell is via a single lane gravel roadway off the perimeter road along the southern bank of the ASB. Vehicle access to the containment cell would need to be upgraded to facilitate containment cell improvements, waste placement, construction of final cover, and post-closure monitoring and care including leachate management. This existing access road would be realigned and widened to facilitate vehicle access. A Shaw Span or series of culverts would be constructed beneath the road to allow the wetlands to return to tidal conditions. The road surface would be granular versus paved.

Construction of temporary access roads into the wetlands to facilitate dewatering and removal activities will also be required. These access points will utilize previously disturbed areas wherever possible, and will utilize shortest paths from established roadways into the wetland area for purpose of mobilizing equipment into the wetlands. Once within the wetland areas, the equipment utilized will work from a base within the area being remediated or will work from the water side (barges) to minimize disturbance to on-shore areas that do not require remediation. With the exception of the access points, no perimeter roadways are expected to be established in areas not requiring remediation around the wetlands.

Temporary access road will be constructed with a granular surface, likely with geogrid or similar approach to provide the required weight-bearing capacity while limiting requirement for permanent ground improvements. Final details of the access roads will be determined during detailed design stage.

2.3.7.3 Permanent and Temporary Linear Infrastructure

Temporary linear infrastructure includes floating pipelines, booster pumping station, temporary power supply to several areas around the Site, wash down areas, and road improvements across existing berms. These components would be removed on conclusion of the works and any disturbed areas stabilized prior to demobilization from the Site. Temporary areas for construction access to the water would be constructed at points adjacent to road/water access from the west side (to lift barges in and out) and using least disruptive/shortest paths to established roadways in the case of the wetland areas.

Temporary intake and discharge piping would also be constructed for the purpose of water supply and discharge, which would result in temporary overland piping reaching from Boat Harbour up to various areas including the containment cell area. Floating pipelines would be utilized for dredging and dewatering effluent. A floating pipeline would also be used for conveyance of TLTF treated effluent to the approved discharge point, which would be utilized during the transition stage after securing dredging operations, and before the final cap is placed onto the disposal cell.

Permanent linear infrastructure improvements include the roadway access from the west side, installation of a precast span or culvert (to permit road traffic above as well as restore tidal influence and small boat/canoe traffic below), adjustment of access road grading, and installation of a truck turnaround to permit safe and easy access to the leachate collection point by truck.

Permanent stormwater control measures such as swales, ditches, and pond would be incorporated into the area around the containment cell. Maintenance roads would be constructed as required to reach several areas around the containment cell to facilitate inspection and monitoring (i.e., perimeter access).

2.3.7.4 Energy

Development of the Alternative Means of Undertaking the Project for Energy

Given the small number of Alternative Means for energy, a simple screening process was identified as a suitable evaluation method. The screening process for the selection of the Preferred Alternative Mean for energy involved three questions regarding technical feasibility, economic feasibility, and environmental impact. Only Alternative Means that received a "Yes" to each of the three questions passed the screening. If the answer to any of the questions was "No" the Alternative Mean was considered to have failed the screening. The results of the screening are summarized below in Table 2.3-8.

Table 2.3-8 Alternative Means for Energy Component Screening

Alternative	Screening Questions			Pass/Fail
	Technical Is the Alternative Mean technically feasible?	Economic Is the Alternative Mean economically feasible?	Environmental Does the Alternative Mean minimize environmental impact?	
1. Tie-in to the existing electrical transmission line	Yes	Yes; more expensive short-term but costs recovered over the long-term.	Yes; environmental effects associated with habitat and vegetation loss within the right of way are minimized by using the same right of way for the access road.	Pass

Table 2.3-8 Alternative Means for Energy Component Screening

Alternative	Screening Questions			Pass/Fail
	Technical Is the Alternative Mean technically feasible?	Economic Is the Alternative Mean economically feasible?	Environmental Does the Alternative Mean minimize environmental impact?	
2. Use of multiple on-site generators	Yes	Yes; more expensive over long-term due to fuel lubricant, transportation, and operation and maintenance costs.	No; increased risk of fire and fuel spills given the generators' fuel requirements; increased impacts to noise levels; increased greenhouse gas emissions.	Fail

As per Table 2.3-8, Alternative Mean 1 (tie-in to the existing electrical transmission line) was selected as the Preferred Alternative Mean for energy.

2.3.8 Summary of Preferred Alternative Means for All Project Components

Summary of the Preferred Alternative for Waste Management

Alternative Mean 1 – Use existing containment cell, was selected as the Preferred Alternative for the management of dewatered sludge and sediment waste. Under Alternative Mean 1, the 220,000 m^3 (waste) design capacity of the existing 6.7 ha containment cell would be exceeded based on the physical properties of the waste and recommended final elevations. The containment cell would be modified to enhance the leachate collection layer and facilitate placement and dewatering of the sludge/sediment in a one-step operation. Final landfill cover contours would be designed to accommodate the anticipated range of final waste volumes, minimize precipitation infiltration through the cap, control the release of landfill gas, and accommodate end use.

Summary of the Preferred Alternative for Dredging

Alternative Mean 1A – Removal in the Wet with Geotube® or equivalent technology Dewatering was selected as the Preferred Alternative for the treatment of sludge and impacted sediment. Removal in the wet would involve dredging sludge from the ASB, Boat Harbour, and estuary under wet conditions, and would be predominantly completed through hydraulic dredging (at a rate of 4,000 m^3 of in-place sludge per day) due to the ease of material transfer. Approximately 0.15 m of material underlying the sludge (e.g., native marine clay in the BHSL meets the applicable remedial quality standards for all sediment COCs.

Hydraulically dredged sludge slurry would be pumped through discharge lines to the sludge management area, located directly in the containment cell. Multiple Geotubes® or equivalent technology would be set up as permitted by space. As a Geotube® or equivalent technology dewaters, additional capacity is created to allow for placement of slurry (typically three pumping events per Geotube® or equivalent technology). Once the capacity of the Geotube® or equivalent technology is used, empty Geotubes® or equivalent technology would be placed adjacent or stacked on top (forming a pyramid shape). It is estimated that between 50 and 130 Geotubes® or equivalent technology would be required to manage sludge from the effluent ditching, twin settling basins, ASB, the BHSL, and estuary, however, the number would vary based on the size of Geotube® or equivalent technology used.

Summary of the Preferred Alternative for Wetland Management

Alternative Mean 1 – Natural Attenuation was selected as the Preferred Alternative for the management of wetlands. Natural attenuation involves no physical removals of the contaminants from the wetlands. This option is available if the contaminants and physical setting they are in have been highly characterized and assessed, and it was determined that this option presents acceptable risk to all possible receptors. Wetland function may be enhanced as well as vegetation density or location through plantings.

It should be noted that based on additional findings through the HHERA, portions of the wetlands and the estuary are impacted above the risk-based criteria established in the HHERA and therefore will need to undergo ex-situ remediation discussed under Alternative Mean 2. Areas where the concentrations are below the risk-based criteria will be managed though natural attenuation, as the Preferred Alternative Mean.

Summary of the Preferred Alternative for Bulk Water Management

Alternative Mean 1 – On-site Management Using Appropriate Technology Treatment System was selected as the Preferred Alternative for bulk water management.

Summary of the Preferred Alternative for Dewatering Effluent Management

Alternative Mean 1 – On-site Management Using Appropriate Technology Treatment System was selected as the Preferred Alternative for dewatering effluent management.

Summary of the Preferred Alternative for Leachate Management

Alternative Mean 2 – Off-site Disposal was selected as the Preferred Alternative for post-remediation leachate treatment. This alternative involves disposing of leachate at an off-site NSE approved facility for disposal by tanker. Leachate would drain from the containment cell to the storage tanks. A truck loading station would facilitate the loading of leachate into a tanker truck. The tanker truck would then transport and dispose of leachate at an off-site NSE approved facility for disposal. It has been assumed that all off-site disposal would be within 175 km of the Site.

Summary of the Preferred Alternative for the Bridge at Highway 348

Alternative Mean 1 – Concrete Girder Bridge was selected as the Preferred Alternative for the Bridge at Highway 348. The new bridge structure would be an approximately 34 m long, single-span structure, maximizing the flow beneath the span through elimination of a center pier. A concrete superstructure is preferred by NSTIR due to its durability, longevity, and low long-term maintenance costs. The rail height on the bridge would be a 1050 mm high, concrete barrier system to meet the necessary requirements for pedestrians and architectural enhancements. The bridge design would incorporate a new support system for the water main.

Summary of the Preferred Alternative for Pipeline Decommissioning – On Land

Alternative Mean 1 – Inspect, and Abandon in place was selected as the Preferred Alternative for pipeline decommissioning on land. Inspecting the pipeline would ensure that the pipeline has been adequately cleaned and that the integrity of the pipeline is sufficient to minimize differential settlement or ground subsidence due to the pipe collapsing. Finally, abandonment would consist of leaving the inspected pipeline in place. The ends of the pipeline would be plugged with an appropriate cap (e.g., concrete plug). Similarly, pipeline ends at each manhole would be cut and plugged with an appropriate cap (e.g., concrete plug). Each manhole would be cut approximately 1 mbg and backfilled (both remaining void space and disturbed area). Any disturbed areas would be graded to match existing hard surfaces and to achieve positive drainage. As detailed in Section 3, PLFN has requested that the pipeline from Indian Cross Point to Highway 348 be fully removed.

Summary of the Preferred Alternative for Pipeline Decommissioning – Under Water

Alternative Mean 1 – Inspect and Abandon in place was selected as the Preferred Alternative for pipeline decommissioning under water. Inspection of the pipeline would ensure that the pipeline has been adequately cleaned. Finally, abandonment would consist of leaving the inspected pipeline in place. The ends of the pipeline would be cut at the nearest manhole and plugged with an appropriate cap (e.g., concrete plug).

Summary of the Preferred Alternative for Treatment Buildings

Alternative Mean 1 – Decommissioning and Demolition of the treatment buildings was selected as the Preferred Alternative for the management of treatment buildings. Re-purposing of buildings will occur on an as-identified basis during operation and decommissioning phases of the Project.

Summary of the Preferred Alternative for the Dam

Alternative Mean 1 – Decommissioning and Demolition of the dam was selected as the Preferred Alternative.

Summary of the Preferred Alternative for Water Supply

The proposed bridge will be designed to accommodate the provision of potable water supply to PLFN, in accordance with potable water guidelines (*Atlantic Canada Guidelines for Drinking Water Supply Systems*).

Summary of the Preferred Alternative for Site Access

The BHETF site has an existing access road (Simpsons Road) that extends from Pictou Landing Road/Highway 348 to the berm separating the ASB from BHSL. Given the presence of this well-established site access road, no alternative site access roads will be explored for the Project.

Summary of the Preferred Alternative for Energy

Alternative Mean 1 – Tie-in to the Existing Electrical Transmission Line was selected as the Preferred Alternative Mean for energy.

Environmental Impact Statement

Section 3 | Project Description

Boat Harbour Remediation Project
Pictou Landing, Nova Scotia

Nova Scotia Lands Inc.

NOVA SCOTIA

Table of Contents

Figure Index

Table Index

3. Project Description

3.1 Project Components

Following the stoppage of effluent flow[1] from the Kraft Pulp Mill to the Boat Harbour Effluent Treatment Facility (BHETF), the Project is to remediate the BHETF and adjacent lands including returning Boat Harbour to a tidal estuary. The components identified in Section 1.2 that comprise of Boat Harbour Remediation Project (BHRP or Project), as shown on Figure 1.2-1, are grouped into the following categories and described further in the subsections below:

- Waste Management
- Dredging
- Wetland Management
- Water Management
- Bridge at Highway 348
- Infrastructure Decommissioning (i.e., pipeline, treatment buildings, dam, berms)
- Remediation Infrastructure

The ultimate responsibility for care and control of the Project components rests with Nova Scotia Lands Inc. (NSLI) as the Proponent. NSLI intends to retain one or more Contractors to complete the preparation and construction and operational phases of the Project. NSLI also intends to retain one or more Contractor(s)/Consultant(s) to execute the post-closure care phase of the Project. The Contractor(s) shall be responsible for their daily activities on the Site, including the development and implementation of Site-specific environmental protection plans (SSEPPs) to ensure compliance with the Environment Management Plan (EMP),the Project Environmental Project Plan (PEPP) , and the contract documents, and by extension all applicable permit and regulatory requirements. The draft EMP and PEPP are included in Appendix B.

To ensure proper care and control of Project components and compliance with the Industrial Approvals, NSLI will enter into a contract with a Construction Management and Oversight Consultant (CMOC). NSLI will be engaging the CMOC as the oversight for day to day operations, auditing, and compliance monitoring for the works completed by the Contractors. The CMOC will carry out an oversight function on behalf of NSLI on a daily basis including the role of Environmental Manager. The CMOC will monitor and advise the Contractor and NSLI of any non-compliant items, including direction for corrective action.

The Contractors will submit plans for review and approval by NSLI via the CMOC and will submit reports to NSLI via the CMOC demonstrating compliance and ensuring any required updates or corrective action is completed.

1 As per the Boat Harbour Act and the Ministerial Order on January 29, 2020 (MO-55774), the flow of effluent into BHETF ceased prior to January 31, 2020.

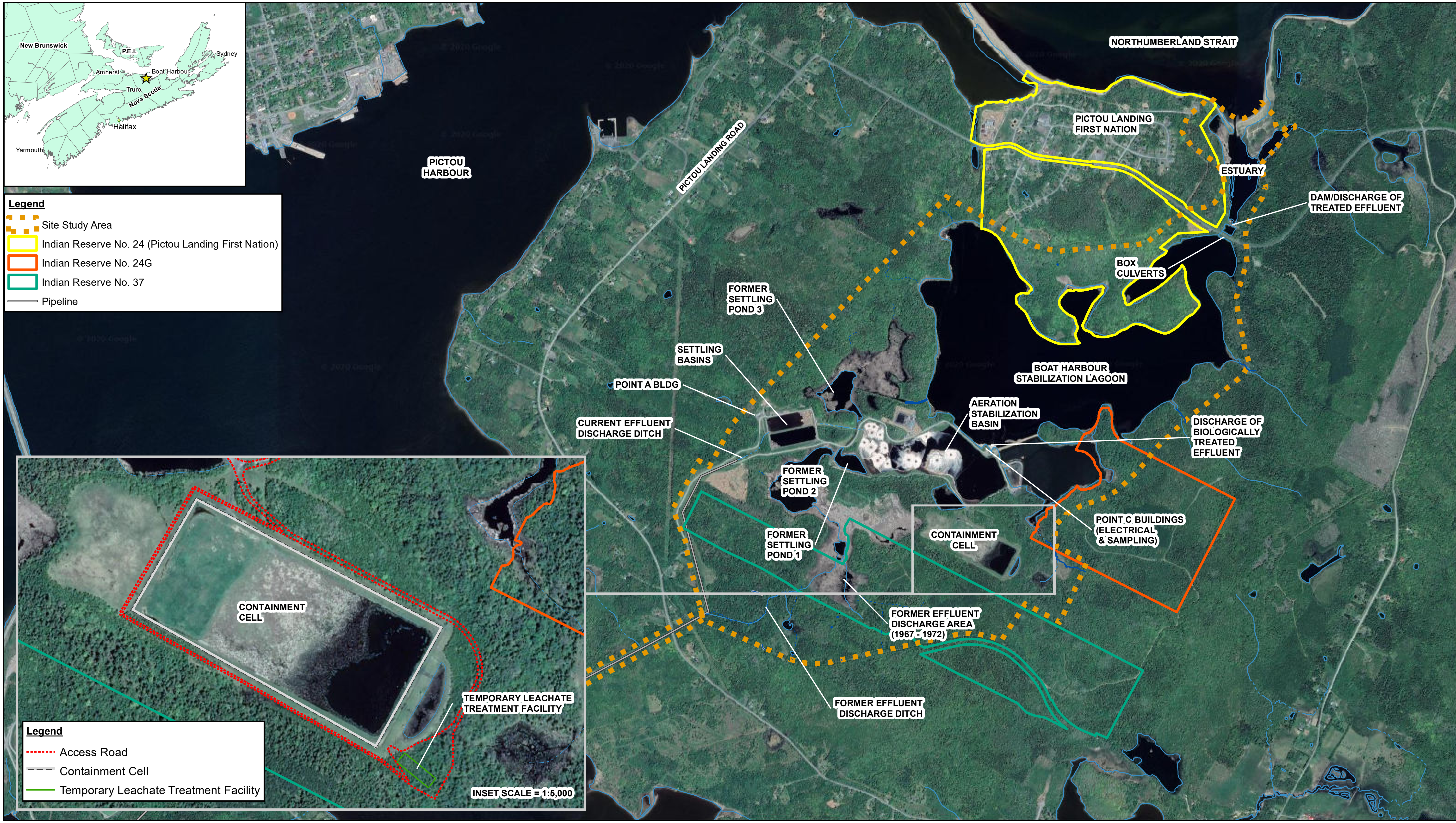
NSLI retains the overall responsibility for compliance, supported by the CMOC and the Contractor's environmental staff.

3.1.1 Waste Management

Remediation of the BHETF would generate the following industrial solid waste streams:

- Waste generated from cleaning of the pipeline; dewatered sludge/sediment waste from remediation of the settling basins, aeration stabilization basin (ASB), Boat Harbour stabilization lagoon (Boat Harbour or BHSL), wetlands, effluent ditches (current and historical); and risk management areas within the estuary.
- Impacted soil generated from decommissioning/demolition of the causeway at Highway 348, BHETF berms, dam, pipeline, and temporary by-pass.
- Industrial waste generated from remediation activities (e.g., spent treatment media).

Solid waste generated during remediation would be disposed of in the existing 6.7 hectare (ha) containment cell. Vertical expansion of the containment cell would be required to accommodate the waste; and the containment cell would be further modified to enhance the base liner system and leachate collection system and facilitate placement and dewatering of the sludge/sediment in a one step operation. Final contours for the containment cell have been designed to accommodate vertical expansion with an increase in the perimeter berm height of up to 3.0 metres (m), minimize precipitation infiltration through the cap, control the release of landfill gas (LFG), and accommodate end use. The location of the containment cell is provided in Figure 3.1-1.



Source: Imagery @2017 Google CNES / Airbus, DigitalGlobe, Landsat / Copernicus; WSP Canada Inc., Project No. 171-10478

0 200 400 600
Meters

Coordinate System:
NAD 1983 CSRS UTM Zone 20N

NOVA SCOTIA LANDS INC
BOAT HARBOUR, NS
ENVIRONMENTAL IMPACT STATEMENT

CONTAINMENT CELL AND TEMPORARY LEACHATE TREATMENT FACILITY LOCATION

11148275-31-03
Sep 22, 2020

FIGURE 3.1-1

GIS File: I:\GIS_DATA\Projects\8-chars\1114----\11148275 Boat Harbour\11148275-REPORTS\11148275-Rpt-26\11148275-31-03(026)GIS-HX003.1-1.mxd

The containment cell final cover contours with 4 horizontal to 1 vertical (4H:1V), as shown in Figures 3.1-2 and 3.1-3, would accommodate 930,000 cubic metres (m^3) of waste, and allow for a 0.75 m thick low permeable final cover. If additional capacity is needed, the side slope will be modified to 3H:1V, which will provide an additional 143,000 m^3 of capacity for waste, for a total waste capacity of 1,073,000 m^3. The final cover would consist of a sand/grading layer, flexible membrane liner, sand drainage layer, and vegetated topsoil constructed to minimize infiltration and leachate generation. The final cover material would be modified to accommodate intended plantings such as short shrubs that would tie the containment cell visually into the surrounding tree line. A digital rendering of the proposed final containment cell is shown in Figure 3.1-4.

As previously noted, expansion of the existing containment cell is required to accept the waste streams generated as a result of the proposed Project. The existing containment cell is approved to receive 220,000 m^3 of sludge from the BHETF. During remediation of the BHETF between 770,000 and 922,000 m^3 of sludge waste (including clean underlying sediment and root mat) is anticipated to be generated and disposed of in the existing containment cell. This volume includes the estimated 180,000 m^3 of sludge (51,000 m^3 solidified sludge and 129,000 m^3 of liquid sludge) previously placed in the containment cell as part of ongoing facility operations. Construction and demolition debris would be disposed of off-site to minimize the amount of waste in the final containment cell.

The final volume to be disposed can only be determined once the remediation is completed, as it is dependent on the actual consolidation rates achieved through dewatering, the volume of root mat to be removed, and the depth of underlying clean sediment removed in conjunction with dredging operations. With this in mind, the total waste capacity this undertaking is seeking approval for has been conservatively estimated to be 1,073,000 m^3, which includes the existing approved capacity of 220,000 m^3.

Leachate management refers to the management of leachate generated from the use of the containment cell for long-term disposal of the waste. Under post-closure conditions (i.e., post capping of the containment cell with a low permeable final cover), the anticipated leachate generation rate from the cell is expected to range from 2,500 m^3 per year to 2 m^3 per year, decreasing over time. As noted in Section 2.3.4.3, Alternative Mean 2 – Off-site Disposal was selected as the Preferred Alternative for post-remediation leachate management. This alternative involves disposal of leachate at an off-site NSE approved facility by tanker truck for treatment and disposal. Leachate would drain from the containment cell to the storage tank(s). A truck loading station would facilitate the loading of leachate into a tanker truck. The tanker truck would then transport and dispose of leachate at an off-site facility for treatment and disposal (within 175 kilometres [km] of the Site). The truck loading area would be graded towards the stormwater pond and a valve would be installed on the stormwater pond outlet structure to contain any spills that may occur during truck loading.

The Nova Scotia Municipal Solid Waste Landfill Guidelines were reviewed when developing the design of the modified containment cell with respect to service life, leachate management and accepted materials. NSLI and GHD consulted with NSE to determine which, if any, landfill in the Province of Nova Scotia could accept the waste. NSE confirmed that the containment cell adjacent to the BHETF, on Provincial lands is the only landfill currently approved to accept the waste from the BHETF given the anticipated levels of dioxins and furans in the sludge/sediment.

The Nova Scotia Municipal Solid Waste Landfill Guidelines do not include service life considerations nor a default leachate quality to consider. As an existing landfill, Canadian Council of Ministers of the Environment standards were not applied. Ontario Regulation (O. Reg.) 232/98 provides the design requirements for landfills in Ontario. It includes expected service life of liner system components based on design principles. It also provides leachate source concentrations that must be considered when designing landfill liner systems. With this in mind, it was determined that information contained within O. Reg. 232/98 would be a reasonable guideline in relation to assessing the assumed service life of the proposed containment cell.

When comparing the forecasted leachate quality to the groundwater criteria, lead and zinc are the only parameters to exceed the criteria, and therefore are carried forward as contaminants of concern with regards to the service life. Dioxins and furans are not considered a contaminant of concern for long-term service life of the containment cell. This is due to the fact that dioxins and furans are extremely hydrophobic and are nearly insoluble, so they are not considered to mobilize into liquid phase long-term. The leachate source concentrations provided in O. Reg. 232/98 include lead at a concentration of 600 ug/L, which is greater than the forecasted 23.3 ug/L in the containment cell. Therefore, the service life considerations in O. Reg. 232/98 are considered reasonable when considering the lead present in the containment cell leachate. Zinc is not considered in O. Reg. 232/98 leachate characteristics. A review of typical leachate quality for municipal solid waste landfills indicates zinc is expected to be present at concentrations of 10,000 to 200,000 ug/L (Solid Waste Landfill Engineering and Design, McBean, Rovers, Farquhar, 1995), which is greater than the forecasted 149 ug/L in the containment cell. Therefore, the service life requirements provided in O. Reg. 232/98 for liner systems are considered appropriate for managing leachate with the contaminant of concern at concentrations forecasted for the containment cell.

The assumed service life requirements (in keeping with O. Reg. 232/98) are listed below along with the requirements that will be carried forward in the containment cell design.

Table 3.1-1 Service Life Design Requirements

O. Reg. 232/98 Service Life	O. Reg. 232/98 Requirement	Containment Cell Design
100-year Leachate Collection System	Pipes bedded in 0.3 m thick layer on slopes and 0.5 m thick layer on base	Thicknesses will be carried
	Drainage blanket stone D85 not less than 37 millimetre (mm), D10 not less than 19 mm, D60/D10 less than 2, no more than 1 percent passing US#200 sieve	Stone gradation will exceed these requirements
	Geotextile separator above and below granular drainage blanket	Woven geotextiles included in design
	Perforated high density polyethylene (HDPE) pipes minimum 150 mm with perforations not less than 12 mm	Pipe diameter greater than 150 mm, minimum perforation size will be used
	Perforated pipes must be bedded in stones so there is at least 250 mm of stone above the pipes and at least 50 mm of stone below the pipes	Minimum cover above and below will be maintained

Table 3.1-1 Service Life Design Requirements

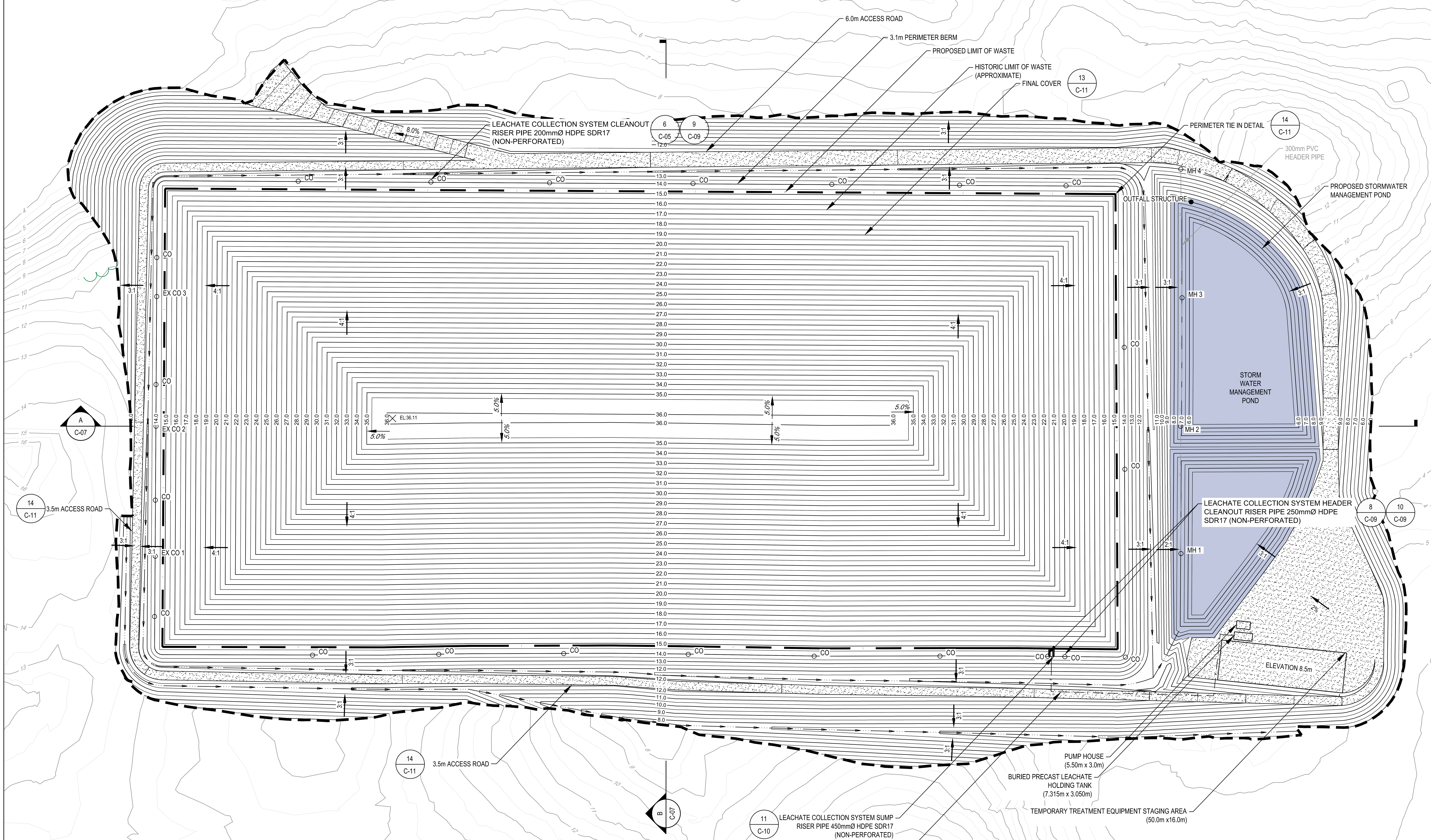
O. Reg. 232/98 Service Life	O. Reg. 232/98 Requirement	Containment Cell Design
	Hydraulic capacity of perforations can accommodate leachate, pipe flow can accommodate leachate, structural integrity of pipe is maintained	Leachate pipe calculations provided to ensure that these hydraulic criteria are achieved
	Maximum drainage path of 50 m	Pipe spacing in direction of flow is 50 m
	Minimum base grade 0.5 percent to pipes	Base grade is 0.8 percent
150-Year Geomembrane Liner	HDPE and minimum 1.5 mm thick	1.5 mm HDPE geomembrane will be used
	Oxidative Induction Time (OIT) must exceed 100 minutes to ASTM D3895-95 and 250 minutes to ASTM D5885-95	HDPE will be specified to meet or exceed this requirement
	OIT after oven ageing per ASTM D5721-95 to exceed 80 percent of the original values above	HDPE will be specified to meet or exceed this requirement
	Geomembrane must be installed in direct contact with suitable foundation or clayey liner	Geomembrane will be in direct contact with geosynthetic clay liner (GCL)
	Geomembrane must be protected from puncturing and load induced damage at all times	Sand protective layer provided in design

Cattails and other organic material where deemed necessary will be removed from the wetlands through clearing and grubbing activities. The material will be mechanically processed through chipping and grinding and stockpiled for future use as mulch/soil amendment. This material may also be removed as part of the dredging operation and disposed of within the containment cell.

LEGEND

EXISTING MAJOR CONTOUR (1.0m INTERVAL)	LIMIT OF WASTE	EXISTING HEADER PIPING
EXISTING MINOR CONTOUR (0.5m INTERVAL)	LIMIT OF GRADING	MH 1 MANHOLE
MAJOR CONTOUR (1.0m INTERVAL)	ACCESS ROAD	CO 1 CLEAN OUT
MINOR CONTOUR (0.5m INTERVAL)	PERIMETER BERM	
INDIAN RESERVE NO.37	DRAINAGE DITCH	
	TREE LINE	
	LEACHATE COLLECTION FORCEMAIN	

0 8 16 24m



SOURCE:
1. ELEVATIONS ARE BASED ON CANADIAN GEODETIC VERTICAL DATUM CGVD2013.
2. CONSTRUCTION OF SLUDGE DISPOSAL CELL AS-BUILT DRAWINGS BY JACQUES WHITFORD ENVIRONMENTAL LIMITED, JANUARY 1999.
3. LIDAR SURVEY COMPLETED BY LEADING EDGE GEOMATICS, MAY 15, 2015.
4. TOPOGRAPHIC SURVEY COMPLETED BY WSP, OCTOBER 18, 2018.
5. TOPOGRAPHIC SURVEY COMPLETED BY WSP, APRIL 2019.

50% DESIGN REVIEW

GHD Limited
120 Western Parkway, Suite 110
Bedford Nova Scotia B4B 0V2 Canada
T 902 468 1248 F 902 468 2207 W www.ghd.com

Reuse of Documents
This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD and shall not be reused in whole or in part for any other project without GHD's written authorization. © 2019 GHD

Client
NS LANDS - BOAT HARBOUR PICTOU LANDING, NOVA SCOTIA

Project
BOAT HARBOUR REMEDIATION

No.	Issue	Drawn	Approved	Date
2.	50% DESIGN REVIEW	KD	DT	12-20-2019
1.	30% DESIGN REVIEW	KD	DT	10-18-2019

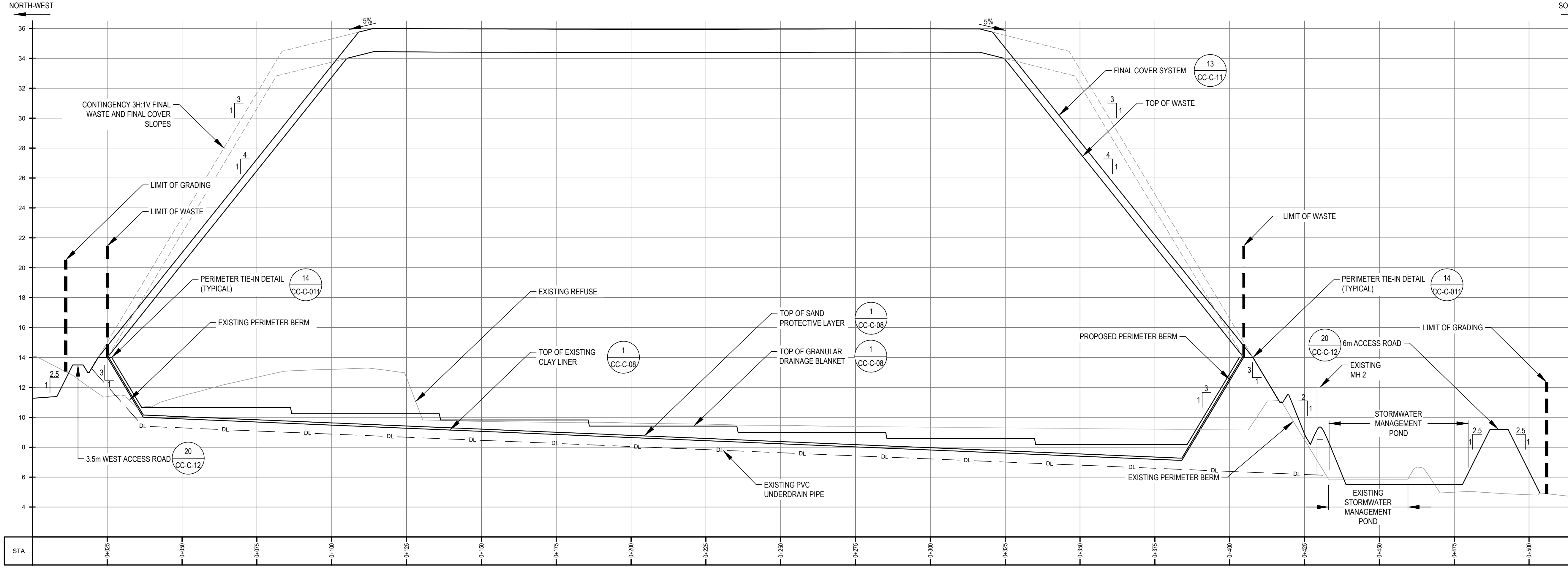
Drawn	K. DHALIWAL	Designer	D. BARTON
Drafting Check	D. CORKILL	Design Check	D. TURNER
Project Manager	C. SKIRTH	Date	Dec 20, 2019
This document shall not be used for construction unless signed and sealed for construction.		Scale	1:750
Original Size	ANSI D	Bar is 20mm on original size drawing	0 20mm

Project No. 11148275

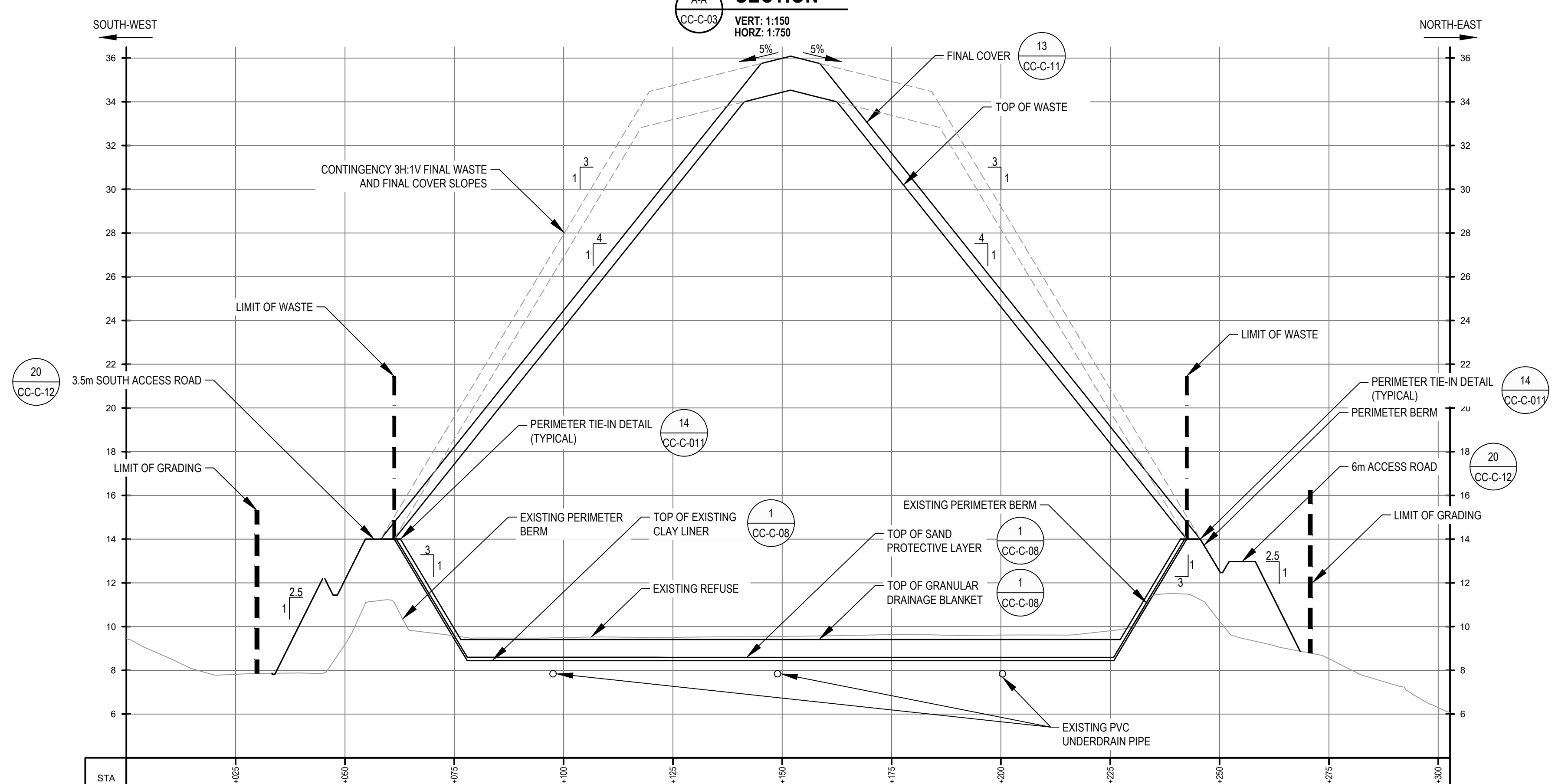
Title
FINAL COVER

Sheet No.
Figure 3.1-2

Sheet 6 of 14



A-A CC-C-03 **SECTION**
VERT: 1:150
HORZ: 1:750



B-B CC-C-03 **SECTION**
VERT: 1:150
HORZ: 1:750

SOURCE:
1. ELEVATIONS ARE BASED ON CANADIAN GEODETIC VERTICAL DATUM CGVD2013.
2. CONSTRUCTION OF CONTAINMENT CELL AS-BUILT DRAWINGS BY JACQUES WHITFORD ENVIRONMENTAL LIMITED, JANUARY 1999.
3. LIDAR SURVEY COMPLETED BY LEADING EDGE GEOMATICS, MAY 15, 2015.
4. TOPOGRAPHIC SURVEY COMPLETED BY WSP, OCTOBER 18, TOPOGRAPHIC SURVEY COMPLETED BY WSP, APRIL 2019.

GHD Limited
120 Western Parkway, Suite 110
Bedford Nova Scotia B4B 0V2 Canada
T 902 468 1248 F 902 468 2207 W www.ghd.com

Reuse of Documents
This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD and shall not be reused in whole or in part for any other project without GHD's written authorization. © 2020 GHD

Client
NS LANDS - BOAT HARBOUR PICTOU LANDING, NOVA SCOTIA

Project
BOAT HARBOUR REMEDIATION

No.	Issue	Drawn	Approved	Date
4.	PRE-TENDER DELIVERABLE	KD	DT	05-21-2020
3.	95% DESIGN REVIEW	KD	DT	03-12-2020
2.	50% DESIGN REVIEW	KD	DT	12-20-2019
1.	30% DESIGN REVIEW	KD	DT	10-18-2019

Drawn	K. DHALIWAL	Designer	D. TURNER
Drafting Check	D. CORKILL	Design Check	D. BARTON
Project Manager	C. SKIRTH	Date	May 20, 2020
This document shall not be used for construction unless signed and sealed for construction.		Scale	AS SHOWN
Original Size	ANSI D	Bar is 20mm on original size drawing	0 20mm

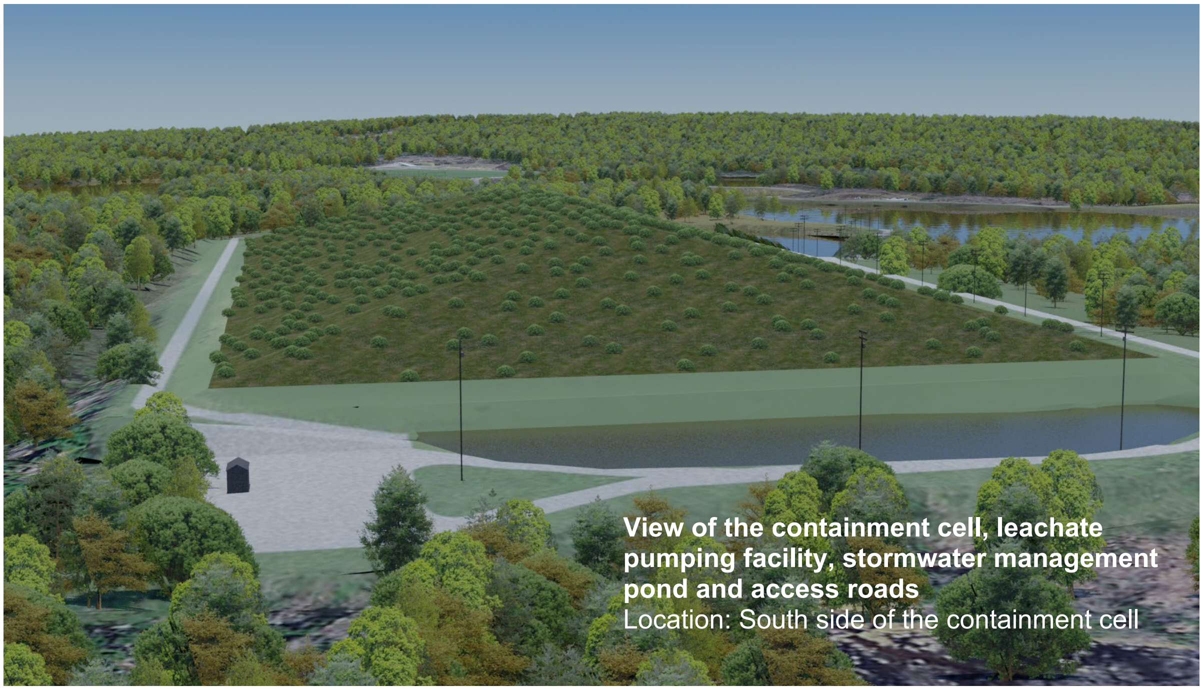
Project No. 11148275

Title
CROSS-SECTIONS

Sheet No.
Figure 3.1-3

Sheet 7 of 33

Figure 3.1-4 Digital Rendering of the Proposed Final Containment Cell



3.1.2 Dredging

Remediation of the BHETF would include dredging of the ASB, BHSL, wetlands, and estuary (Figure 3.1-5). As per the description of Alternative Mean 1A – Removal in the Wet with Geotube® or equivalent technology Dewatering in Section 2.3.2, dredging would be completed in the wet, predominantly via hydraulic dredge. Dredged sludge slurry would be pumped through discharge lines to the sludge management area, located in the containment cell, where it would dewater within Geotubes® or equivalent technology.

Source: Imagery @2017 Google CNES / Airbus, DigitalGlobe, Landsat / Copernicus

0 150 300 450
Meters

Coordinate System:
NAD 1983 CSRS UTM Zone 20N

NOVA SCOTIA LANDS INC
BOAT HARBOUR, NS
ENVIRONMENTAL IMPACT STATEMENT

11148275-31-03
Feb 5, 2020

AREAS TO BE DREDGED AND ACCESS POINTS

FIGURE 3.1-5

GIS File: I:\GIS_DATA\Projects\8-chars\1114----\11148275 Boat Harbour\11148275-REPORTS\11148275-Rpt-26\11148275-31-03(026)GIS-HX003.1-5.mxd

Based on the pilot scale work, dredging equipment that relies on outriggers or similar mechanisms for stability would have difficulty achieving a required dredging tolerance from the target cut line due to the low bearing capacity of the sludge and underlying marine sediment. Real time Global Positioning System controls that track position would be required to accurately dredge to the target depth during full-scale remediation and track dredged areas and depths. Use of this equipment would help to ensure the sludge is adequately removed, without dredging excessive sediment volume, to preserve the containment cell capacity.

The shorelines of the ASB, BHSL, wetlands and estuary, and the settling basins, and effluent ditches (current and historical) would be mechanically excavated. The material would be loaded directly into a truck (if at shore) or barge (if on the water) and subsequently loaded into a truck for transport for disposal in the containment cell or made into a slurry (sludge-water mixture) and transferred via a pipe to the Geotubes® or equivalent technology located within the containment cell.

3.1.3 Wetland Management

Between 1967 and 1972, prior to construction of the settling basins and the ASB, effluent from the pipeline was routed by open ditch from the pipeline on the east side of Highway 348 to a natural wetland area (Former Settling Ponds 1, 2, and 3) before being discharged into the BHSL. The impacted area in the wetlands is approximately 31 hectares (ha) and contains a conservatively estimated 352,000 m^3 of sludge, sediment, and root mass to be managed. Sludge and root mass in the wetlands are impacted with metals, TPH, polycyclic aromatic hydrocarbons (PAHs), and dioxins and furans.

Effluent from the BHETF was discharged through the dam into the estuary before being released to the Northumberland Strait. The estuary area is approximately 7.6 ha in size and is located north of Highway 348 and the dam. The estuary is delineated to the south by the dam and north by the Northumberland Strait. Sludge/sediment in the estuary is impacted with metals, petroleum hydrocarbons, PAHs, and dioxins and furans. The impacted area in the estuary is approximately 4 ha and contains an estimated 27,000 m^3 of sludge and sediment. The native marine clay, which underlies the sludge, is not impacted to levels exceeding provincial and federal criteria and does not require remediation. Surface water in the estuary is impacted with metals, petroleum hydrocarbons, and cyanide.

The wetlands, BHSL, and the estuary have undergone a risk-based remedial approach. The risk-based approach is a scientific method widely accepted by regulators to evaluate potential environmental impacts and to estimate if these impacts are likely to cause adverse health effects to humans or ecological receptors. The risk assessment process requires thorough evaluation of potential contaminants associated with a specific site or property, identification of human and ecological receptors that may use the property, and ways these receptors may be exposed to potential contaminants (e.g., direct exposure to soil, consumption of plants/wildlife, consumption of water, etc.).

The primary benefit of using the risk-based approach is that it allows for a site-specific evaluation of potential interactions between receptors and contaminants in the environment and focuses future cleanup activities or management programs on the areas of greatest concern. This approach also has the potential to minimize remedial efforts and unnecessary disturbances to sensitive environments that are unlikely to pose an adverse health effect, now or in the future. The risk assessment process also identifies risk management measures required to mitigate the risk. Risk management measures may include ex-situ remediation of impacted material or a cap to prevent contact with the impacted sludge/sediment or removal of impacted materials. Following completion of the final draft Human Health and Ecological Risk Assessment (HHERA) (Appendix A - GHD February 2020), it was determined that ex-Situ remediation of potions of the wetland, all of BHSL and a portion of the estuary would require active remediation through dredging in the wet with Geotube® or equivalent technology dewatering. The interpreted horizontal limit of wetlands and estuary requiring remediation is shown on Figure 3.1-6. However, additional sampling is being conducted to refine the areas within the wetlands and Estuary that require remediation so there may be minor refinements to the horizontal limits shown below.

Source: Imagery @2017 Google CNES / Airbus, DigitalGlobe, Landsat / Copernicus

0 150 300 450
Meters

Coordinate System:
NAD 1983 CSRS UTM Zone 20N

N

GHD

NOVA SCOTIA LANDS INC
BOAT HARBOUR, NS
ENVIRONMENTAL IMPACT STATEMENT

11148275-31-03
Feb 5, 2020

WETLANDS TO BE REMEDIATED AND ACCESS POINTS

FIGURE 3.1-6

GIS File: I:\GIS_DATA\Projects\8-chars\1114----\11148275 Boat Harbour\11148275-REPORTS\11148275-Rpt-26\11148275-31-03(026)GIS-HX003.1-6.mxd

3.1.4 Water Management

Bulk Water Management

The term bulk water management refers to impacted surface water and groundwater that would need to be managed prior to, during, or post sludge/sediment removal, and excludes leachate from sludge/sediment treatment processes (i.e., discharges from the containment cell following cessation of dredging operations). As is detailed below, the proposed alternative for the management of bulk water during active remediation of the BHETF is natural attenuation with no physical or chemical treatment beyond that achieved through the use of the Geotube® or equivalent technology dewatering process for dredged sludge/sediments.

The BHSL continuously receives surface water flow from the collection area surrounding the harbour. In addition to surface water drainage, the BHSL also receives continuous influence from groundwater. The compound flow of surface water drainage and groundwater infiltration into the BHSL is estimated to range from 7,200 (low) to 64,000 m^3/day (peak) and a 28,000 m^3/day (average) flow. Thus, the BHSL would be continuously flushed with water of quality equal to natural background condition in the area of Boat Harbour. With the termination of the flow of effluent from the Kraft Pulp Mill to the BHETF in the spring of 2020, it is expected that the quality of water within Boat Harbour would progressively improve as the only contributing sources of water to the BHETF would be groundwater discharge, surface water runoff and direct precipitation. Given the timing of the termination of the effluent flow into BHETF, analysis surface water quality in, is ongoing. However, in comparing the initial results from water quality samples that were collected from the BHSL over the summer of 2020 to the water quality at Point C (within the BHSL) in the winter of 2018 and spring of 2019 (while mill discharges continued to be received by the BHETF), a general improvement in water quality is observed. Concentrations measured at Point C in the samples collected in the summer of 2020 have been observed to have significantly decreased metals, dioxins and furans, soluble organics, and total petroleum hydrocarbons. Further water quality samples are planned for key contributing streams into Boat Harbour to ensure that the water quality in Boat Harbour is progressively improving as anticipated.

With the implementation of conservative silt curtain containment (which would prevent migration of impacted solids during dredging operations), the quality of water within the BHSL is expected to approach natural background during the site preparation and construction phase of the Project. This proposed water management strategy is currently being discussed with NSE.

Dewatering Effluent Management

Dewatering effluent is water generated from dewatering sludge/sediment using Geotubes® or equivalent technology and effluent from the containment cell which has come in contact with waste. A slurry at a 3 to 5 percent solids concentration is expected to be pumped to the Geotubes® or equivalent technology established in the existing containment cell yielding approximately 5,200,000 m^3 of dewatering effluent during dredging. Dredging would be executed at a rate of approximately 4,000 m^3/day of in-place material. Geotube® or equivalent technology dewatering operations would occur within the containment cell. Geotube® or equivalent technology effluent would be collected and directed by discharge piping back to the BHSL in the areas being dredged, or into an area that has not been remediated. Through Geotube® or equivalent technology dewatering the effluent is pre-treated through chemical dosing and Geotube® or equivalent technology filtration. The dewatering effluent then mixes with the bulk water and is managed through natural attenuation.

Leachate Management

Immediately following cessation of dredging operations, an interim period of time would occur between the completion of dredging (when the containment cell is uncovered or under interim cover), through progressive and final complete cover/closure of the containment cell. During this interim period, the waste within the containment cell would continue to release water as the solids thicken and consolidate. The waste would be completed with an interim cover to reduce the amount of precipitation that comes in contact with the waste. All water that comes in contact with the waste would be managed as leachate. During the interim period, leachate would be directed from the containment cell to the stormwater management pond (which will be operated as a retention pond), prior to being conveyed to a temporary leachate treatment facility (TLTF) configured in the area immediately east of the containment cell (Figure 3.1-1). The TLTF would be configured as multiple parallel treatment trains, sized to manage an average flow of <200 m^3/day, providing treatment for flows up to a peak of 1,000 m^3/day. All solid residuals resulting from temporary leachate treatment would be disposed of in the containment cell (prior to the placement of final cover on the cell, if practical) and off-site following placement of final cover and closure of the containment cell and once the volumes are reduced such that off-site disposal is practical. Treated effluent from the TLTF that meets the appropriate discharge criteria would be conveyed to the discharge point of the BHSL to the estuary. Effluent from the TLTF that does not meet the criteria, if any, would be recirculated and retreated. Long-term leachate would be managed through off-site disposal. It is expected that the TLTF would be required for approximately 1-2 years following cessation of dredging operations and for a few months following placement of final cover and closure of the containment cell.

Under post-closure conditions (i.e., after capping the containment cell with a low permeable final cover), the anticipated leachate generation rate from the containment cell is expected to be less than 2,500 m^3 per year (≤7.0 m^3/day), decreasing over time. In this post closure period, the TLTF would no longer be employed. All TLTF components would be demobilized from the Site. Leachate collected within the containment cell would be directed (pumped) to a 40 m^3 buried holding tank. Stored leachate would be pumped from the holding tank to tanker trucks (ranging in size from approximately 10-40 m^3). Loading of the trucks for off-site disposal would be achieved by two (lead-lag) self-priming leachate loading pumps. The leachate loading station would include a load-out billing station for verification of the volumes and hauler removing leachate from the Site. The leachate loading pumps and associated electrical/control hardware associated with the leachate loading station would be configured in a pump house located adjacent to the buried leachate holding tank. Upgrades to access roads in the vicinity of the containment cell would permit truck access to the temporary leachate treatment equipment staging area and leachate loading station.

3.1.5 Bridge at Highway 348

A causeway along Highway 348 crosses the downstream end of Boat Harbour (Figure 3.1-7). It is constructed with three 1500-millimetre (mm) diameter concrete culverts and two 3600 x 3000-mm concrete box culverts connecting Boat Harbour to the downstream dam. A water main running from the Pictou Landing First Nation (PLFN) well field to the PLFN community is buried within the causeway. The causeway would be demolished/decommissioned using mechanical means and replaced with a concrete girder bridge along the same alignment to return Boat Harbour to tidal conditions and to allow for boat access to the harbour.

The new bridge structure would be approximately 34 m long, single-span structure, maximizing the flow beneath the span through elimination of a center pier. The bridge would have a sidewalk on both sides and a decorative concrete and metal rail barrier to meet the necessary requirements for pedestrians and architectural enhancements. The bridge design would incorporate a new support system for the water main, including galvanized steel brackets equally spaced at approximately 1.8-2.4 m across the bridge.

A temporary by-pass (causeway) would be constructed on the north side of the existing causeway (between the dam and the causeway) to facilitate traffic flow during bridge construction.

The bridge would be constructed prior to dam decommissioning to allow sediment to be managed within Boat Harbour and prevent its migration downstream to the estuary or Northumberland Strait.

South view of proposed concrete girder bridge

East view of proposed concrete girder bridge

Source: Imagery @2017 Google CNES / Airbus, DigitalGlobe, Landsat / Copernicus; WSP Canada Inc., Project No. 171-10478

0 50 100 150
Meters

Coordinate System:
NAD 1983 CSRS UTM Zone 20N

N

NOVA SCOTIA LANDS INC
BOAT HARBOUR, NS
ENVIRONMENTAL IMPACT STATEMENT

11148275-31-03
Feb 4, 2020

LIMIT OF DISTURBANCE OF THE BRIDGE AT HIGHWAY 348
AND THE TEMPORARY BY-PASS CAUSEWAY

FIGURE 3.1-7

GIS File: I:\GIS_DATA\Projects\8-chars\1114----\11148275 Boat Harbour\11148275-REPORTS\11148275-Rpt-20\extra\11148275-31-03(020)GIS-HX025.mxd

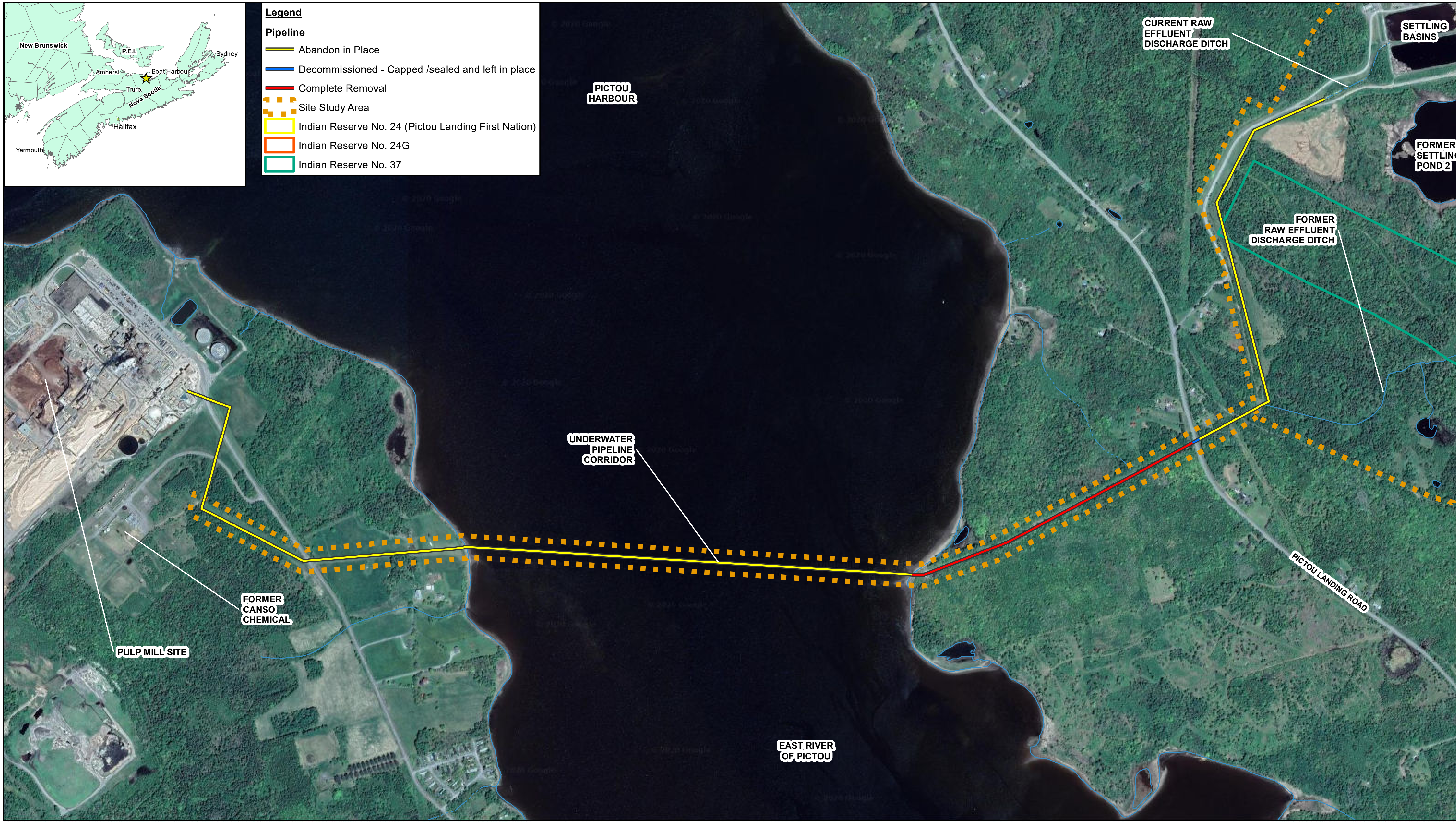
3.1.6 Infrastructure Decommissioning

Decommissioning Pipeline

When operational, the wastewater effluent pipeline conveyed up to 75,000 m^3 per day of wastewater from the Kraft Pulp Mill to the BHETF (Figure 3.1-8). The pipeline consists of approximately 2,305 m of 0.915 m diameter fiberglass reinforced plastic pipe buried on land (starting at a standpipe adjacent to the Kraft Pulp Mill property and running to the East River and emerging at Indian Cross Point then running under Highway 348 to the first BHETF open drainage ditch) and approximately 1,220 m of 1.1 m diameter high density polyethylene pipe buried below the East River.

At the direction of Nova Scotia Environment (NSE), the owners of the Kraft Pulp Mill have cleaned and inspected the pipeline and confirmed that no effluent remains, and only 10 percent gravel remains in low portions of the pipeline that will not be removed. Therefore, no additional activities (i.e., further cleaning or inspection) as part of this Project are required for the decommissioning of the pipeline sections that will be abandoned in place. .

The under water portions of the pipeline would be abandoned in place. The section of pipeline on land from the shoreline of Indian Cross Point east up to the Highway 348 property line, adjacent to a historic Mi'kmaq burial ground will be removed completely, as requested by PLFN. The portion of the on land pipeline that goes under Highway 348 has been severed, filled, and capped by Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR). The rest of the on-land pipeline will be abandoned in place.



Source: Imagery @2017 Google CNES / Airbus, DigitalGlobe, Landsat / Copernicus; WSP Canada Inc., Project No. 171-10478

0 100 200 300
Meters

Coordinate System:
NAD 1983 CSRS UTM Zone 20N

N

GHD

NOVA SCOTIA LANDS INC
BOAT HARBOUR, NS
ENVIRONMENTAL IMPACT STATEMENT

11148275-31-03
Sep 15, 2020

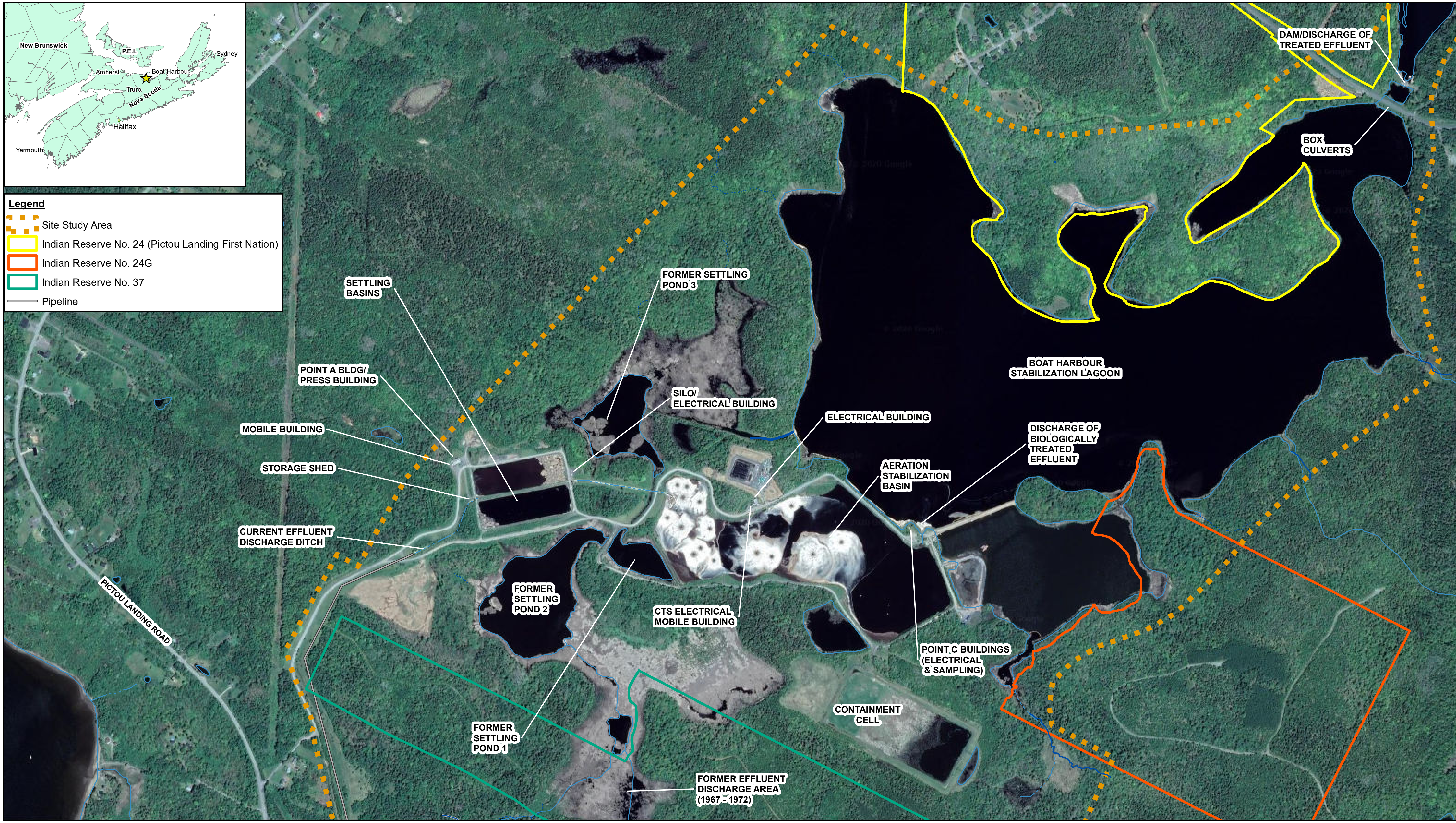
PIPELINE

FIGURE 3.1-8

GIS File: I:\GIS_DATA\Projects\8-chars\1114----\11148275 Boat Harbour\11148275-REPORTS\11148275-Rpt-26\11148275-31-03(026)GIS-HX003.1-8.mxd

Treatment Buildings

Numerous treatment buildings and small structures, (including Mobile Building Adjacent to Press Building; Storage Shed; Air Monitoring Shelter; Mobile Building belonging to CTS Electrical; Silo and Electrical Building; Point A Building; and Point C Building), were part of the BHETF (Figure 3.1-9). Treatment buildings and smaller infrastructure would undergo a chemical sweep, cleaning, designated substance removal (if any), followed by demolition using mechanical means. Footing and foundations would be cut and buried. Only above-grade structures would be removed. The remedial approach consists of decommissioning and demolishing each building/structure and transporting waste materials for disposal or recycling. If an end use for PLFN is identified for a building it would undergo inspection and repurposing. PLFN's potential future use of a building will be confirmed through further consultation with them.



Source: Imagery @2017 Google CNES / Airbus, DigitalGlobe, Landsat / Copernicus; WSP Canada Inc., Project No. 171-10478

0 100 200 300
Meters

Coordinate System:
NAD 1983 CSRS UTM Zone 20N

N

NOVA SCOTIA LANDS INC
BOAT HARBOUR, NS
ENVIRONMENTAL IMPACT STATEMENT

TREATMENT BUILDINGS

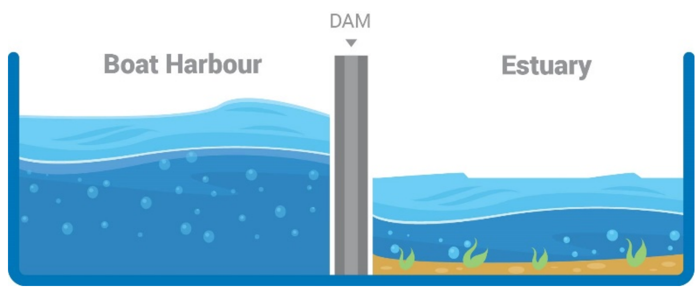
11148275-31-03
Sep 22, 2020

FIGURE 3.1-9

GIS File: I:\GIS_DATA\Projects\8-chars\1114----\11148275 Boat Harbour\11148275-REPORTS\11148275-Rpt-26\11148275-31-03(026)GIS-HX003.1-9.mxd

Dam

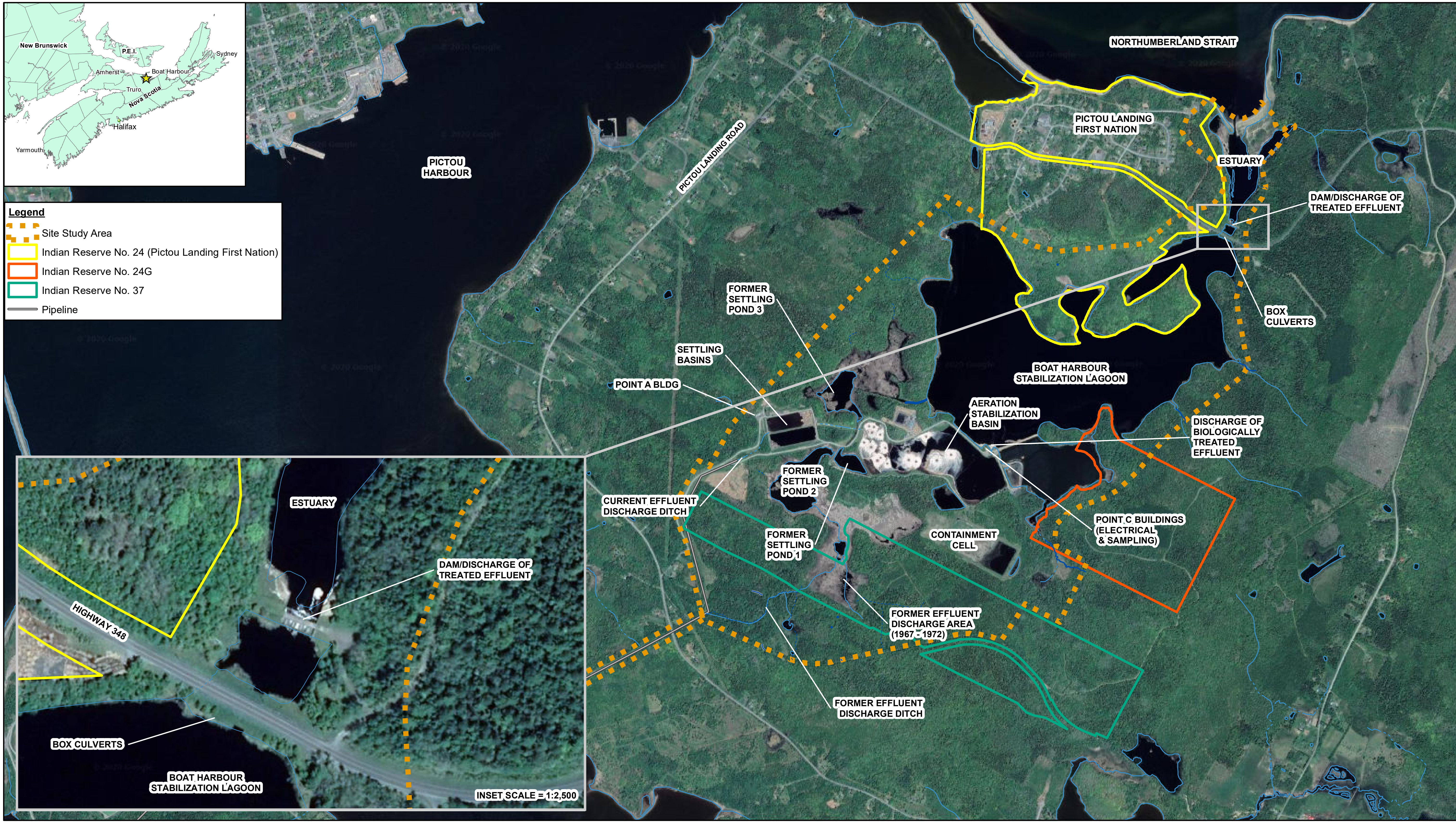
The dam is used to regulate the water level in the BHSL and is located north of the causeway at Highway 348 at the mouth of the estuary (Figure 3.1-10). The dam is a flat concrete slab structure with retaining walls supporting the earth embankments at both ends, the bottom elevation of the slab is approximately at minus 0.92 metres above mean sea level (mAMSL)[2] which is about the equivalent of low tide. The water levels are controlled by an adjustable weir/stop log arrangement within the dam structure. Under current operations, salt water intrusion of Boat Harbour occurs during high tide situations.



At completion of remediation activities within Boat Harbour, the remedial approach involves the demolition of the dam structure, stabilization of the estuary embankment slopes and dredging of the channel to ensure the hydraulics are maintained throughout the channel. Access to the location point for dredging of the channel will require the widening of an existing unmaintained road and establishment of a staging area. The limit of disturbance associated with removal of the Dam, widening of the access road, and establishment of the staging area is shown in Figure 3.1-10.

View of Dam from Causeway looking northeast towards Northumberland Strait

2 Above Mean Sea Level (AMSL); Based on CGVD26 Datum



Source: Imagery @2017 Google CNES / Airbus, DigitalGlobe, Landsat / Copernicus; WSP Canada Inc., Project No. 171-10478

0 200 400 600
Meters

Coordinate System:
NAD 1983 CSRS UTM Zone 20N

N

GHD

NOVA SCOTIA LANDS INC
BOAT HARBOUR, NS
ENVIRONMENTAL IMPACT STATEMENT

11148275-31-03
Sep 22, 2020

DAM

FIGURE 3.1-10

GIS File: I:\GIS_DATA\Projects\8-chars\1114----\11148275 Boat Harbour\11148275-REPORTS\11148275-Rpt-26\11148275-31-03(026)GIS-HX003.1-10.mxd

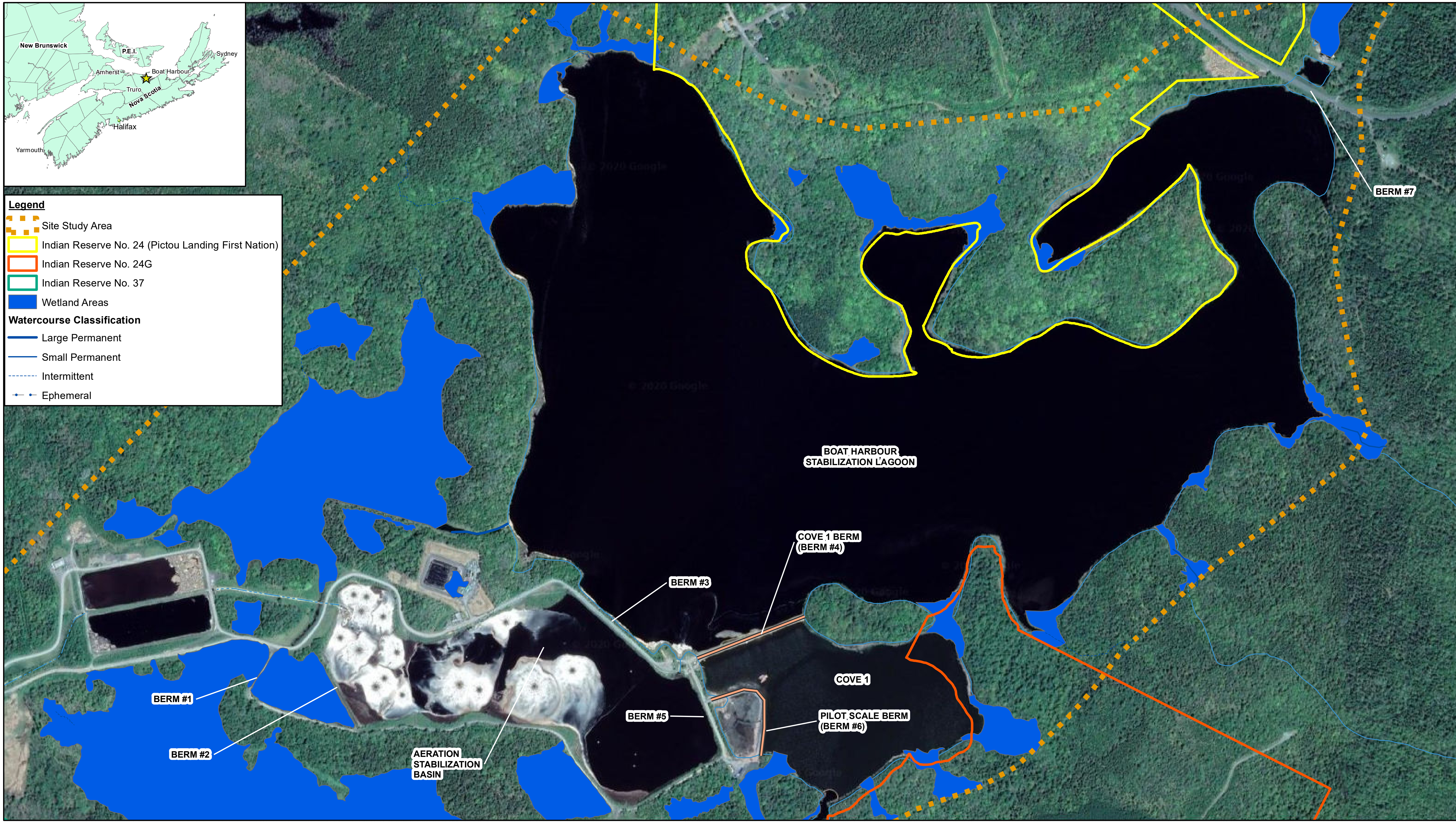
Berms

A series of berms were constructed as the BHETF was developed to segregate various basins and lagoons to facilitate the treatment process. Two additional berms associated with the Pilot Scale Testing Program were constructed to isolate areas for testing. There are a total of seven berms to be decommissioned, as shown in Figure 3.1-11. In addition, the temporary by-pass would also need to be decommissioned.

To achieve the goal of returning Boat Harbour to tidal conditions and restoring the Site to natural conditions wherever possible, the man-made berms would be removed as part of remediation. Berm decommissioning would be completed using excavators to remove the berm material. This material would be hauled and temporarily stockpiled until soil sampling results confirm material to be clean fill or contaminated soil. It is expected that the outer layer of the berms is likely to be contaminated, while the core of the berms should be clean. Clean fill may be used on-site for restoration and grading activities, while contaminated soil would be managed within the containment cell.

Berm #1 would be removed at the beginning of remediation when access improvements are being made and the Berm #1 road is replaced with a prefabricated bridge structure. Berm #6 (i.e., the Pilot Scale Berm) would likely be removed prior to remediation of Cove 1, to facilitate the dredging activities. Berm #7 (i.e., the causeway at Highway 348) would be removed immediately prior to bridge construction. The remainder of the berms (Berm #5, Berm #4, Berm #3, and Berm #2) would be consecutively removed toward the end of the Project as the respective areas are restored.

The temporary by-pass would be removed once the new bridge is operational.



Source: Imagery @2017 Google CNES / Airbus, DigitalGlobe, Landsat / Copernicus; WSP Canada Inc., Project No. 171-10478

0 75 150 225
Meters

Coordinate System:
NAD 1983 CSRS UTM Zone 20N

N

GHD

NOVA SCOTIA LANDS INC
BOAT HARBOUR, NS
ENVIRONMENTAL IMPACT STATEMENT

BERMS

11148275-31-03
Sep 22, 2020

FIGURE 3.1-11

GIS File: I:\GIS_DATA\Projects\8-chars\1114----\11148275 Boat Harbour\11148275-REPORTS\11148275-Rpt-26\11148275-31-03(026)GIS-HX003.1-11.mxd

3.1.7 Remediation Infrastructure

In order to facilitate the proposed remedial works described in the preceding subsections, additional Site infrastructure would be required.

Water Supply (Drinking and Industrial)

Drinking Water

The existing water wells on-site associated with the BHETF would be decommissioned.

Construction activities would not require potable water, except for consumption by staff. The quantity of drinking water required on-site during construction will vary based on the size of the construction crew during the various phases of the Project. Potable water for staff will be imported to Site by the Contractor(s) as required to service staff needs.

PLFN Water Supply

The proposed bridge would be designed to accommodate the provision of potable water supply to PLFN, in accordance with potable water guidelines (Atlantic Canada Guidelines for Drinking Water Supply Systems). Temporary water supply service would be required during causeway removal and bridge construction activities. Upon completion of bridge construction, permanent water supply services would be reinstated. Permanent water supply services would be conveyed by a pipeline suspended from the bridge and would require continual electric power source/supply for heat tracing.

Industrial Water

Industrial water is not anticipated to be required on-site. Boat Harbour water will be recycled and used for polymer preparation for treatment of the Geotube® or equivalent technology dewatering effluent during dredging operations. Dredging operations will be recycling water from and back to Boat Harbour at a rate estimated to be 12,000 m^3/day. Water for polymer preparation to support the dredging will amount to an estimated additional flow of up to 1,200 m^3/day but depending on selected dosing rates could be much lower. It should be noted that all water noted here is recycled flows, so there is no net change to amount drawing from Boat Harbour.

After securing dredging operations, Boat Harbour water will be used for polymer preparation for the TLTF, during the stage after dredging and prior to capping of the containment cell. During the TLTF operation, surface water use is anticipated to be on the order of 3 m^3/day.

Site Access

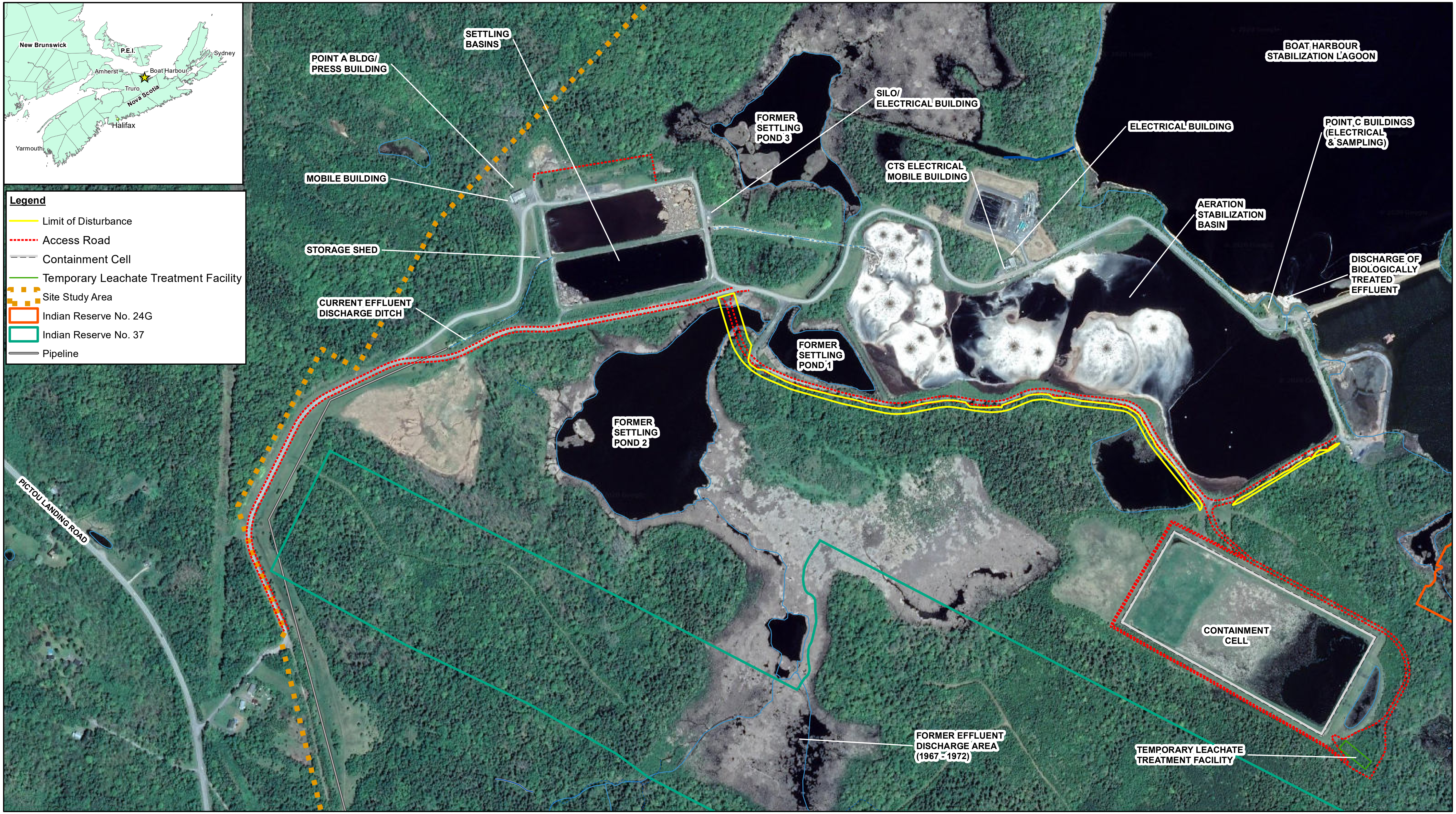
As noted in Section 2, the BHETF Site has an existing access road (Simpsons Road) that extends from Pictou Landing Road/Highway 348 to the berm separating the ASB from BHSL.

Given the presence of this well-established Site access road, no alternative Site access roads would be explored for the Project.

Similarly, the existing perimeter road adjacent to the settling basins was deemed to be sufficient for the Project and no alternatives are being explored.

Access to the containment cell is via a single lane gravel roadway off the perimeter road along the southern bank of the ASB. Vehicle access to the containment cell would need to be upgraded to facilitate cell improvements, waste placement, construction of final cover, and post-closure monitoring and care including leachate management. This existing access road would be realigned and widened to facilitate vehicle access. A pre-cast concrete rigid-portal frame structure or series of culverts would be constructed beneath the road to allow the wetlands to return to tidal condition. The road surface would be granular versus paved.

Figure 3.1-12 identifies the approximate limit of disturbance required for access road upgrades.



Source: Imagery @2017 Google CNES / Airbus, DigitalGlobe, Landsat / Copernicus; WSP Canada Inc., Project No. 171-10478

0 60 120 180
Meters

Coordinate System:
NAD 1983 CSRS UTM Zone 20N

N

GHD

NOVA SCOTIA LANDS INC
BOAT HARBOUR, NS
ENVIRONMENTAL IMPACT STATEMENT

11148275-31-03
Sep 22, 2020

ACCESS ROADS AND LIMIT OF DISTURBANCE

FIGURE 3.1-12

GIS File: I:\GIS_DATA\Projects\8-chars\1114----\11148275 Boat Harbour\11148275-REPORTS\11148275-Rpt-26\11148275-31-03(026)GIS-HX003.1-12.mxd

Construction of temporary access roads into the wetlands to facilitate dewatering and removal activities would also be required. These access points would utilize previously disturbed areas wherever possible and would utilize shortest paths from established roadways into the wetland area for purpose of mobilizing equipment into the wetlands. Once within the wetland areas, the equipment utilized would work from a base within the area being remediated or would work from the water side (barges) to minimize disturbance to on-shore areas that do not require remediation. With the exception of the access points, no perimeter roadways are expected to be established in areas not requiring remediation around the wetlands.

Temporary access roads would be constructed with a granular surface, likely with geogrid or similar approach to provide the required weight-bearing capacity while limiting requirement for permanent ground improvements. Final details of the access roads would be determined during the detailed design stage.

Permanent and Temporary Linear Infrastructure

Temporary linear infrastructure includes floating pipelines, booster pumping station, temporary power supply to several areas around the Site, wash down areas, and road improvements across existing berms. These components would be removed on conclusion of the works and any disturbed areas stabilized prior to demobilization from the Site. Temporary areas for construction access to the water would be constructed at points adjacent to road/water access from the west side (to lift barges in and out) and using least disruptive/shortest paths to established roadways in the case of the wetland areas.

Temporary intake and discharge piping would also be constructed for the purpose of water supply and discharge, which would result in temporary overland piping reaching from Boat Harbour up to various areas including the containment cell area. Floating pipelines would be utilized for dredging and dewatering effluent. A floating pipeline would also be used for conveyance of treated interim leachate treatment system effluent to the approved discharge point, which would be utilized during the transition stage after securing dredging operations, and before the final cap is placed onto the disposal cell.

Permanent linear infrastructure improvements include the roadway access from the west side, installation of a precast span or culvert (to permit road traffic over as well as restore tidal influence and small boat/canoe traffic under), adjustment of access road grading, and installation of a truck turnaround to permit safe and easy access to the leachate collection point by truck.

Permanent stormwater control measures such as swales, ditches, and pond would be incorporated into the area around the containment cell. Maintenance roads would be constructed as required to reach several areas around the containment cell to facilitate inspection and monitoring (i.e., perimeter access).

Energy Supply

In the earliest stages of the Project the energy supply to the Site on the west side would be improved and extended to reach the containment cell. This extension is required to permanently power the leachate collection system and truck loading station.

This same line would be used for temporary power supply to construction trailers and water management pumps in the cell area in order to minimize impact to surrounding area.

The dredging operations would require power for both dredge operation and pumping of dredged material to the containment cell. These systems would be diesel powered, as they are typically required to be mounted on floating equipment/barges.

3.2 Project Activities

The remedial works would be generally sequenced from upstream to downstream as follows (years following approval). Note that the conceptual schedule shown is based on initiation of site works in spring of that year:

Years	1	2	3	4	5	6	7	Ongoing
Site Preparation and Construction								
Site Preparation and Controls	■							
Pipeline Cleaning and Settling Basins Initial Remediation	■							
Influent Ditch Remediation	■							
Water Level Controls Installation	■							
Containment Cell Modifications	■	■						
Operation and Decommissioning								
Wetland Remediation		■						
ASB Remediation			■					
Boat Harbour Stabilization Lagoon Remediation			■	■	■			
Berm Removal				■	■			
Final Sedimentation Basin Remediation					■			
Containment Cell Interim Closure					■			
Temporary Leachate Treatment						■		
Causeway Removal and Bridge Construction						■		
Containment Cell Consolidation Period (2-4 years)						■	■	
Temporary Infrastructure Removal and BHETF Infrastructure Decommissioning						■	■	
Dam Removal							■	
Containment Cell Operation and Maintenance and Final Closure							■	■

Seasonality and Frequency of Activities

All planned Project activities will be governed under the overall environmental assessment approval; however, many activities will require separate approvals such as an Industrial Approval(s). The EIS describes planned Site activities, however, should deviations from the plans described in the EIS occur during Project implementation, separate approvals or amendments to existing approvals may be required. NSLI has spent over 5 years in the planning of the Project and liaised closely with regulatory agencies and therefore is fully aware of the requirements and the processes involved with obtaining the necessary approvals and any amendments. The knowledge gained through consultation with regulatory agencies and other external stakeholders such as PFLN has been carefully considered in the planning of the Project and will continue to be considered throughout the tendering, implementation and post remediation monitoring stages of the Project.

Site Preparation and Construction

Access road upgrades will involve tree removal. The work will be scheduled to avoid breeding season for migratory birds where practical as articulated in the EMP/PEPP. Any site preparation and construction work which involves vegetation removal (i.e., Access point construction for dredging operations, clearing for bridge construction, and dam removal) where possible will also be scheduled outside of the breeding season for migratory birds. Where scheduling outside of breeding season is not possible, appropriate bird surveys will be completed and if no nesting birds are present, clearing will then be completed. Additional scheduling requirements may be issued by the regulatory agencies through the EA Approval or Industrial Approval(s).

Operation and Decommissioning

Activities that will occur on land during operation are anticipated to occur year-round until the activity has been completed, with the exception of tree clearing for site preparation and construction as noted. Additional scheduling requirements may be issued by the regulatory agencies through the EA Approval or Industrial Approval(s).*In-water Works within Boat Harbour*

Dredging in Boat Harbour is expected to occur daily from March to November but may be outside this timeframe due to variable weather experienced in Nova Scotia. In order to maximize productivity and expedite the remediation, the dredging operation is anticipated to run at a productivity rate up to 24 hours/day. Additional scheduling requirements may be issued by the regulatory agencies through the EA Approval or Industrial Approval(s).

In-water Works within the Estuary

Dredging in the estuary will occur daily during the summer low flow period, which typically occurs between June 1 and September 30 in Nova Scotia to avoid sensitive life stages (egg and fry immobility) for anadromous species. Additional scheduling requirements may be issued by the regulatory agencies through the EA Approval and the permitting process).

Project Phases

Project activities will be completed in three phases; site preparation and construction, operation and decommissioning and abandonment as outlined in the Final EIS Guidelines. Activities for each phase specific to each Project component are discussed below. However, not all phases apply to each Project component (appropriate rationale provided within subsequent subsections below).

Management of Workforce

The number of workers anticipated during site preparation and construction and operation is outlined below for each phase and Project component. In total approximately 60 to 100 workers are anticipated over the 7-year span of the Project. Where possible, the Contractor(s) will be encouraged to hire local workers, including PLFN residents. Therefore, the number of non-local workers is anticipated to be low and any accommodations required would be satisfied by the local lodging available in New Glasgow.

3.2.1 Site Preparation and Construction

As the Site is large in size there will be ample space for all workers (local and non-local) to park on-site. Therefore, no additional off-site parking or shuttle system is anticipated. The total number of workers required during site preparation and construction is anticipated to be approximately 40 to 60 individuals. The number of workers required for site preparation and construction of each Project component is described below along with the anticipated equipment requirements.

No new borrow materials will be extracted from the Site and therefore approved off-site sources will be used to source the required clean materials. Approximately 101,000 m^3 of material is present on the site in existing berms and the causeway on Highway 348. This material will be removed as part of the Project. Approximately 41,000 m^3 of this material is anticipated to be contaminated and will be disposed of in the containment cell. The other 60,000 m^3 of material is anticipated to be clean and re-purposed on-site as part of site grading. The detailed final quantities and sources will be determined by the Contractor(s).

Further contaminant testing of the material will be completed to confirm it meets the soil screening guidelines referenced in the HHERA before it is used on-site. Approximately 85,000 m^3 of common fill and granular material will be required for the Project for containment cell improvements for the berm and granular drainage. This does not include sand protection material which is considered part of the containment liner design. Similarly, imported material in the form of aggregates will be required, amounting to approximately 10,000 m^3. All new sources or materials that will come from off-site will be sourced from clean/approved borrow sites that will be determined by the Contractor(s).

Handling of Hazardous Materials

During the majority of the on-land works, the storage and handling of hazardous materials would primarily apply to fuel and fluids servicing the heavy equipment (i.e., diesel fuel, oil). The Contractors will include provisions in the General Conditions to hold the Contractor to prohibit any contaminants, hazardous materials/wastes and solid wastes, whether pre-existing or otherwise, including, but not limited to, chemicals, fuels, lubricants, calcium chloride, sewage, and water containing sediments and other deleterious, poisonous, toxic, hazardous, or oxygen demanding substances, to be released or further released into the environment, including any land, soil, sediment, streams, lakes, other surface waters, groundwater, and the atmosphere.

Specific accidental spill management plans included within the EMP are required to be submitted and approved to manage chemicals and fuels to be used on site. Submission of procedures for fuelling and maintenance including for in-water equipment is required for approval by the CMOC. Adherence to the Petroleum Management Regulations (N.S. Reg. 44/2002) will be required for the storage of fuels or refueling on-site. Controls indicated in the overall site EMP include but are not limited to:

- When not in use, all hazardous materials (e.g., oils, lubricants, fuels, paints, solvents, paint thinners, etc.) will be securely locked-up in the office yard to avoid vandalism and accidental spills. Materials will be stored in a dry location that is clean, and well-ventilated. Furthermore, hazardous materials will be stored on impermeable pads a minimum of 30 m from water or wetlands and handled in a manner which prevents release into the environment, unless otherwise approved.
- No hazardous material or equipment containing hazardous material will be stored overnight in isolated areas of a waterbody or wetland (e.g., cofferdam), with the exception of dewatering pumps due to the increased risk of flood.
- As required, all deleterious substances (including fuel, cleaners, solvents, paint, etc.) will be transferred at designated refuelling areas. Each piece will be established in a dedicated containment tray to prevent contamination of the Site in the event of a leak or spill during refueling. Refueling will occur with a containment tray in place, and a portable spill kit will be on hand.

  A refuelling plan and spill management plan will be developed for the refuelling of dredging related equipment while in or near the water.

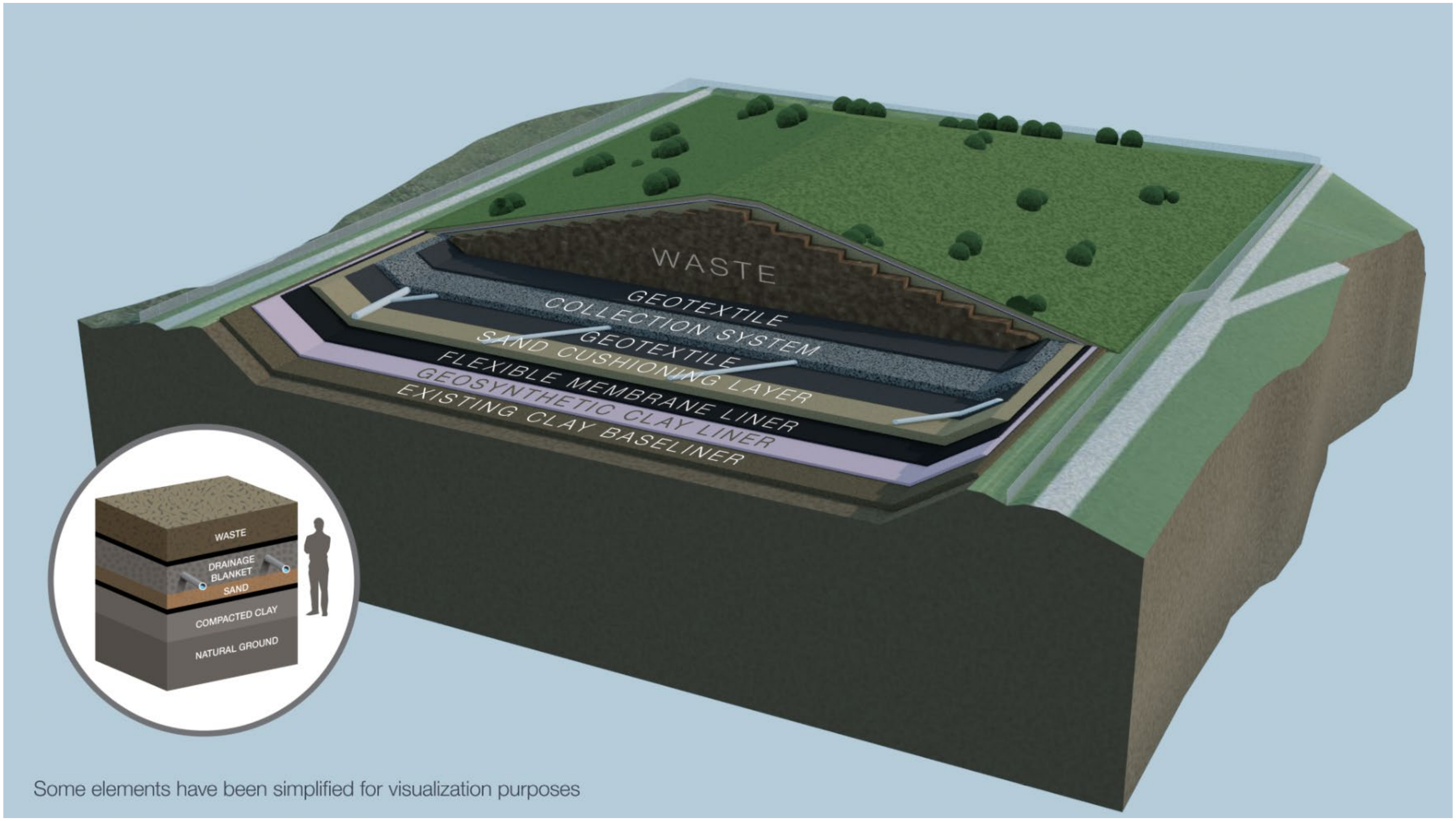
3.2.1.1 Waste Management

Containment Cell Modifications

Prior to the receipt of waste from remedial activities, the containment cell and leachate collection and liner systems would be upgraded to facilitate waste placement and dewatering in a one-step operation. The existing waste in the containment cell would be temporarily relocated either by pumping or hauling to existing Site infrastructure (i.e., settling basins, ASB) or constructed staging areas. The waste would be covered with water and/or tarps as needed to eliminate/minimize the release of atmospheric emissions, primarily particulate matter, from the stored waste. Sludge relocation would facilitate construction of the raised perimeter berms and installation of the new liner and leachate collection system components. During remediation, the existing waste would be reconsolidated within Geotubes® or equivalent technology in the containment cell.

The existing containment cell liner consists of a 0.6 m thick clay-till layer. Beneath the clay liner is an underdrain leak detection system with piping discharging to manholes and conveyance system to the ASB. Above the clay liner is a leachate collection system consisting of a granular filter bed at the eastern end of the cell and a stop log decant structure with a pipe draining to a manhole and conveyance system to the ASB. The containment cell improvements would include removal of the existing overlying leachate collection infrastructure and exposure of the clay liner to install an engineered single composite liner system (Figure 3.2-1). An estimated 150 mm of the existing clay liner may be removed during the removal of the existing waste. Repairs will be made to the underdrain leak detection system, as needed. A new geosynthetic clay liner (GCL) would be installed over the existing clay liner to replace the portion of removed clay and provide the liner system up the extended perimeter berms. A new Flexible Membrane Liner (FML) and a protective cover system consisting of a sand layer and geotextile would be installed over the GCL, followed by a leachate collection system consisting of leachate collection piping and a granular drainage layer overlaid with a geotextile over the entire cell footprint.

Figure 3.2-1 Virtual rendering of the cross section of the Containment Cell



Leachate generation rates were calculated using Hydrologic Evaluation of Landfill Performance (HELP[3]) modelling for the containment cell as follows:

Current conditions (i.e., 0.6 m clay base, open cell)

During remediation (i.e., modified containment cell base with engineered single composite liner system, open cell)

Post-closure (i.e., modified containment cell base with engineered single composite liner system, final cover installed)

Leachate generation rates are high for both current conditions and during remediation as there is no final cover in place, so approximately 60 percent of the total annual precipitation infiltrates the waste layer and contributes to leachate generation. Leachate generated during remediation would be managed as dewatering effluent. However, the improved containment cell during remediation outperforms the existing 0.6 m clay base layer for leachate confinement. The HELP model shows that during remediation, the containment cell releases approximately 0.01 percent the amount of leachate as seen under current conditions. The containment cell base modifications would therefore significantly improve the containment cell performance.

Under post-closure conditions, once the containment cell has been closed with final cover, precipitation is modelled to be successfully diverted with only 0.002 percent of precipitation infiltrating the waste and contributing to leachate generation. The leachate generation under post-closure conditions displays greater than 99 percent reduction in leachate amounts (also referred to as leachate head) on the liner and displays the least amount of release of leachate through the containment cell.

During sludge relocation prior to containment cell improvements, the existing leachate conveyance infrastructure would continue to convey leachate to the ASB, as under current conditions. Following temporary waste relocation, the ASB leachate conveyance piping would be decommissioned by cutting and capping the ends. During active remediation, dewatering effluent would be pumped via temporary above ground piping to the BHSL to manage the high flows expected during dewatering and to preserve the upgraded leachate collection system for long-term use. The dewatering effluent would be pumped to the active dredging area of Boat Harbour or an area downstream of the active area that has yet to be dredged. A leachate storage and loading station would be constructed at this stage for future use for long-term leachate management following containment cell closure. The stormwater management pond would also be constructed at this stage for long-term Site operations.

Improved vehicle access to the containment cell would facilitate cell improvements, waste placement, construction of final cover, and post-closure monitoring and care. The access road would be designed to accommodate two lane heavy vehicle traffic during construction and the long-term perimeter roads would be designed to accommodate pickup truck access for areas requiring routine inspection and maintenance and tanker truck access for the area where leachate removal would take place. The existing perimeter fence would also need to be upgraded/extended to prevent public access to the containment cell and supporting infrastructure. Signage would need to be posted

[3] The HELP model estimates water balances for landfills and includes rainfall, runoff, and infiltration to understand how much leachate is generated within the landfill.

along the access road, perimeter fence, and all access gates. Visual screening would be achieved through strategic tree and shrub plantings in the vicinity of the containment cell.

Staff and Equipment Requirements

The Site preparation and construction works consist of the preparation of the Site and containment cell to support the second phase of the remediation contract. The roadway improvements will consist of 10 to 20 workers, with four to six pieces of heavy grading equipment, such as D8 (30 or 45 ton) excavator and daily hauling of material from off-site using a 15 yard capacity, tri-axle dump truck.

The cell improvements will begin with relocation of the current contents of the containment cell, the scraping/preparation of the existing clay layer and importing fill material and grading of berms. This will require a similar crew of five to ten personnel with two to four pieces of heavy equipment, which could include the following: excavators (30 to 45 ton), rock trucks (30 ton), bobcat (small excavator/dozer), loader (e.g., CAT 930G), D7 size dozer, mid-size compactor, slurry pumps, and temporary generators. A 15 yard capacity, tri-axle dump truck would be used to import materials to the Site.

When installing the liners, specialized personnel will be required with an additional staff of seven to ten.

3.2.1.2 Dredging

Site preparation and construction would include installation of silt curtains, dredging anchor points, Geotubes® or equivalent technology, and the slurry dosing system. Construction would include the water level control structure at the causeway, which would be used to adjust the BHSL water level as needed for dredging and to prevent discharge of water that is not in compliance with the discharge criteria. For sludge removal within the impacted wetlands and potentially areas of BHSL, temporary access points would be constructed off of the existing Site access roads.

Staff and Equipment Requirements

Construction of temporary access points is anticipated to use a crew of three -to six staff and -two to four pieces of heavy equipment, which would include the following: excavators (30 to 45 ton), rock trucks (30 ton), bobcat (small excavator/dozer), loader (e.g., CAT 930G), D7 size dozer, mid-size compactor, and pile drivers (for bride abutments).

3.2.1.3 Wetland Management

As noted, the wetlands and the estuary have undergone a risk-based remedial approach. Through completion of the HHERA, areas of the wetlands and the estuary would require remedial action through dredging with Geotube® or equivalent technology dewatering. Construction of access roads would be required to facilitate dewatering and removal activities prior to remediation.

Staff and Equipment Requirements

The staff and equipment need for the site preparation for wetland management activities will be the same as the dredging activities, as described above.

3.2.1.4 Bridge at Highway 348

The bridge would be constructed prior to dam decommissioning to allow sediment to be managed within Boat Harbour and prevent its migration downstream to the estuary or Northumberland Strait.

A water main is constructed within the existing Highway 348 causeway embankment and provides water supply from the nearby well field to PLFN. Prior to construction, a temporary water main would need to be constructed adjacent to the new bridge. This temporary water main would be overland along the edge of the temporary by-pass.

Staff and Equipment Requirements

Site preparation for the bridge works would include preparation for water main tie-in, clearing and grubbing. A construction crew of -eight to ten staff with -two to four pieces of heavy equipment at any given time is anticipated, which could include the following: rock trucks (30 ton), bobcat (small excavator/dozer), and mid-size compactor.

3.2.1.5 Infrastructure Decommissioning

Pipeline

There is no site preparation and construction phase for the decommissioning of the under water pipeline and the on-land pipeline sections that will be abandoned in place. As stated in Section 3.1.6, at the direction of NSE, the owners of the Kraft Pulp Mill have cleaned and inspected the pipeline. NSE has deemed the pipeline as being clean, therefore, no further cleaning or inspection of the pipeline sections that will be abandoned in place will be completed as part of this Project.

However, the section of pipeline on land from the shoreline of Indian Cross Point east up to the Highway 348 property line, that will be removed completely may require additional cleaning to remove any residual gravel if present.

Treatment Buildings

Prior to demolishing the numerous Treatment Buildings as well as small structures (including Mobile Building Adjacent to Press Building; Storage Shed; Air Monitoring Shelter; Mobile Building belonging to CTS Electrical; Silo and Electrical Building; Point A Building; and Point C Building), any hazardous materials would be abated and a chemical sweep and cleaning would be completed. All residual products would be containerized and packaged, transported, and disposed of in accordance with provincial and federal regulations. Any non-hazardous waste would be collected and disposed or recycled. Building surfaces would be cleaned, as needed, to remove any residues. Electrical connections would be de-energized and disconnected. Similarly, any buried services would be decommissioned, as needed.

Dam

Prior to demolition of the dam structure, electrical connections will be fully de-energized.

Staff and Equipment Requirements

A construction crew of four to eight staff with some supporting equipment such as bobcat (small excavator/dozer), dump truck, and boom-lift to access disconnection points is expected to be required.

3.2.2 Operation

The total number of workers required during operation of the Project is anticipated to be approximately 20 to 40 individuals. The number of workers required for the operation of each Project component is described below along with the anticipated equipment requirements.

Handling of Hazardous Materials

During operation, chemicals will be stored on site to support the dredging dewatering applications, and then in later stages to support the TLTS. These chemicals will be stored on sited based on detailed plans submitted by the Contractor(s) and approved by NSLI via the CMOC.

Contractor(s) will be required to develop management plans which will at a minimum include the following requirements:

- All areas and equipment with the potential to cause a leak or spill will have adequate protection and will be stored in designated areas. Adequate protection shall include but is not limited to: spill containment systems for oils, fuels and chemical storage and transfer areas; spill containment systems under stationary equipment such as generators, pumps and compressors; and containment and isolation from concrete works.
- Spill containment systems and drip trays will be impermeable and selected to allow full containment of spills and be able to handle the volumes expected from an accidental release. This includes being able to contain 125 percent of the liquid storage capacity of the equipment it is housing.
- All staff will be trained on the proper actions to follow in the event of a spill. This will include spill source recognition, spill prevention techniques, and proper spill reporting protocol. The spill response procedure will be posted and made available in the Site office trailer.
- At least two spill response kits are to be kept and maintained on each active area of the Site. One spill kit must be in close proximity to working equipment that contains deleterious liquid such as hydraulic fluid or fuel. All staff will be informed on the location of spill kits and kits will be replenished in the event that the contents contained within are used. The spill kits shall be appropriate in content for the material that could be spilled on-site.

3.2.2.1 Waste Management

Waste Placement

The majority of the sludge would be pumped into Geotubes® or equivalent technology located in the containment cell and would dewater by gravity over time. Initial dewatering and treatment of dewatering effluent would be achieved through chemical addition (i.e., polymer, coagulant, lime). The containment cell improvements to the leachate collection system and the Geotube® or equivalent technology fill plan would allow for the collection and conveyance of dewatering effluent to the BHSL. Geotubes® or equivalent technology would be stacked in place to create the basis of the cell shape and would be left in place for added stability following sludge dewatering.

Other wastes generated through the Project such as impacted soil would be used to fill the voids between the Geotubes® or equivalent technology and shape the cell, as available. Mechanically excavated sludge would be managed through a combination of slurrying and pumping (e.g., sludge from the edges of BHSL) and loading in a dump truck and end dumping into the containment cell (e.g., settling basins, ditches). Soil excavated from causeway and berm removal would be hauled by truck for temporary stockpiling or placement, with contaminated soil being end dumped into the containment cell and clean soil being used to fill the settling basins and other grading. End dumped sludge would be placed in lifts of approximately 1 to 3 m, followed by compaction to maximize containment cell air space, and used to fill the gaps between the filled Geotube® or equivalent technology bags. Dewatering effluent would be managed via drainage to sumps within the containment cell and the temporary above ground piping. Other waste materials generated as part of remediation would be placed in the containment cell similar to the mechanically excavated sludge. Following active remediation, an interim cover would be placed on the containment cell and the waste would be allowed to consolidate and settle for a period of 1-2 years or more as needed, prior to final capping. During the remediation period (active remediation and when the containment cell is under interim cover), the liner and leachate collection system performance would be monitored, and the infrastructure would be maintained though routine cleaning.

Leachate Management

Leachate generated in the containment cell is currently returned to the ASB via the decant and leachate collection systems. The existing leachate contains elevated concentrations as compared to criteria of chloride, ammonia, nitrite and nitrate, as well as select metals including aluminum, arsenic, cadmium, chromium, copper, iron, lead, mercury, silver, and zinc; based on the containment cell – BHETF – 2018 Monitoring Report (Dillon, 2019).

Under the selected remedial approach, dewatering effluent from Geotubes® or equivalent technology would be collected and conveyed through to Boat Harbour where it would undergo natural attenuation processes before being discharged to the estuary. The effluent discharge criteria are currently being developed using a risk based approach. Final discharge criteria would be adopted through the Provincial IA process required for the remediation. The contaminants of concern in the effluent based on pilot and bench scale testing include PHCs, dioxins and furans, cyanide, and metals (i.e., cadmium, chromium, copper, lead, mercury, and zinc). The containment cell monitoring program does not currently include sampling for PHCs, dioxins and furans, or cyanide. The post-closure monitoring program would be amended to include these contaminants of concern.

Leachate will need to be managed during the interim stage, when the containment cell has received interim cover and prior to long-term leachate management. During the interim stage, the same effluent criteria as listed above would continue to apply.

Following initial sludge dewatering and containment cell capping, there would be ongoing leachate to manage post-remediation. The leachate quality would be impacted by leaching of both the existing waste and the dewatered sludge within the Geotubes® or equivalent technology. Contaminants of concern would include those listed above for both existing leachate and dewatering effluent. The annual leachate generation rate is estimated to range from 2,500 m^3 to 2 m^3 per year, decreasing over time, based on using a FML in the final cover system and assuming approximately 1,247 mm of rainfall per year.

The recommended leachate management option is off-site disposal. A storage tank with a capacity of approximately 40 m^3 would store generated leachate. A truck loading station would be constructed to facilitate off-site disposal at a licenced facility.

Surface Water Management

There is currently an overflow pond to the east of the containment cell, which collects stormwater from the east cell embankment and excess surface water from the containment cell via the emergency overflows.

During remediation, clean surface water runoff in the vicinity of the containment cell would continue to be diverted away from the cell and controlled by infiltration and overland flow. Water that comes in contact with the waste would be managed as leachate and conveyed with the dewatering effluent to BHSL.

As part of detailed design, a hydrological model would be developed to calculate peak flows and runoff volumes from the containment cell under various storm event conditions, and evaluate the size of perimeter ditches, culverts, the stormwater management pond, and any other stormwater infrastructure. Surface water conveyance infrastructure would be designed to accommodate a 25-year storm event, and the stormwater management pond would be designed to accommodate a 100-year storm event.

It is noted that the proposed location of the stormwater management pond is in the existing overflow pond area. This area may need to be remediated and therefore disturbed prior to the construction of the lined pond. The vegetation would be removed, and the underlying material should be tested to confirm whether it is clean. If the soil is clean it can remain in place or any cut can be used as general fill for remediation activities on-site. If the soil is impacted, it would need to be managed within the containment cell. During remediation of the pond, the majority of the stormwater would be redirected as surface flow around the area using shallow ditching, and the pond bottom would be temporarily re-graded to temporary local sump locations and drains to manage flows.

The upgraded stormwater management pond outlet structure would include a discharge control valve operated in the normally open position. This valve can be closed to prevent discharge in the event of a spill contained within the stormwater management pond.

Staff and Equipment Requirements

Waste management staff requirements would vary from -three to six staff at any given time, with associated trucks and temporary pumping for three to four pieces of heavy equipment, which could include the following: excavators (30 to 45 ton), rock trucks (30 ton), bobcat (small excavator/dozer), loader (e.g., CAT 930G), D7 size dozer, mid-size compactor, slurry pumps, and temporary generators.

Once the containment cell is under interim closure and the TLTS is in operation, it is estimated that one to two operators would be on site five to seven days per week.

3.2.2.2 Dredging

Ditches and Initial Settling Basin Remediation

During this initial remediation stage, the pipeline would have been cleaned and decommissioned, but the containment cell improvements would not yet be completed. As such one of the settling basins and/or the ASB would be used for temporary sludge disposal at this time. These initial remedial works consist of the following:

- Dewater the settling basins through existing decant structures
- Disconnecting/blocking flow from settling basins to the ASB
- Excavation of sludge/contaminated sediment in the effluent ditches
- Backfilling ditches to match adjacent grades with clean fill, followed by placement of topsoil and seeding and erosion control measures as needed
- Excavation of residual impacted soil/sludge within one of the settling basins

Dewatered Sludge from Pilot Scale Testing Relocation

Once the containment cell improvements have been made, the sludge contained within Geotube® or equivalent technology at the Pilot Scale Testing Treatment Pad would be hauled by trucks to the containment cell for bulk disposal.

Wetlands/Estuary Remediation

The wetlands areas for which active remediation has been deemed necessary through the risk assessment, would be remediated through a mix of hydraulic and mechanical dredging. The vegetation would be excavated, and the sludge would be hydraulically dredged and pumped to the Geotubes® or equivalent technology for dewatering or mechanically excavated and hauled to the containment cell for bulk disposal and gravity dewatering.

ASB Remediation

All equipment located within the ASB would be decommissioned prior to remediation of the ASB. The ASB would be remediated in sections, separated with silt curtains. Impacted sludge/sediments from the ASB would be hydraulically dredged and conveyed to the Geotubes® or equivalent technology located within the containment cell for dewatering and disposal.

Boat Harbour Stabilization Lagoon Remediation

Impacted sediment/sludge in Boat Harbour Stabilization Lagoon (BHSL) would primarily be hydraulically dredged and conveyed to the Geotubes® or equivalent technology located within the containment cell for dewatering and disposal. Mechanical dredging may be employed as needed in shallower areas at the edges of BHSL. BHSL would be dredged in sub-areas divided by silt curtains.

During dredging, downstream areas of BHSL would receive effluent from the containment cell and Cove 1 of the BHSL would provide a discharge area for debris accumulated in the dredging forcemain (i.e., rock trap discharge). The water level control structure at the causeway will provide the ability to hold water in BHSL should the water quality exceed discharge criteria. The design of the control structure will be finalized by the Contractor, but the performance requirement set as part of this EIS is the ability to raise and lower the water level in 150 mm increments. In the event of a failure of the primary and secondary means of turbidity containment (dual silt curtains), the water level control structure can be raised to provide several days of storage at average flow, which would permit the silt to settle and testing to be completed prior to release of any potentially impacted bulk water.

Settling Basins Final Remediation

Prior to final remediation of the settling basins, any residual sludge and contaminated soil would be hauled to the containment cell for bulk disposal. The settling basins would be filled with clean fill and graded to match surrounding elevations, followed by placement of topsoil and seed and erosion controls.

QA/QC Program for Dredging

Site quality control will take place during dredging by the contractor. Sludge/sediment samples will be taken from the bottom of the area undergoing active dredging. The samples will allow for identification of the extent of dredging remediation via qualitative comparison of sludge samples versus known characteristics of impacted sludge/sediment and native marine sediment.

The CMOC will confirm that dredging has been completed to the target evaluation (less than 0.025 m of sludge remaining). Following dredging to the target elevation, a sediment sampling program would be implemented to confirm that the bottom surface meets the proposed criteria/site specific target levels (SSTLs) for the contaminants of concern (COC). Surface-weighted average concentrations, also referred to as spatially-weighted average concentrations, or SWACs, is the method proposed for determining if the SSTL (or remedial objective) has been achieved following completion of the remedial activities. SWACs are calculated by defining the areal extent represented by each confirmation data point, multiplying the area by the concentration of the COC, and repeating for each data point. The products are then summed and divided by the total surface area of the assessment area. As it is likely humans would be exposed to COCs at multiple locations at the Site and not a single point, SWACs integrate exposure and uptake of COCs over the entire assessment area. Similarly, upper trophic level ecological receptors forage on aquatic prey at multiple locations rather than a single location.

Table 3.2-1 presents the SSTLs calculated in the final draft HHERA.

Table 3.2-1 Site Specific Target Levels

Medium	COC	Sediment SSTL
Sediment	Vanadium	49 mg/kg
	Dioxin and Furan Total Equivalent	29 pg/g

In areas that do not meet the remediation criteria a second dredging pass would be conducted followed by confirmatory sampling. This process would be repeated until the remediation criteria has been met in all areas.

The use of silt curtains would help reduce the migration of suspended sludge to remediated areas.

The Site-specific risk-based sediment compliance criteria and confirmatory sampling methodology for full-scale remediation is currently being developed, in consultation with NSE. Analytical results from this sediment sampling program would be considered in the criteria development. The results of this program can be more critically evaluated and assessed for full-scale remediation implications once the sediment compliance criteria have been established.

Staff and Equipment Requirements

The dredging operations will include one to two dredges in operation. The dredge operating personnel is anticipated to be a crew of two to four staff with support staff on shore of another two to four personnel for site supervision. Geotube® or equivalent technology maintenance and installation will be a separate shore-based crew anticipated to be three to six staff.

The on-shore crew size will fluctuate with addition of specialized smaller crews (four to six staff typically) depending on the concurrent sub-tasks being completed, with additional heavy equipment, such as excavators (30 to 45 ton), rock trucks (30 ton), bobcat (small excavator/dozer), loader (e.g., CAT 930G), D7 size dozer, mid-size compactor to support decommissioning, regrading, and planting operations.

3.2.2.3 Wetland Management

The impacted sediment in the wetlands would be hydraulically and/or mechanically dredged and conveyed to the Geotubes® or equivalent technology located within the containment cell for dewatering and disposal. Depending on the dredging method and water levels in the wetlands, makeup water would be required to permit hydraulic dredging. This water would be taken from Boat Harbour, or a clean water source.

In areas where sludge is to be completely removed, remaining sediments would meet risk-based sediment criteria that is protective of ecological and human health.

Staff and Equipment Requirements

The staff and equipment need for the wetland management activities will be the same as the dredging activities, which is described above.

3.2.2.4 Bridge at Highway 348

The anticipated span of the bridge is 34 m (to match historical bridge span), constructed at a height of approximately 4 m above the water during high tidal conditions. The bridge shall be designed in accordance with the requirements specified in CSA S6-14 - Canadian Highway Bridge Design Code, and applicable Navigable Waters Bridges Regulations (C.R.C., c. 1231). Additional construction details (i.e., footings, abutments, arches) may be dictated by the Nova Scotia Watercourse Alterations Standard (NSE 2015b). The bridge would be designed to accommodate design vehicle configuration CL-625, applying a gross vehicle weight of 625 kiloNewtons (kN) or 64 tonnes, in accordance with requirements specified in CSA S6-14 - Canadian Highway Bridge Design Code.

Incorporated into the bridge design would be a new support system for the water main. The line would be rerouted within the embankment to be adjacent to the new bridge foundations and be supported under the exterior concrete deck of the bridge. The water main would be supported by galvanized steel brackets that are equally spaced at approximately 1.8-2.4 m across the bridge. The bridge would have a sidewalk on both sides and a decorative concrete and metal rail barrier to meet the necessary requirements for pedestrians and architectural enhancements. There would be a street light on the approach on either end of the bridge.

Staff and Equipment Requirements

Bridge construction crew sizes will vary as the work progresses through preparation, bypass construction, pile installation an abutment construction, and superstructure installation. Typical crew sizes will vary from six to 12, with three to five pieces of heavy equipment in support, which may include the following: excavators (30 to 45 ton), rock trucks (30 ton), bobcat (small excavator/dozer), loader (e.g., CAT 930G), D7 size dozer, mid-size compactor, pile drivers (for bride abutments), and mobile crane for placement of large or precast components.

3.2.2.5 Infrastructure Decommissioning

There is no operation phase for the decommissioning of the on-land pipeline and under water pipeline, treatment buildings, or dam.

3.2.3 Decommissioning and Abandonment

3.2.3.1 Waste Management

Containment Cell Closure and Post-Closure

The decommissioning and abandonment phase for the containment cell is referred to as 'closure and post-closure' as it is more appropriate for describing the end of life for containment cells. The containment cell will not be decommissioned (i.e., withdrawn from service), it will be capped, and waste will be continued to be stored within it. After the containment cell is capped and closed, on-going monitoring (long-term) will occur therefore, it is better described as post-closure than abandonment. The closure and post-closure process is discussed below.

Once active remediation is complete, a TLTF would treat leachate from the containment cell until the leachate storage and loading station is fully commissioned, the containment cell is completed with final cover, and dewatering has stabilized such that leachate hauling is feasible. Final cover would be placed once remediation of the BHETF is completed, including dam decommissioning, and all wastes placed in the containment cell, and the containment cell has dewatered and stabilized to permit final grading and the placement of final cover. The final cover contours would be designed to accommodate the final waste volumes, minimize precipitation infiltration through the cap, control the release of LFG, and accommodate end use. The 0.75 m thick low permeable final cover would consist of a sand/grading layer, FML, sand drainage layer, and vegetated topsoil. The final cover material may be modified to accommodate intended plantings such as short shrubs that would tie the containment cell visually into the surrounding tree line. A surface water ditching and ponding system would be integrated with the final cover to control clean surface water runoff from the containment cell. As part of containment cell closure, infrastructure for long-term monitoring and care of the containment cell would be constructed.

This would include required groundwater and leachate monitoring wells, gas monitoring probes, surface water monitoring station, perimeter fencing, signage as needed, and access road for long-term maintenance and inspection. Leachate collection system cleanout riser piping would be installed to allow for long-term inspection, maintenance, and cleaning of the leachate collection piping.

Leachate Management

During post-closure phase of the landfill, leachate will continue to be disposed of off-site at an NSE approved facility by tanker truck.

Landfill Gas Management

LFG is produced by the biological decomposition of waste placed in a landfill. LFG composition is highly variable and depends upon a number of -site-specific conditions including waste composition, density, moisture content, and age. LFG is typically comprised of methane (approximately 50 percent by volume) and carbon dioxide (approximately 50 percent by volume). LFG may also contain nitrogen, oxygen, and trace quantities of other gases (such as hydrogen sulphide and mercaptans).

LFG management may be required to control potential impacts relating to the release of LFG to the atmosphere and migration of LFG through the soil surrounding the Site.

The release of LFG into the air may contribute to odours in the vicinity of the Site, and the addition of "greenhouse gases" into the atmosphere. LFG odours are primarily a result of the presence of hydrogen sulphide and mercaptans. These compounds may be detected by sense of smell at very low concentrations (0.005 and 0.001 parts per million for hydrogen sulphide and mercaptans, respectively). It is generally recognized that the impacts related to these compounds are nuisance odours.

LFG produced by the containment cell are anticipated to be predominantly methane and carbon dioxide as a result of the anaerobic decomposition of the organic fraction of the waste. The LFG production would be evaluated as part of the detailed design and is expected to be small as compared to municipal solid waste due to the organic material being degraded and not readily biodegradable.

LFG would be managed using a passive venting system which allows the release of pressure build up within the closed cell.

3.2.3.2 Dredging

There is no decommissioning and abandonment phase associated with dredging.

3.2.3.3 Wetland Management

Once the wetlands are remediated, the impediments for restoration would be removed allowing for future reestablishment of vegetation and wetland function to start to occur before Boat Harbour is returned to tidal conditions. The remediation phase would include, in addition to the infilling and regrading of wetlands, planting or seeding of native aquatic and terrestrial vegetation in the construction areas only.

Disturbed areas along the shoreline will be re-seeded with a hydraulic seed mix suited to low-lying wetlands, consisting of native non-invasive species. Higher areas away from shoreline and remediated access road and work areas will be mechanically seeded, including addition of native species of trees and shrubs to better promote a mix of vegetation matching surrounding areas.

3.2.3.4 Bridge at Highway 348

It is anticipated that the bridge would have a service life of approximately 75 years. As the end of design life approaches, the bridge would most probably be refurbished, if community and traffic requirements do not require a significant change (either increase or removal) to the functionality of the bridge. Should the bridge no longer be required at end of design life, selective deconstruction and demolition would permit much of the bridge material to be removed and recycled or repurposed. For example, concrete can be broken down and the aggregate recycled into production of new concrete, and the main girders and metal work can also be recycled. As the design life of the bridge is so long, the components and design are already manageable by current deconstruction methods without modifications, and methods of deconstruction that far into the future are uncertain, no specific modifications to the design have been made to facilitate deconstruction.

3.2.3.5 Infrastructure Decommissioning

Pipeline

The section of pipeline on land from the shoreline of Indian Cross Point east up to the Highway 348 property line, adjacent to a historic Mi'kmaq burial ground will be removed completely, as requested by PLFN. This would require clearing and grubbing within the existing pipeline easement prior to excavation and removal. Archaeological monitoring would be conducted.

The portion of the on-land pipeline that goes under Highway 348 has been severed, filled and capped by NS TIR on the Indian Cross Point side of Highway 348. The rest of the on-land pipeline would be abandoned in place. Abandonment of the rest of the portions of the on-land pipeline and the under water pipeline would consist of leaving the pipeline in place. The ends of the pipeline would be plugged with an appropriate cap (e.g., concrete plug). Each manhole will be cut approximately 1 metre below grade (mbg) and backfilled (both remaining void space and disturbed area). Disturbed areas will be graded to match existing hard surfaces and to achieve positive drainage.

Treatment Buildings

Demolition of the Treatment buildings and small structures would commence once each building has been decommissioned and has been released for demolition. Demolition would require the use of an excavator, with a standard bucket or potentially mechanical shears for cutting large structural elements and collapsing the structure for cleanup. For larger structures, such as the silo, demolition would be done with a more methodical process using a crane and taking the structure apart in pieces. Footings and foundations would be removed to a depth of 0.9 m below finished grade. There may be an opportunity to re-purpose buildings where it may be beneficial to PLFN, which would require some modified approach to the decommissioning process. PLFN's potential use of buildings will be confirmed through further consultation with them.

The demolition waste would be stockpiled and disposed of off-site at an appropriate landfill facility as per Nova Scotia's Management Guide for Construction and Demolition Debris[4]. As lead paint has been confirmed to be present within the buildings on-site, a leachate test would have to be conducted on the waste generated from the buildings to determine if the waste could be disposed of in a construction and demolition debris disposal site. If the lead on the material failed the leachate test then the waste will have to be disposed of at a secure facility.

Dam

The demolition of the dam structure would consist of using mechanical equipment to break the concrete structure into smaller components to be excavated and dumped into a dump truck for off-site disposal at a construction and demolition facility licensed to accept the waste/recyclable materials. The smaller elements of the structure would be demolished by hand, such as the timber screens and fences. The earthen berm connecting the dam to the banks would also be removed, as needed, to facilitate boat access to Boat Harbour.

One of the major items for consideration is the requirements for erosion control during and after demolition. Demolition would commence once the remediation is complete and Boat Harbour is ready to be reinstated back to tidal conditions. A temporary cofferdam or similar would be installed between the dam and the mouth of the estuary to prevent the tidal influence on the decommission activities. Silt curtains would be installed in the water upstream and downstream of the dam decommissioning works to control the migration of silt generated as a result of the dam removal. Once the dam structure is removed, the channel would be dredged to match the channel shape and depth of the bridge (that would be installed to replace the causeway) to ensure the hydraulics are maintained throughout the channel.

Staff and Equipment Requirements

Based on the proposed activities under the Decommissioning and Abandonment phase, typical crew size is limited as the majority of the activities relate to on-site monitoring of the physical structures, including the containment cell and leachate management. This will require two to three crew and one to two pieces of heavy equipment such as a mini-excavator and a mid-sized compactor on-site to repair any settlement or erosion. With respect to the treatment building demolitions, this typically requires a crew of four to five with three to four pieces of heavy equipment in support.

[4] Nova Scotia. 2013. Management Guide for Construction and Demolition Debris. Available at: https://divertns.ca/assets/files/Guides/CandDManagementGuide.compressed.pdf

about GHD

GHD is one of the world's leading professional services companies operating in the global markets of water, energy and resources, environment, property and buildings, and transportation. We provide engineering, environmental, and construction services to private and public sector clients.

Blair Shoniker
Blair.Shoniker@ghd.com
905.429.5040

Christine Skirth
Christine.Skirth@ghd.com
613.297.7687

www.ghd.com