8.0 Environmental Effects Assessment

An assessment of the environmental effects of the project on each of the identified VECs is provided in this chapter.

Following an identification of project interactions with the environment, potential environmental effects in the absence of mitigation were described at a high level with a view to determining if an interaction between the project and the VEC could occur. The identification of project-VEC interactions was done for each project phase in a matrix format (see **Table 8.0-1**, below, Project Interactions with the Environment) to determine which potential interactions may occur. Then, for each VEC for which an interaction with the project was identified, a more detailed assessment was provided in a standalone section whereby: the scope of the VEC was defined; existing environmental conditions were established; potential effects without mitigation were identified; mitigation to avoid, reduce, or eliminate environmental effects were described; and residual environmental effects after the application of mitigation, as well as plans for follow-up monitoring were described.

The identification of potential interactions between the project and the VECs has been undertaken in consideration of the nature of the project and its planned activities during each phase. Additionally, accidents and malfunctions were considered separately in **Section 10**.

The phases of the project include:

- Construction;
- Operation and maintenance; and
- Decommissioning.

This initial screening (i.e., project interaction matrix) highlights the potential of an interaction between the activities being carried out in each phase of the proposed project and the VEC. A qualitative rating system was used to evaluate the potential for interactions between the project and the environment. One of the following two ratings was prescribed for each individual VEC:

- An interaction between the project and the environment could occur (which is identified with a checkmark in the matrix below); or
- No interaction occurs between the project and the environment (blank cell in table).

Based on the description of project phases (refer to **Section 5.3**), the general environmental setting of the area, and the scope of the EA (refer to **Section 7**), the potential interactions between the project and the environment are summarized in **Table 8.0-1** below. Note that this table does not include potential interactions that may occur as a result of accidents or malfunctions.

Table 8.0-1: Potential Interactions Between the Project and the Environment

Valued Environmental Component (VEC)	Project Phases		
	Construction	Operation and Maintenance	Decommissioning
Atmospheric Environment	✓	✓	✓
Acoustic Environment	✓	✓	✓
Soils and Geology	✓		✓
Surface Water	✓		✓
Groundwater	✓		✓
Aquatic Habitat	✓		✓
Wetlands	✓		✓
Flora/Floral Priority Species	✓		✓
Terrestrial Wildlife/Priority Species	✓		✓
Migratory Birds and Priority Species/Habitat	✓	✓	✓
Harbour Physical Environment, Water Quality and Sediment Quality	✓	✓	✓
Marine Fish and Fish Habitat	✓	✓	✓
Marine Mammals, Sea Turtles and Marine Birds	✓	✓	✓
Socio-Economic Environment	✓	✓	✓
Human Health	✓	✓	✓
Indigenous Peoples	✓	✓	✓
Marine Archaeological Resources	✓		✓
Terrestrial Heritage Resources	✓		✓
Effects of the Environment on the Project	✓	✓	✓

VECs for which an interaction occurs are carried forward in the environmental effects assessment in **Sections 8.1** to **8.17**, below. Some VECs may not have any interactions during a project activity.

Stantec Consulting Ltd. provided technical support in the assessment of the following marine VECs: harbour physical environment, water quality and sediment quality; marine fish and fish habitat; marine mammals, sea turtles and marine birds; and marine archaeological resources.

Dr. Fraser Clarke provided technical support in the water quality and marine fish assessment focusing on lobster.

Cultural Resource Management Group Limited provided technical support in the assessment of the terrestrial archaeological resources.

Membertou Geomatics Solutions provided technical support in the completion of the MEKS.

8.1 Atmospheric Environment

The atmospheric environment is a component of the environment that comprises the layer of air near the earth's surface to a height of approximately 10 km. The atmospheric environment includes: air quality, and climate (including GHGs), as follows.

- Air quality is characterized by the composition of the ambient air, including the presence and quantity of air contaminants in the atmosphere in comparison to applicable air quality objectives; and
- Climate is characterized by the historical seasonal weather conditions of a region, which can include temperature, humidity, precipitation, sunshine, cloudiness, and winds. Statistical climate data are typically averaged over a period of several decades (GOC 2018). Project-based releases of GHGs, such as CO_2, methane (CH_4), and nitrous oxide (N_2O), are typically used as an indicator of the potential for environmental interactions with climate change. It is understood that GHG releases on a global scale from both natural processes/sources and human activities are increasing global concentrations of GHGs in the atmosphere and they contribute to climate change.

8.1.1 Scope of VEC

The atmospheric environment has an intrinsic or natural value because the atmosphere helps maintain the health and well-being of humans, wildlife, vegetation, and other biota. Emissions from the project to the air (including odour) may cause adverse environmental effects through the various transport, dispersion, deposition, and transformation processes that occur in the atmosphere. GHG emissions accumulate in the atmosphere and are thought to be a major factor in affecting global climate.

The atmospheric environment includes consideration of potential environmental effects on air quality, including GHG emissions. These components constitute a VEC due to:

- Emissions of contaminants (including odour) to the atmosphere during construction, operation and maintenance of the project, which may present a pathway for humans and biota to be exposed to air contaminants;
- Provisions regarding air contaminant emissions under the Nova Scotia *Air Quality Regulations*; and
- Releases of GHGs and their accumulation in the atmosphere influence global climate and may affect emission reduction targets for GHGs that have been set or are being developed federally and provincially.

Air quality in Nova Scotia is regulated pursuant to the Nova Scotia *Air Quality* Regulations under the Nova Scotia *Environment Act*. Federally, the main instrument for managing air quality is the CEPA as well as Canada-Wide Standards (CWS) developed by the CCME.

Nova Scotia's *Air Quality Regulations* specify maximum permissible concentrations for six air pollutants, namely total suspended particulate (TSP), CO, SO_2, nitrogen dioxide (NO_2), ozone (O_3) and hydrogen sulphide (H_2S). The criteria in the regulations are based on the National Ambient Air Quality Objectives (NAAQOs), although the two do differ slightly, as presented in **Table 8.1-1**. The *Air Quality Regulations* are legally binding in Nova Scotia, whereas the NAAQOs are guidelines used as a benchmark to assess the effects of air pollutants.

Table 8.1-1: Ambient Air Quality Standards and Objectives

		Nova Scotia Air Quality Regulations		National Ambient Air Quality Objectives (NAAQO)			
Air Contaminant	**Averaging Period**	**Maximum Permissible Ground Level Concentration**		**Maximum Acceptable Level**		**Maximum Desirable Level**	
		(ppb)	**(µg/m³)**	**(ppb)**	**(µg/m³)**	**(ppb)**	**(µg/m³)**
O_3	1 hour	82	160	80	160	50	100
TSP	24 hour	-	120	-	120	-	-
	Annual	-	70 (geometric mean)	-	70	-	60
CO	8 hour	11,000	12,700	13,000	15,000	5,000	6,000
	1 hour	30,000	34,600	31,000	35,000	13,000	15,000
NO_2	1 hour	210	400	210	400	-	-
	Annual	50	100	50	100	30	60
SO_2	1 hour	340	900	340	900	170	450
	24 hour	110	300	110	300	60	150
	Annual	20	60	20	60	10	30
H_2S	1 hour	30	42	-	-	-	-
	24 hour	6	8			-	-

Source: Nova Scotia Air Quality Regulations; NAAQO (Environment Canada, National Air Pollution Surveillance (NAPS) Network, 2007, p. 156). Note: NAAQO uses conditions of 25 °C and 101.3 kPa in converting from µg/m³ to ppm.

8.1.1.1 Boundaries

Spatial boundaries for the assessment of environmental effects on the atmospheric environment include the following:

- The **project footprint area (PFA)** is defined as the maximum extent of the physical area of disturbance associated with the project. The PFA will include all temporary and permanent areas of ground and marine disturbance. The PFA is defined in **Section 5.1.1**.
- The **local assessment area** is the maximum area within which environmental effects from the project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence (i.e., the zone of influence of the project's emissions on the atmospheric environment).

For the purpose of this EA Registration, the local assessment area for atmospheric environment consists of an area of 30 km by 30 km centred on the project on NPNS property, coinciding with the model domain from the air quality dispersion model for the project, beyond which the emissions arising from the project would not be distinguishable from background levels.

Temporal boundaries for the assessment of environmental effects are based on the project schedule described in **Section 5.4** and include periods of construction, operation and maintenance, and decommissioning. Construction is estimated to be approximately 21 months, beginning second quarter of 2019, commencing as soon as the EA review has been completed and the applicable permits, approvals or other forms of authorization have been obtained. Operation and maintenance will commence immediately following the construction phase and will continue to operate efficiently and safely for several decades and likely much longer with a well-maintained system. For the purpose of this EA Registration, it has been assumed that the operation and maintenance phase will begin in the fourth quarter of 2020. Decommissioning of the project would occur at the end of mill life following the completion of operations. Once the ETF or pipeline is nearing the end of a useful service life, a decommissioning plan will be developed and will be submitted for a separate review requiring NSE approval.

8.1.1.2 Significance Criteria

A significant adverse residual environmental effect on the atmospheric environment is one where project-related releases result in a frequent exceedance of the Nova Scotia or federal ambient air quality standards or objectives as defined in **Table 8.1-1** above. A frequent exceedance is defined as one that occurs more than 1% of the time.

8.1.2 Existing Environment

The existing conditions for atmospheric environment are defined in terms of climate and ambient air quality.

8.1.2.1 Climate

Despite being mostly surrounded by water, the climate of Nova Scotia is closer to continental rather than maritime. The ocean is a major influence on Nova Scotia's climate, moderating temperatures in winter and summer. Winter temperatures are higher and summer temperatures are lower than those encountered in communities farther inland. The constant temperature of the Atlantic Ocean moderates the climate for most of the province, other than northern Nova Scotia where heavy ice build-up in the Gulf of Saint Lawrence (GSL) makes winters colder. Due to the ocean's moderating effect, Nova Scotia is the warmest of the Maritime Provinces, on average. Nova Scotia also experiences frequent coastal fog. Dominant westerly winds are another main factor influencing Nova Scotia's climate.

Climate normals from the nearest weather stations are presented in **Table 8.1-2** and **Table 8.1-3** below. Climate station locations are provided in **Figure 8.1-1**.

Table 8.1-2: Representative Climate Normals for Lyons Brook

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature Normals, Lyons Brook NS (1981 - 2010)													
Daily Average (°C)	-6.2	-5.9	-1.7	4.2	10.2	15.3	19.3	19.1	14.8	9.2	3.7	-2.5	6.6
Daily Maximum (°C)	-1.5	-1.1	2.9	8.6	15.6	20.9	24.8	24.5	20.0	13.7	7.4	1.5	11.4
Daily Minimum (°C)	-11.0	-10.7	-6.2	-0.3	4.7	9.7	13.8	13.6	9.6	4.7	-0.0	-6.5	1.8
Precipitation Normals, Lyons Brook NS (1981 - 2010)													
Rainfall (mm)	40.2	31.6	50.4	74.3	82.7	89.7	76.6	81.4	117.6	128.1	117.5	63.2	953.3
Snowfall (cm)	69.6	63.1	49.9	19.3	1.2	0.0	0.0	0.0	0.0	0.4	17.6	57.9	279.0
Precipitation (mm)	109.7	94.7	100.3	93.7	83.9	89.7	76.6	81.4	117.6	128.6	135.1	121.1	1232.2
Source: Canadian Climate Normals (GOC 2018)													

Table 8.1-3: Representative Climate Normals for Debert

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature Normals, Debert NS (1981 - 2010)													
Daily Average (°C)	-6.7	-6.1	-1.8	4.3	10.2	15.1	18.6	18.2	13.7	8.0	3.0	-3.2	6.1
Daily Maximum (°C)	-1.5	-0.9	3.2	9.2	16.5	21.5	24.8	24.3	19.5	12.9	6.9	1.0	11.4
Daily Minimum (°C)	-11.8	-11.2	-6.8	-0.7	3.9	8.7	12.4	12.1	7.9	3.0	-1.0	-8.2	0.7
Precipitation Normals, Debert NS (1981 - 2010)													
Rainfall (mm)	54.0	44.3	58.7	79.0	106.1	95.9	90.7	89.6	109.1	107.9	101.8	73.9	1010.9
Snowfall (cm)	38.8	35.1	32.2	8.7	0.7	0.0	0.0	0.0	0.0	0.0	10.1	31.9	157.5
Precipitation (mm)	92.8	79.4	90.8	87.7	106.8	95.9	90.7	89.6	109.1	107.9	111.9	105.8	1168.3
Wind Normals for Debert, NS (1981-2010)													
Maximum Hourly Speed (km/h)	93	71	64	61	61	48	48	58	51	64	68	69	Not applicable
Direction of Maximum Hourly Speed	SW	N	SE	E	W	S	SW	W	SE	W	SW	W	Not applicable
Source: Canadian Climate Normals (GOC 2018)													

Northern Pulp Nova Scotia Corporation
Replacement Effluent Treatment Facility
Environmental Assessment

Air Quality and Noise Sampling Stations
Figure 8.1-1

NORTHERN PULP
NOVA SCOTIA CORPORATION
A PAPER EXCELLENCE COMPANY

Approximate Project Footprint Area*	Climate Station	Pictou Landing First Nation	Roads
Approximate Outfall Location	Air Quality Monitoring Station	Open Water	Watercourse
Noise Sampling Location			Railline

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY Northern Pup Nova Scotia, ECCC, NSE, NSDNR, GeoNova, NSDNR, ESRI

MAP CREATED BY: SCM
MAP CHECKED BY: AB
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 0.5 1 2 km

N E S W

*Precise Project Footprint to be determined following completion of detailed design

PROJECT: 17-6461

Date: 2019-01-30

GHG emissions in Canada totaled 704 metric tonnes as CO_2-equivalents (Mt CO_2eq) in 2016 (ECCC 2018a) as published in Canada's most recent annual report on greenhouse gas emissions. Greenhouse gases from heavy industry represented 11% of total emissions. Total greenhouse gases for Nova Scotia in 2016 were 15.6 Mt CO_2eq. For comparison, emissions of GHGs in Nova Scotia in 1990 were 19.6 Mt CO_2eq and in 2005 were 23.2 Mt CO_2eq. Since 2005, Nova Scotia has seen a 33% decrease in total GHG emissions. According to Environment Canada's Greenhouse Gas Reporting Program (ECCC 2018b), GHG emissions from NPNS in 2016 were 69,870 tonnes of CO_2eq emitted (or 0.45% of total GHG emissions for Nova Scotia).

8.1.2.2 Air Quality

The air quality within the local assessment area can be defined from historical air quality monitoring conducted in the region for the key regulated contaminants. Data collected at Nova Scotia Environment's Pictou monitoring station and TSP monitoring conducted by Northern Pulp at Pictou Landing are summarized in **Table 8.1-4** below.

Table 8.1-4: Ambient Monitoring Data – Pictou Landing, 2015-2017 Maximums

Air Contaminant	Averaging Period	2015 Maximum	2016 Maximum	2017 Maximum	Regulatory Criteria	No. of Exceedances
O_3 (ppb)	1 hour	60.8	48.9	64.8	82	0
TSP ($\mu g/m^3$)[A]	24 hour	-	-	63.2	120	0
	Annual	-	-	15.4	70 (geometric mean)	0
$PM_{2.5}$ ($\mu g/m^3$)	24 hour	32.8	25.2	16.1	30[C]	-
	Annual	7.0	4.5	5.3	-	0
NO_2 (ppb)	1 hour	18	13	14	210	0
	Annual	1	0	0	50	0
SO_2 (ppb)	1 hour	0	34.5	42.1	340	0
	24 hour	ND	5.5	11.7	110	0
	Annual	0	0.2	0.5	20	0
TRS (ppb)[B]	1 hour	9.1	9.1	10	30	0
	Annual	0.2	0.2	0.2	6	0

A TSP data provided by NPNS
B H_2S criteria used for comparison to total reduced sulphur (TRS) monitored data
C CCME Canada-Wide Standard for $PM_{2.5}$ (3-year average of the 98th percentile of the daily 24-hour average)

Odour is another consideration with respect to air quality and can be related to a variety of factors, sources and compounds. Odour is not necessarily associated with the release of one specific compound, which makes it almost impossible to address from a regulatory standpoint without grouping specific families of compounds (for example TRS or VOCs). Because the perception of odour and its effects are subjective and relative to an individual's perceptions, limits, and tolerances, it is more frequently treated as a nuisance issue. As with other Kraft mills, there is potential for odour to be perceived at locations beyond the facility property during specific meteorological conditions because of very low detection threshold of some compounds released from the process.

Though there have been instances of reported odour occurrences, there have been no exceedances of the regulatory criteria for all air contaminants monitored.

Discussion of Volatile Organic Compounds (VOC's)

A recent paper by Hoffman et al. (2017) evaluated ambient air levels of seven volatile organic compounds (VOCs), based on ambient monitoring data reported from the National Air Pollution Surveillance Network (NAPS). There are two NAPS monitoring stations near the NPNS mill that have historically monitored for VOCs. This paper focused on ambient monitoring data for the following VOCs: chloroform; 1,3-butadiene; vinyl chloride; benzene; carbon tetrachloride; trichloroethylene; and, perchloroethylene. The paper reported that results of the conducted temporal and spatial statistical analyses indicated that 1,3-butadiene, benzene, and carbon tetrachloride air concentrations routinely exceeded EPA air toxics-associated cancer risk thresholds, and that 1,3-butadiene and perchloroethylene levels in air were significantly higher when the prevailing wind direction blew from the northeast and the NPNS mill towards the Granton NAPS site. Conversely, when prevailing winds originated from the southwest towards the mill, higher median VOC air toxics concentrations at the NAPS site, except carbon tetrachloride, were not observed. These outcomes have not been corroborated by regulatory agencies or other parties at this time. While this study was quick to attribute elevated ambient VOC concentrations to the NPNS mill based on a spatial and temporal evaluation only (i.e., a statistical evaluation of ambient data in correlation with wind direction, without further site-specific investigation), it did not attempt to rule out contributions from other potential sources of VOCs in the area (e.g., transportation sources, or other industrial sources like the Michelin tire plant or the Trenton coal-fired power plant, presumably all sources of VOC emissions to some degree). The study authors documented a number of limitations of their study but purported that VOC levels were elevated in the community surrounding the NPNS mill. The study authors also noted that study limitations preclude the explicit attribution of ambient air toxic exposures to the risk potential for cancer for community residents. Thus, the study outcomes, given the study design and its inherent limitations, can only be viewed as suggestive. The study design and methods do not enable any causal inferences.

Technical review of this paper reveals some issues that question some of the paper's conclusions.

- The seven VOCs focused on in the paper may be emitted in small amounts in stack and fugitive emissions at the NPNS mill but a number of other point and mobile local sources also emit these substances within the local airshed. The study's methods do not enable any VOC source attribution that is scientifically defensible, nor was source attribution among the study's objectives;
- The seven VOCs are not known (based on literature review) to be associated with pulp mill activities and air emissions to any significant extent;
- The authors did not (or could not) estimate annual average air concentrations for the seven VOCs; and
- When other study uncertainties are considered (including the use of one ambient air station only for study analyses; the use of measured concentrations only with no information provided on data quality review; the lack of modelled data to corroborate potential ground level air concentrations of the VOCs), it must be concluded that there is no current air quality issue with the seven targeted VOCs in the Pictou County area.

Further analysis and commentary is provided by Stantec regarding the Hoffman et al. paper. This additional supporting information is provided in **Appendix K**.

Overall, the Hoffman et al. (2017) paper is not relevant to the current NPNS project and is not considered further at this time.

8.1.3 Impact Evaluation/Effects Assessment

The environmental effects of the project on the atmospheric environment are assessed in this section.

8.1.3.1 Potential Environmental Effects

Without mitigation, the project could interact with the atmospheric environment in the following ways:

- Emissions of combustion gases and fugitive dust from construction activities associated with the replacement ETF, pipeline, and marine outfall/diffuser, and related transport of materials during construction, could result in air contaminants that could disperse in the atmosphere to off-site receptors; and
- Emissions of combustion gases, particulate matter, and possibly odour from the replacement ETF during operation and maintenance could result in air contaminants that could disperse in the atmosphere to off-site receptors.

Additionally, since the project will include the combustion of sludge generated in the replacement ETF for energy recovery and odour control, emissions from the combustion of such sludge in the power boiler during operation and maintenance could disperse from mill stacks to off-site receptors.

8.1.3.2 Mitigation

The following mitigation measures will be implemented to reduce environmental effects on the atmospheric environment:

- Application of dust suppressants via water truck during dry periods when appropriate;
- Instituting and following a non-idling policy;
- Vehicles and equipment will be maintained in proper working order;
- Operation of the facility will follow regulatory requirements;
- Continuous solids removal from clarifiers to mitigate odour potential by preventing sludge from turning septic;
- Subsurface air injection in the AS to mitigate odour potential;
- Indirect effluent cooling (heat exchangers) to mitigate odour potential; and
- Combustion of sludge in the power boiler may reduce CO_2eq emissions through displacement of other fuels.

8.1.3.3 Characterization of Residual Environmental Effects

Residual environmental effects (after the application of mitigation) of the project on the atmospheric environment are assessed in this section.

Construction Phase

During the construction phase, emissions are expected to be primarily related to fugitive dust and the operation of heavy equipment, trucking, and related construction activities. Construction activities have the potential to result in changes in the local air quality, primarily related to fugitive dust and particulate matter from material movement as well as emissions from combustion associated with construction equipment.

The construction phase emissions will consist of combustion gas emissions and fugitive dust from the equipment and material movement during the construction of the replacement ETF and from the digging, laying of pipe and material fill during the installation of the new effluent pipeline. These emissions will be of low magnitude, temporary, highly localized (largely remaining either on the project site or within the NSTIR ROW) and transient along the ROW, and are not expected to be distinguishable from current ambient air quality most of the time.

During the construction of the replacement ETF, emissions are expected to be primarily related to operation of heavy equipment and related construction activities. Construction related activities have the potential to result in changes in local air quality, primarily related to dust and particulates from material movement and emissions from combustion associated with construction equipment. Emissions related to construction activities are expected to be fairly localized, short-term and reversible.

Given that the replacement ETF will be constructed on an operating pulp mill facility and the project site's relative distance to the nearest residential receptor, the potential for construction-related emissions to adversely affect nearby receptors is expected to be minimal. Similarly, emissions of construction equipment and fugitive dust associated with the new effluent pipeline will be highly localized, temporary and transient and are not expected to adversely affect nearby receptors. Given that construction emissions are not likely to be substantive and remain largely within the PFA, they are therefore not assessed further.

Total GHG emissions during construction are expected to be immaterial in the context of Nova Scotia's last reported total of 15.6 Mt CO_2eq. Given the relatively low magnitude of emissions, no further action is taken in the analysis as per the guidance provided in the document *Incorporating Climate Change Considerations in Environmental Assessment: General Guidance for Practitioners* (CEAA 2003).

Operation and Maintenance Phase

Releases of the contaminants listed in the Nova Scotia Air Quality Regulations from the NPNS mill have previously been modelled. Because sludge from the replacement ETF will be combusted in the power boiler as part of the project, the assessment of environmental effects of the project on the atmospheric environment needs to consider a comparison between overall emissions from the pulp mill currently versus those that will occur once the replacement ETF is operational. Therefore, emissions at the existing BHETF are considered for the baseline scenario, and emissions estimated for the proposed replacement ETF are considered for the future operation scenario. The co-combustion of sludge with hog fuel in the power boiler is also considered in the future operation scenario.

During the operation phase, emissions are primarily related to existing emission sources at the facility and fugitive emissions from the replacement ETF. These activities have the potential to result in changes in the local air quality. There are no features of the effluent pipeline on land or in the marine environment that would be expected to affect air quality during operation, and as such the effluent pipeline during operation is not discussed further.

Estimates of emissions associated with the existing operation of the NPNS mill (which will continue during construction of the project, but are unrelated to the project itself) are summarized in **Table 8.1-5**.

Table 8.1-5: Emissions Inventory – Existing Operations (Baseline Conditions during Construction)

Source	Carbon Monoxide (g/s)	Nitrogen Oxide (g/s)	Sulphur Dioxide (g/s)	TSP (g/s)	$PM_{2.5}$ (g/s)	Hydrogen Sulphide (g/s)
Power Boiler	11.4	3.40	-	3.87	1.14	-
Other Mill Point Sources [1]	76.9	8.72	1.73	5.61	0.79	1.60
ETF – Settling Pond	-	-	-	-	-	0.0202
ETF – Cell 1	-	-	-	-	-	0.00008

Source	Carbon Monoxide (g/s)	Nitrogen Oxide (g/s)	Sulphur Dioxide (g/s)	TSP (g/s)	$PM_{2.5}$ (g/s)	Hydrogen Sulphide (g/s)
ETF – Cell 2	-	-	-	-	-	0.00006
ETF – Cell 3	-	-	-	-	-	0.0001
ETF – Cell 4	-	-	-	-	-	0.0001

"-" air contaminant is not released in a substantial amount from this source
[1] Each "Other Mill Point Source" was modelled individually and the total emission rate is shown in Table 4.1
Reference: Stantec (2019)

Estimates of emissions associated with the operation phase of the project are summarized in **Table 8.1-6**.

Table 8.1-6: Emissions Inventory – Future Operation and Maintenance

Source	Carbon Monoxide (g/s)	Nitrogen Oxide (g/s)	Sulphur Dioxide (g/s)	TSP (g/s)	$PM_{2.5}$ (g/s)	Hydrogen Sulphide (g/s)
Power Boiler	**3.26**	**7.42**	**0.358**	**2.77**	**0.595**	-
Other Mill Point Sources [1]	76.9	8.72	1.73	5.61	0.79	1.60
Primary Clarifier	-	-	-	-	-	**0.059**
Aeration Basin						**0.015**
Secondary Clarifier 1	-	-	-	-	-	**0.005**
Secondary Clarifier 2	-	-	-	-	-	**0.005**

"-" air contaminant is not released in a substantial amount from this source
"bold" indicates sources/emissions rates that have changed from existing operations
1 Each "Other Mill Point Source" was modelled individually and the total emission rate is shown in Table 4.2
Reference: Stantec (2019)

The US EPA, in its rulemaking process related to the "Identification of Non-Hazardous Secondary Materials That Are Solid Waste" under the *Resource Conservation and Recovery Act* (RCRA), has made a technical determination that dewatered pulp and paper sludges that are not discarded and are generated and combusted on-site by pulp and paper mills that burn a significant portion of such materials where such dewatered residuals are managed in a manner that preserves the meaningful heating value of the materials, can be considered a standard fuel, with combustion-related emissions that are no different than other forest-based solid fuels such as bark. (Reference: 40 CFR 241, final rule dated February 7, 2013)

The potential effects of facility emissions on ambient air quality for the existing baseline and future operation phases of the project were predicted by conducting a dispersion modelling study. The facility emissions calculations and dispersion modelling assessment were conducted by Stantec Consulting Ltd.

in their report entitled "Air Dispersion Modelling Study – Replacement Effluent Treatment Facility", prepared for Northern Pulp Nova Scotia Corporation (Stantec 2019) and attached in **Appendix K**.

Ground-level concentrations (GLCs) of air contaminants were predicted for two modelling scenarios, as follows:

1. Existing Operations – emissions consist of existing facility point sources and fugitive emissions from the existing ETF; and
2. Future Operations – emissions consist of existing facility point sources (with the power boiler co-combusting sludge and hog fuel) and fugitive emissions from the new replacement ETF.

Modelling was conducted for a 30 km by 30 km study area with varying receptor grid spacing as presented in Figure 5.3 of the Stantec report. Additionally, ten discrete receptor locations were identified representing the nearest sensitive receptors (residential locations). The locations of these receptors relative to the project are presented in Figure 5.5 of the Stantec report (Stantec 2019).

Based on the modelling results, the predicted concentrations of the air contaminants of concern (i.e., CO, NO_2, SO_2, TSP, $PM_{2.5}$ and H_2S) from the operation of the existing mill and the future mill (with replacement ETF) are both expected to be in compliance with the reference criteria at the representative off-property discrete receptors. (Stantec 2019). Modelled exceedances of H_2S were estimated to occur less than 0.05% of the time, and were determined to be largely an artifact of the model inputs (i.e., meteorological anomalies in the meteorological data used as inputs to the dispersion model).

The diversion of sludge for combustion in the power boiler may displace the use of fossil fuel, depending on the dryness, thereby reducing the overall GHG emissions from the pulp mill. Given some potential GHG reduction and considering the change in total GHG emissions during future operation are expected to be immaterial in the context of Nova Scotia's last reported total of 15.6 Mt CO_2eq, no further action is required in the analysis as per the guidance provided in the document *Incorporating Climate Change Considerations in Environmental Assessment: General Guidance for Practitioners* (CEAA 2003).

8.1.4 Summary

In summary, the residual environmental effects of the project on the atmospheric environment are summarized in **Table 8.1-7** below.

Table 8.1-7: Summary of Residual Environmental Effects Related to the Atmospheric Environment VEC

VEC	Activities	Potential Effects	Mitigative Measure	Residual Effect	Significance of Residual Effect
Site Preparation and Construction					
Atmospheric - Air Quality (dust)	Vegetation removal Restoration following pipe installation Site preparation	Dust and airborne particulate generation and deposition	• Application of dust suppressants where appropriate • Institute anti-idling policy • Maintain equipment	• Negligible with standard mitigation applied. • Indirect, Reversible • Magnitude - negligible • Duration – short-term • Geographic extent – local to construction area, transient • Context – existing and proposed buffers from receptors	Not Significant -Adverse
Atmospheric – Air Quality Combustion gases (NOx, SOx, CO, H_2S)	Emissions from construction equipment	Contribution to degradation of air quality	• Institute anti-idling policy • Maintain equipment	• Negligible with standard mitigation applied. • Indirect, Reversible • Magnitude - negligible • Duration – short-term • Geographic extent – local to construction area, transient • Context – existing and proposed buffers from receptors	Not Significant -Adverse
Atmospheric - Climate (GHG Emissions by vehicles)	Operation of construction machinery in all activities and transport vehicles	Contribution to degradation of air quality	• Institute anti-idling policy • Maintain equipment	• Negligible. • Indirect, Irreversible • Magnitude - negligible • Duration – short-term • Geographic extent - regional • Context - global atmosphere	Not Significant -Adverse
Operation and Maintenance					
Atmospheric – Air Quality Combustion gases (NOx, SOx, CO, H_2S)	Emissions from transport vehicles	Contribution to degradation of air quality	• Institute anti-idling policy • Maintain equipment	• Negligible with standard mitigation applied. • Indirect, Reversible • Magnitude - negligible • Duration – short-term • Geographic extent – local to construction area • Context – existing and proposed buffers from receptors	Not Significant -Adverse
Atmospheric - Air Quality Point and Fugitive Emissions (H_2S/odour)	Fugitive emissions from ETF and power boiler	• Nuisance effect • Potential for perception by nearby receptors at times	• Continuous solids removal from clarifiers • Subsurface air injection • Indirect effluent cooling	• Negligible with standard mitigation applied. • Indirect, Reversible • Magnitude - negligible • Duration – short-term • Geographic extent - site-specific • Context – infrequent, nuisance effect	Not Significant - Adverse

VEC	Activities	Potential Effects	Mitigative Measure	Residual Effect	Significance of Residual Effect
Atmospheric – Climate (GHG Emissions by vehicles)	Operation of facilities in all activities and transport vehicles	Contribution to degradation of air quality	• Institute anti-idling policy • Maintain equipment	• Negligible. • Indirect, Irreversible • Magnitude - negligible • Duration – long-term • Geographic extent - regional • Context - global atmosphere	Not Significant -Adverse

The effects of construction on ambient air quality due to fugitive dust and emissions from equipment are expected to be very localized and minimal using standard and site specific mitigation as identified. Appropriate mitigative measures will be taken when required to ensure nuisance dust levels are controlled. It is unlikely that emissions will exceed Nova Scotia or federal air quality ambient air quality objectives.

GHGs for the future operating scenario are not anticipated to be materially different from the existing facility emissions, with the overall change being immaterial in the context of regional emissions. Emissions of the regulated air contaminants are predicted to be below the provincial maximum permissible GLCs (Stantec 2019).

In consideration of the above, and in light of the proposed mitigation, the residual environmental effects of the project on the atmospheric environment during all phase of the project are rated not significant, with a high level of confidence.

8.1.5 Follow-up and Monitoring

Follow up and monitoring using the mill's current regulated source emission testing program will verify the environmental effects predictions and the effectiveness of mitigation. The facility currently undergoes a source emissions testing program, which will continue as per the Industrial Approval. Pulp and paper mill sludges are considered, in most jurisdictions, a standard fuel with no requirements for additional monitoring outside of the source emissions testing program.

The existing ambient air monitoring program is expected to continue during future operation and will collect data on the concentration of the various air contaminants over time for comparison to the Nova Scotia *Air Quality Regulations* Maximum GLCs and the model predictions conducted for the project.

8.2 Acoustic Environment

The acoustic environment focuses on ambient noise within the study area, both natural and man-made. It is identified as a VEC as specific noise levels are regulated, and noise levels may be of concern in relation to human health, socioeconomic values, and in relation to potential disturbance of ecological functions.

The following section is an overview of the existing environment as it pertains to the acoustic environment, an evaluation of potential impacts as a result of the project and an environmental effects assessment, the significance of potential environmental effects, and a plan for follow-up and monitoring throughout the duration of the project.

8.2.1 Scope of VEC

Potential changes to the acoustic environment may affect humans or wildlife. Components considered under this VEC are sound pressure levels. Human influenced noise is typically evaluated based on the NSE noise guidelines, as noted below.

NSE has established the following noise guidelines for Nova Scotia entitled "Guidelines for Environmental Noise Measurement and Assessment" (NSE 1990):
- 65 A-weighted decibels (dBA) from 7 am to 7 pm (Days);
- 60 dBA from 7 pm to 11 pm (Evenings); and
- 55 dBA from 11 pm to 7 am (Nights).

8.2.1.1 Boundaries

Spatial boundaries for the acoustic environment reflect the nearest potential receptors. The spatial boundaries for the assessment environmental effects of the project on the acoustic environment include the following:
- The **project footprint area (PFA)** is defined as the maximum extent of the physical area of disturbance associated with the project. The PFA will include all temporary and permanent areas of ground and marine disturbance. The PFA is defined in **Section 5.1.1**.
- The local assessment area is defined as the maximum anticipated area within which project-related environmental effects are expected. For the acoustic environment, the local assessment area includes the project footprint area plus a 1 km radius surrounding the new ETF as well as 1 km on each side of the overland pipeline, beyond which noise levels from the project would not likely be distinguishable from background levels. The LAA can be thought of as the "zone of influence" of the project.

Temporal boundaries for the assessment of environmental effects are based on the project schedule described in **Section 5.4** and include periods of construction, operation and maintenance, and decommissioning. Construction is estimated to be approximately 21 months, beginning second quarter of 2019, commencing as soon as the EA review has been completed and the applicable permits, approvals or other forms of authorization have been obtained. Operation and maintenance will commence immediately following the construction phase and will continue to operate efficiently and safely for several decades and likely much longer with a well-maintained system. For the purpose of this EA Registration, it has been assumed that the operation and maintenance phase will begin in the fourth quarter of 2020. Decommissioning of the project would occur at the end of mill life following the completion of operations. Once the ETF or pipeline is nearing the end of a useful service life, a decommissioning plan will be developed and will be submitted for a separate review requiring NSE approval.

8.2.1.2 Significance Criteria

A significant adverse residual environmental effects on the acoustic environment is defined as one where the project-related emissions of noise (as determined through noise modelling) results in a prolonged exceedance of the NSE noise guidelines identified in **Section 8.2.1** above, or a prolonged increase in ambient noise levels of 10 dBA above existing background levels at a sensitive receptor. For the purpose of this threshold, “prolonged” is defined as a continuous period of 24 hours.

8.2.2 Existing Environment

The NPNS facility is located in Abercrombie Point, Pictou County, Nova Scotia. The proposed project extends from Abercrombie Point, along Highway 106 to the outfall location in the marine environment located northeast of Caribou Point.

The emission of sound waves from natural and manmade sources, their propagation through the atmosphere, and their detection through auditory or other means at a noise sensitive receptor in the ambient environment characterizes sound quality. Sound pressure level in units of dBA is the typical measure of sound. The A-weighting scale is the most commonly used scale for expressing the perception of audible noise by humans.

8.2.2.1 Baseline Sound Monitoring

In order to establish sound levels in the existing acoustic environment in the areas surrounding the NPNS mill, a baseline sound monitoring program was completed. The baseline sound monitoring consisted of at least 72 hours of continuous sound monitoring at four discrete noise receptor locations identified in **Figure 8.1-1** in **Section 8.1**. Four discrete receptor locations were selected roughly to the north, south, east and west of the NPNS facility.

The baseline sound monitoring was completed using four calibrated RION Type II sound level meters, each being equipped with windscreen and datalogger. The baseline sound monitoring was completed between December 15 and December 19, 2017. The baseline measurements commenced on a Friday evening at three locations and on a Saturday morning at the fourth location, and concluded on a Tuesday morning in order to encompass periods of time when background sounds are typically relatively lower (i.e., weekends). The baseline monitoring was paused for two periods of time due to air temperatures falling below the equipment limitations of -10°C. The pausing of the measurements occurred during the evening of December 16, 2017 until the early morning of December 17, 2017 and again during the evening of December 17, 2017 until the morning of December 18, 2017.

The A-weighted maximum, minimum, and mean hourly equivalent sound levels (1-hour Leq) for daytime (7 am – 7 pm), evening (7 pm – 11 pm), and nighttime (11 pm – 7 am) are presented in **Table 8.2-1**. Also included in this table are the 90th percentile sound levels (i.e., Lp90, which indicates that 90% of the time, the baseline noise levels are at or below this level).

Table 8.2-1 Baseline Sound Monitoring Results, December 15-19, 2017

Receptor ID	Receptor Description	Receptor Address	Maximum Hourly Leq (dBA)	Minimum Hourly Leq (dBA)	Geometric Mean Leq (dBA)	Lp90 (dBA)
Daytime (7 am – 7 pm)						
R1	Maritime Odd Fellows Home - Single Story Residential	143 Norway Point Road, Pictou, NS	61.7	40.9	49.5	43.8
R2	Single Story Residential	12 Birch Lane, Pictou Landing, NS	57.7	37.5	47.0	43.4
R3	Two Story Residential	1220 Loch Broom Loop, Loch Broom, NS	47.8	28.3	39.4	33.4
R4	Two Story Residential	108 Granton Abercrombie Branch Road, Pictou, NS	58.3	39.0	47.2	42.4
Evening (7 pm – 11 pm)						
R1	Maritime Odd Fellows Home - Single Story Residential	143 Norway Point Road, Pictou, NS	52.7	41.9	47.2	40.5
R2	Single Story Residential	12 Birch Lane, Pictou Landing, NS	61.4	41.9	50.0	46.2
R3	Two Story Residential	1220 Loch Broom Loop, Loch Broom, NS	48.6	25.5	36.1	31.6
R4	Two Story Residential	108 Granton Abercrombie Branch Road, Pictou, NS	53.0	37.1	46.0	41.8
Nighttime (11 pm – 7 am)						
R1	Maritime Odd Fellows Home - Single Story Residential	143 Norway Point Road, Pictou, NS	51.8	36.7	45.1	37.1
R2	Single Story Residential	12 Birch Lane, Pictou Landing, NS	60.1	34.6	45.5	42.1
R3	Two Story Residential	1220 Loch Broom Loop, Loch Broom, NS	47.0	22.6	37.9	32.0

Receptor ID	Receptor Description	Receptor Address	Maximum Hourly Leq (dBA)	Minimum Hourly Leq (dBA)	Geometric Mean Leq (dBA)	Lp90 (dBA)
R4	Two Story Residential	108 Granton Abercrombie Branch Road, Pictou, NS	52.5	32.8	44.9	41.0

The locations of each of the four receptor discrete locations are illustrated in **Figure 8.1-1** in **Section 8.1.**

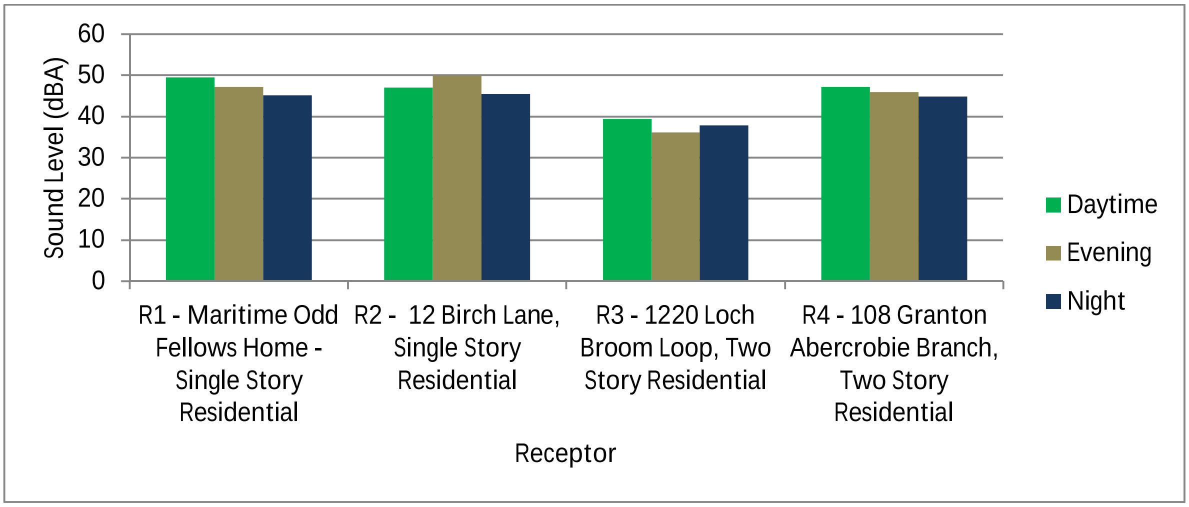
Receptor R1 is located in the Town of Pictou, across Pictou Harbour from the NPNS mill and is a 47 bed continuing care facility. At the time of the baseline sound monitoring, the dominant sound sources at R1 included breaking waves, rustling of trees, and a low frequency hum from the NPNS mill.

The second receptor, R2, is located in Pictou Landing across the East River and is a small single story residential building. The dominant sound sources at R2 were operational noise from the NPNS mill and waves breaking along the shoreline.

Receptor R3 is a two story residence located to the west of the NPNS mill across the Highway 106 causeway. The predominant sound source audible at R3 is the rustling of the trees; however, some sounds from the NPNS mill can be heard at R3. In addition, R3 is located along a rural road with minimal traffic.

Receptor R4 is located approximately 750 m to the southwest from the NPNS mill. Dominant sound levels at R4 include traffic noises from Abercrombie Branch Road and operational sounds from the NPNS mill.

The average A-weighted maximum, minimum, and mean hourly sound level equivalents (Leq) for daytime (7 am – 7 pm), evening (7 pm – 11 pm), and nighttime (11 pm – 7 am) for the four baseline noise measurement locations was assessed. The average Leq calculated during the baseline sound measurement for the four receptors are below the NSE noise guidelines, as presented in **Graph 8.2-1**. Hourly results of the baseline sound measurements and hourly weather data are provided in **Appendix L** for the four receptors.



Graph 8.2-1: Average Baseline Hourly Equivalent Sound Level (Leq) for Daytime, Evening and Night at the four receptors where baseline sound monitoring was completed.

The baseline sound monitoring results are indicative of normal suburban residential areas (USEPA 1971).

8.2.3 Impact Evaluation/Effects Assessment

The environmental effects of the project on the acoustic environment are assessed in this section.

8.2.3.1 Potential Environmental Effects

Without mitigation, the project could produce changes in the acoustic environment at nearby residential receptors as follows:

- Noise emissions from the NPNS mill due to construction activities associated with the replacement ETF and the transportation of materials to and from the NPNS project;
- Noise emissions during the construction of the overland portion of the pipeline along Highway 106 due to construction activities; and
- Noise emissions from the operations of the replacement ETF.

The current sound levels relating to the sound level monitoring conducted in December 2017 are considered as the baseline scenario and representative of existing environmental conditions. Potential noise effects from the future operation of the pipeline and the marine outfall were considered negligible as they will be buried infrastructure and there is no active source of noise associated with the conveyance or release of effluent via the pipeline. Effects to the acoustic environment from the pipeline during operation and maintenance are therefore not considered further.

8.2.3.2 Mitigation

The following mitigation measures will be used to control nuisance noise during construction:

- Utilization of construction scheduling restrictions, where possible (or alternative mitigation implemented), to ensure construction activities with elevated noise emissions occur during the day;

- Vehicles and equipment shall be maintained in good working order with quality mufflers;
- Requirements will be in tenders clauses that assure minimization of noise;
- Regular discussions will be conducted with workers and contractors on noise minimization practices;
- Timing windows, as identified in **Section 8.10**, in relation to migratory bird sensitivities;
- NPNS will ensure drivers know the designated vehicle routes, parking locations, idling policy, normal delivery hours and use of engine brakes policy; and
- Use of current NPNS communication procedures, via telephone or email, to communicate with local residents who have questions or concerns related to project noise.

Mitigation measures for minimizing noise during the operation of the replacement ETF will include following manufacturer's specifications and operating instructions during operation and maintenance. Following the operating instructions will minimize nuisance noise issues.

8.2.3.3 Characterization of Residual Environmental Effects

Residual effects following the application of mitigation are assessed below for the construction phase and operation and maintenance phase.

Construction Phase

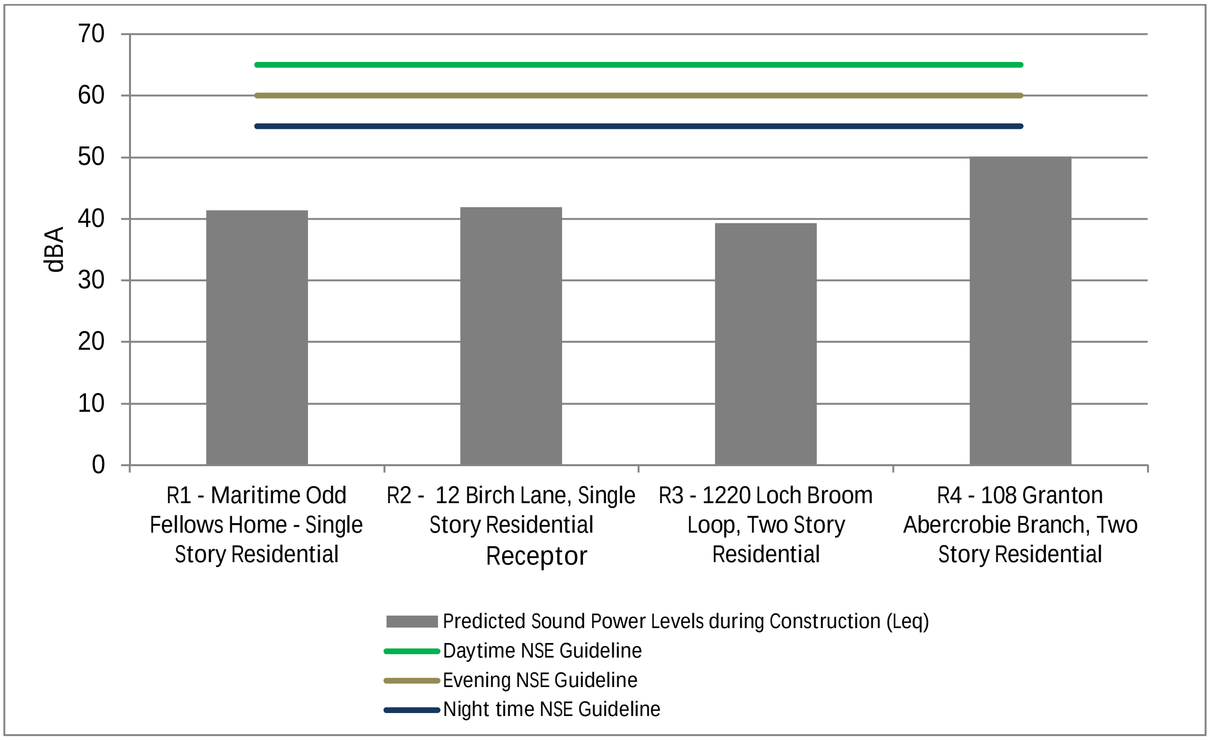
Construction related activities have the potential to result in noise emissions with potential disturbance effects for humans. During the construction of the replacement ETF, sound emissions are expected to be primarily related to operation of heavy equipment and related construction activities. Given that the replacement ETF will be constructed on an existing, mature operating pulp mill that has existed at this location for several decades, and given the project site's relative distance to the nearest residential receptor (approximately 750m), the potential for construction-related sound emissions to adversely affect residential receptors is expected to be minimal. Even though the potential sound emissions from construction activities are expected to be minimal, acoustic modelling of the potential sound emissions and their associated levels at the four discrete residential receptors was undertaken. Modelling was conducted for both the construction of the replacement ETF at the NPNS mill as well as for the construction activities associated with the overland portion of the effluent pipeline leading to the marine environment.

The United States Department of Transportation, Federal Highway Administration Roadway Construction Noise Model (RCNM) (FHWA 2006) was used to predict the construction noise. While the model was initially designed to predict the change in sound levels from the construction of highways, it has been used throughout Canada and the United States on a wide variety of construction sites. Preliminary construction information indicates that excavators, cranes, loaders, dozers, concrete mixing trucks, concrete pump trucks, dump trucks, and a variety of other construction equipment will be used. A list of anticipated construction equipment, and the measured sound pressure levels (FHWA 2006) associated with them, is provided in **Table 8.2-2**

Table 8.2-2: Typical Construction Equipment Sound Pressure Levels (FWHA 2006)

Description	Actual Maximum (Lmax, dBA measured at 15 m from the equipment)	Assumed Number of Each Type of Equipment Used During Construction
Dump Truck	76.5	4
Excavator	80.7	2
Backhoe	77.6	1
Concrete Mixer Truck	78.8	2
Concrete Pump Truck	81.4	1
Crane	80.6	1
Front End Loader	79.1	1
Pickup Truck	75	1
Dozer	81.7	1
Compactor (ground)	83.2	1

The RCNM was used to predict the Leq and Lmax at the four discrete receptor locations. The number and types of each equipment operating at a time were presented above. During the modelling, the equipment operating was assumed to be operating 24 hours a day, seven days a week, and thus the results are conservative as much of the construction will be carried out during the daytime. The predicted construction sound pressure levels for each time period (day, evening, and night) at each discrete receptor location are presented in **Graph 8.2-2**.



Graph 8.2-2: Predicted Sound Levels for each Discrete Receptor during Construction of the new ETF, compared to NSE Guidelines.

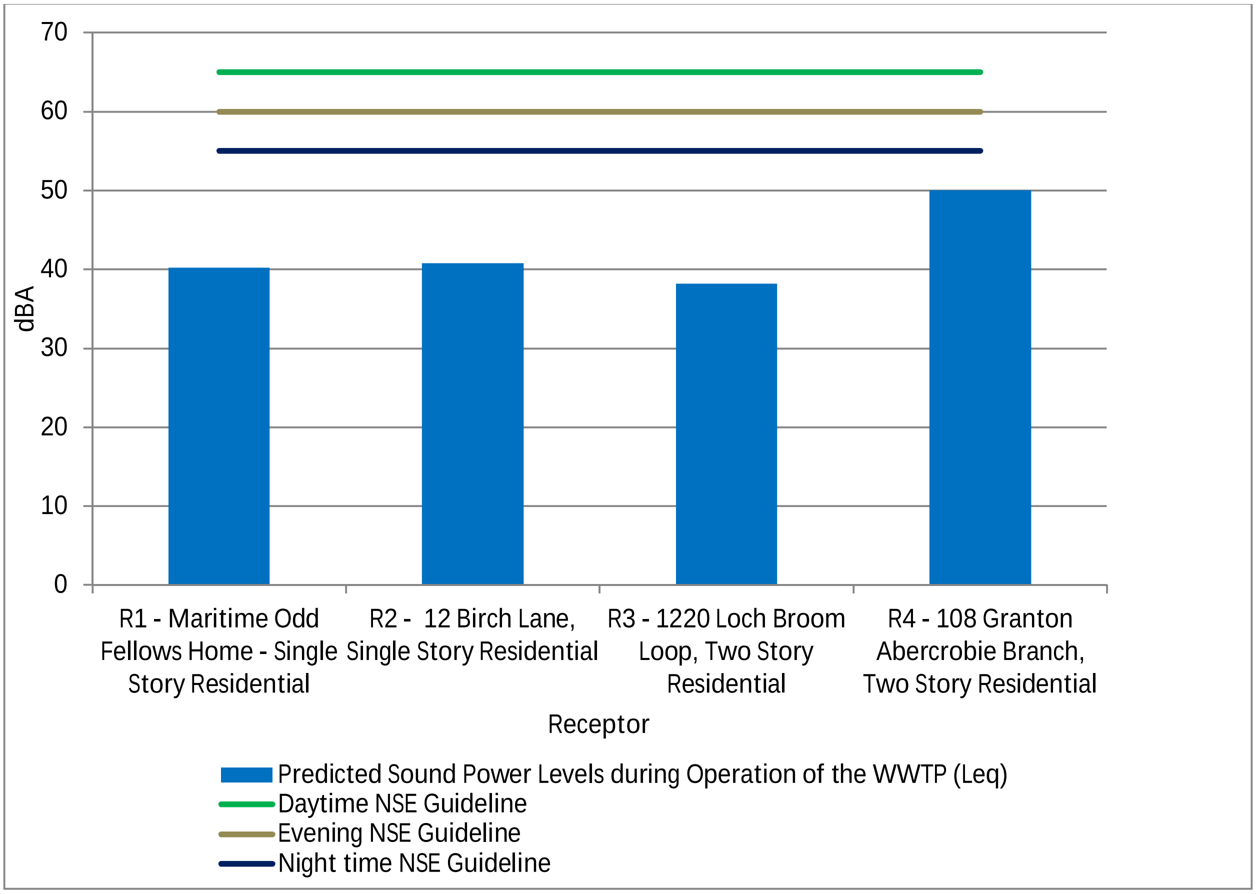
It is observed that the predicted construction sound levels of the replacement ETF will not exceed the NSE guidelines at any of the four receptors.

During the construction of the overland portion of the pipeline, sound emissions are expected to be primarily related to operation of heavy equipment for installation of the pipeline in the shoulder of the Highway 106. The closest residential receptor to Highway 106 is approximately 300 m away from the road. Using the RCNM, the predicted noise level during the construction of the pipeline is not expected to exceed 57.2 dBA. Given that construction is not expected to take place during the evenings or at night, the predicted noise levels from the construction of the pipeline are not expected to exceed the NSE guidelines. It is acknowledged that for traffic reasons the pipeline construction may occur at night. If this option is chosen, appropriate mitigation measures will be implemented.

Operation and Maintenance Phase

Noise modelling was conducted during the operation and maintenance phase for the operation of the replacement ETF only, since the presence of the pipeline itself or the associated marine outfall are not expected to result in noise emissions. Noise modelling was conducted in much the same manner as during construction, using the USEPA's RCNM (FHWA 2006). Operation of the replacement ETF was assumed to occur 24-hours per day, and as such noise modelling was conducted assuming continuous operation.

During the operation of the proposed replacement ETF, sound emissions are expected to predominantly occur from the aeration blowers. The replacement ETF will have three blowers that have maximum noise emissions of 85 dBA each. Using the same equations and modelling methods in the RCNM, the predicted Leq and Lmax levels at the same four discrete receptor locations were predicted and presented in **Graph 8.2-3**. The three blowers will be constructed in an enclosed and insulated building that will incorporate noise reducing measures for the intakes for the blowers; therefore, a 10 dBA shielding was included in the modelling.



Graph 8.2-3: Predicted Sound Levels for each Discrete Receptor during Operation and Maintenance of the new ETF, compared to NSE Guidelines.

The predicted noise levels from the operation of the replacement ETF are not expected to exceed the NSE Guidelines during the day, evening, or night at any of the four discrete receptor locations where baseline noise monitoring was conducted.

8.2.4 Summary

Table 8.2-3 provides a summary of the residual environmental effects analysis for the acoustic environment.

Table 8.2-3: Summary of Residual Environmental Effects to the Acoustic Environment

Project Activities	Potential Effects	Mitigation	Residual Effect	Significance of Residual Effects
Construction Phase				
Operation of construction machinery in all activities (new replacement ETF and overland portion of the effluent pipeline)	Noise at nuisance levels to local residences/businesses	• Utilize construction scheduling restrictions when possible to ensure noise from construction activities does not occur during nighttime; • Vehicles and equipment shall be maintained in good working order with quality mufflers; • Ensure workers have adequate hearing protection; • Include requirements in tenders clauses that assure minimization of noise; • Have regular discussions with workers and contractors on noise minimization practices; • Timing windows in relation to migratory bird sensitivities (see **Section 8.10**). • Ensure drivers know the designated vehicle routes, parking locations, idling policy, normal delivery hours and use of engine brakes policy; and • Use of current NPNS communication procedures, via telephone or email to communicate regarding concerns related to project noise.	Negligible with mitigation applied. Indirect, Reversible Magnitude - negligible Frequency - continuous Duration – short-term Geographic extent – local to construction area Context – existing and proposed buffers from receptors	Not Significant - Adverse
Operation and Maintenance				
Operation of the replacement ETF.	Noise at nuisance levels to local residences/businesses	• Follow manufacturer's specifications and operating instructions when operating the facility	Negligible. Indirect, Reversible Magnitude - negligible Frequency - continuous Duration – short-term Geographic extent - site-specific Reversibility – reversible Ecological/socioeconomic Context - Within previously disturbed subject property	Not Significant - Adverse

During the construction of the new replacement ETF, sources of noise are expected to be primarily related to operation of heavy equipment and related construction activities. Construction related activities have the potential to result in changes in local noise levels due to the operation of construction equipment. Noise levels associated with construction activities are expected to be fairly localized, short-term, and reversible.

Given that the ETF will be constructed on an operating pulp mill and given the project site's relative distance to the nearest residential receptor (approximately 750 m), the potential for construction-related noise emissions to adversely affect nearby receptors is expected to minimal.

Noise emissions from construction equipment associated with the construction of the new pipeline will be highly localized, temporary and transient and are not expected to adversely affect nearby receptors.

The predicted noise levels from the operation of the replacement ETF are not expected to exceed the NSE Noise Guidelines during the day, evening, or night at any of the four discrete receptors where baseline noise monitoring was conducted.

In summary, in consideration of the nature of the project, its anticipated environmental effects, the existing developed nature of the area, and proposed mitigation, the residual environmental effects of the project on the acoustic environment during all phases of the project are rated not significant, with a high level of confidence.

8.2.5 Follow-up and Monitoring

There is no follow-up proposed to verify the effects predictions or the effectiveness of mitigation. However, periodic noise monitoring may be conducted as spot-checks to ensure compliance with noise guideline levels and/or in response to noise complaints.

NPNS will continue to use their communication procedures, via telephone or email, to communicate with local residents who have questions or concerns related to the facility.

8.3 Soils and Geology

Bedrock geology, surficial geology, and soils are the components of the environment that encompass the Earth's surface. These components were chosen as a VEC in relation to their contribution to environmental quality. Release of contaminants from (and in the case of soils, from and to) these components has the potential to affect other VECs such as surface water quality or aquatic habitat.

The following section is an overview of the existing environment as it pertains to this VEC, an evaluation of potential impacts as a result of the project and an effects assessment, the significance of a potential impacts, and a plan for follow-up and monitoring (as applicable) for the duration of the project.

8.3.1 Scope of VEC

Consideration of effects to the bedrock geology, surficial geology, and soils VEC focuses on determination of the project in relation to release of contaminants including suspended solids and encountering bedrock which may generate acid rock drainage (ARD), as well as considering potential for karst topography that may affect project safety. Marine sediments are considered separately in **Section 8.11**.

Key regulatory drivers are related to surface water and groundwater quality as outlined in **Sections 8.4** and **8.5**, respectively. Additionally the Nova Scotia *Environment Act* regulates disposal of acid producing rock through the *Sulphide Bearing Material Disposal Regulation*.

8.3.1.1 Boundaries

The spatial boundaries of the study in regards to potential effects related to bedrock and surficial geology and soils are defined by the footprint of project activities. **Figure 1.1-1** (in **Section 1**) represents the potential ultimate "disturbed" area. The spatial boundaries for the bedrock geology, surficial geology, and soils VEC include the following:

- The project footprint area (PFA) is defined as the maximum extent of the physical area of disturbance associated with the project. The PFA will include all temporary and permanent areas of ground and marine disturbance. The PFA is defined in **Section 5.1.1**.
- The local assessment area is the maximum area within which environmental effects from the project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence (i.e., the potential zone of influence of the project's indirect effects, such as noise on the wildlife VEC). For the bedrock geology, surficial geology, and soils VEC, the local assessment area is limited to the project footprint area as the zone of influence of the project on this VEC is limited to the area of physical disturbance for the project.

Temporal boundaries for the assessment of environmental effects are based on the project schedule described in **Section 5.4** and include periods of construction, operation and maintenance, and decommissioning. Construction is estimated to be approximately 21 months, beginning second quarter of 2019, commencing as soon as the EA review has been completed and the applicable permits, approvals or other forms of authorization have been obtained. Operation and maintenance will commence immediately following the construction phase and will continue to operate efficiently and safely for several decades and likely much longer with a well-maintained system. For the purpose of this EA Registration, it has been assumed that the operation and maintenance phase will begin in the fourth quarter of 2020. Decommissioning of the project would occur at the end of mill life following the completion of operations. Once the ETF or pipeline is nearing the end of a useful service life, a decommissioning plan will be developed and will be submitted for a separate review requiring NSE approval.

8.3.1.2 Significance Criteria

A significant adverse effect on bedrock geology, surficial geology, and soils is one that affects this VEC such that the regulatory criteria are not met (e.g. *Canadian Soil Quality Guidelines*, or *Sulphide Bearing Material Disposal Regulation*). Effects related to water or surface water quality and associated habitats are considered under **Sections 8.4**, **8.5** and **8.6**.

8.3.2 Existing Environment

Existing environment data for soils and bedrock is summarized below based on existing available datasets. **Figure 8.3-1** illustrates bedrock and surficial geological features.

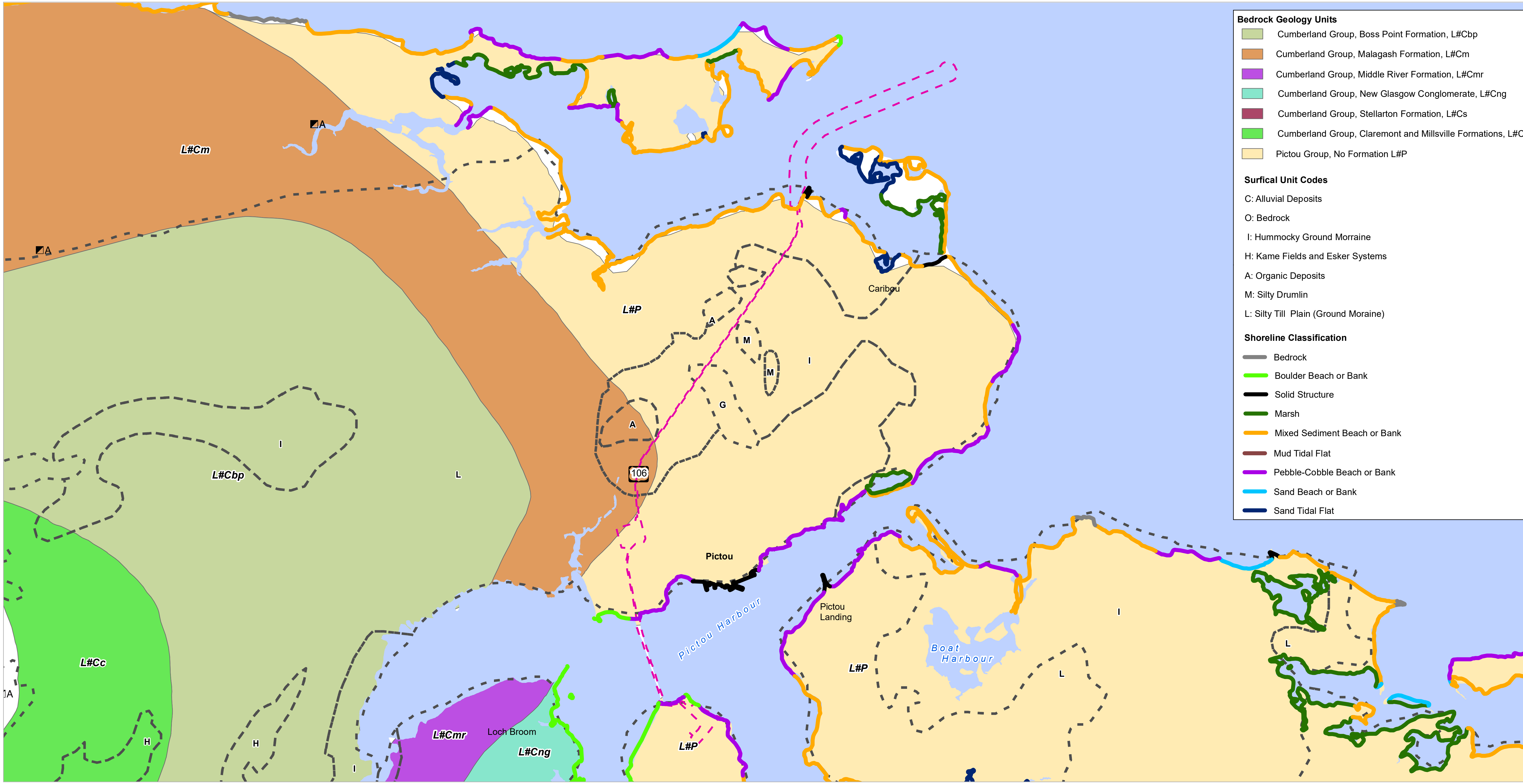
Soils

Soils at the ETF site and throughout much of the pipeline alignment are described as Pugwash Association, a moderately well drained to imperfectly drained sandy loam to loam over compact reddish brown sandy loam to loam till derived from Carboniferous sandstone. This Association is generally characterized as having good surface drainage with higher than average permeability. Additional soil units encountered along the pipeline route include:

- The Castely soil unit, a very poorly drained organic soil consisting of partially decomposed organic matter with depth of 40-60 cm;
- A Stewiacke Association soil unit characterized as a silt loam to silty clay loam over sandy loam that exhibits very poor drainage and depths of 60-100 cm; and
- A Hebert Association soil unit described as gravelly loamy sand to gravelly loam over loose glaciofluvial sands and gravels that are usually stratified. The Herbert soil unit is a slightly stony, rapidly to well-drained soil with depth of 40-60 cm (Webb 1990).

Surficial Geology

The surficial geology underlying the ETF site and much of the pipeline alignment is a Silty Till Plain composed of ground moraine and streamlined drift deposited during the Wisconsinan glacial stage. The Nova Scotia Geoscience Atlas online interactive map (NSDNR website accessed 2018) describes the surficial unit as silty, compact, material derived from both local and distant sources, and the topography as flat to rolling with few surface boulders and till thick enough to mask bedrock undulations (i.e., thickness of 3-30 m).



Northern Pulp Nova Scotia Corporation

Replacement Effluent Treatment Facility
Environmental Assessment

Bedrock and Surficial Geology
Figure 8.3-1

NORTHERN PULP
NOVA SCOTIA CORPORATION
A PAPER EXCELLENCE COMPANY

Approximate Project Footprint Area*

Open Water

Surficial Geology Unit

A Abandoned Mine Shaft

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY Northern Pulp Nova Scotia, NSDNR, Environment and Climate Change Canada

MAP CREATED BY: SCM
MAP CHECKED BY: AB
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 0.5 1 2 km

*Precise Project Footprint to be determined following completion of detailed design

PROJECT: 17-6461

Date: 2019-01-30

Other surficial deposits underlying the pipeline alignment include a hummocky ground moraine unit between Division Road and approximately 100 m southwest of Three Brooks Road. This surficial unit is described as a mixture of gravel, sand and mud derived directly from glaciation. The topography of this unit is irregular and rough with local ridges and depressions or pits. The thickness of the till ranges from 2-25 m.

Based on site observations made by Dillon during previous assessments, the NPNS facility is blanketed by reddish brown silty, sandy, clay till. Till thickness varies from a thin veneer of less than one metre to a covering greater than 7 metres (Dillon 2012).

Bedrock Geology

According the Nova Scotia Geoscience Atlas online interactive map (NSDNR website accessed 2018), the PFA (i.e., the ETF site and the pipeline alignment) is underlain almost entirely by bedrock of the Late Carboniferous Pictou Group (undivided). The bedrock is composed of a sedimentary sequence of interbedded mudstone, siltstone, sandstone, conglomeritic sandstone and minor coal seals (Dillon 2012). The Pictou Group found in northern Nova Scotia extends (non-contiguously) from Merigomish Island to New Brunswick (Keppie 2000).

Along the pipeline route, Late Carboniferous Malagash Formation bedrock is encountered north of the Town of Pictou (in the area of Division Road W, where Highway 106 curves towards the northeast). This formation is generally described as a braided stream sandstone, mudstone, rare coal and lacustrine limestone (100-400 m thick).

A structural feature due to intermittent uplift of the highlands after the Acadian orogeny exists in this area known as the Scotsburn Anticline. The Scotsburn Anticline, for which folding presents the youngest rocks along the limb of the fold and oldest rocks at the core, is a northeast plunging structure (Gibb and McMullin 1980). Historical mapping (including Gibb and McMullin 1980) shows the hinge line reaching across Highway 106 and into the Pictou Group bedrock; however, the provincial mapping presented in **Figure 8.3-1** (which is based on 1:500,000 scale), does not show the same level of detail, with only a fault appearing west of the Claremont and Millsville Formations. The importance of this structural feature in relation to groundwater is that, since the layers of bedrock dip downwards along the limbs of the fold, then there is potential for a preferential pathway for groundwater migration along the bedrock layers. Similarly, the presence of a fault in the rock would also provide a preferential pathway for groundwater to follow the orientation of the fault, which may not necessarily be vertical.

8.3.3 Impact Evaluation/Effects Assessment

The environmental assessment for the bedrock geology, surficial geology, and soils VEC is provided below. Potential accidental effects or malfunctions are considered in **Section 10**.

8.3.3.1 Potential Environmental Effects

Key potential interactions between the project and bedrock geology, surficial geology, soils and sediments with the potential to result in adverse environmental effects include:

- Exposure of sulphide-rich rocks to oxidizing environments such as rainwater. Earthwork activities around sulphide-rich rocks can increase the rock's exposure and thus have acid generation potential;
- Exposure of karst. In areas where karst topography is a potential, earthwork activities around soluble rocks, such as limestone, dolomite and gypsum, can increase the rate of dissolution and therefore contribute to the generation of karst topography;
- Construction-related land disturbance resulting in erosion and leading to increased levels of TSS and turbidity in surface water; and
- Exposure of contaminated soils during excavation.

Based on the local geology described above, sulphide-rich rocks are not anticipated to be present and limestone may be present in the area of the Malagash Formation. No potential environmental effects to bedrock geology, surficial geology, and soils are expected during operation and maintenance of the project.

8.3.3.2 Mitigation

Mitigation measures to lessen environmental effects to bedrock geology, surficial geology, and soils are as follows.

ARD Potential - In Nova Scotia, ARD is most commonly associated with slate from the Halifax Formation of the Meguma Group and coal-bearing shales. As noted above, the bedrock underlying the project site contains minor coal amounts compared with the nearby Stellarton formation. Yeo (1988) describes the coal formations in Pictou County as having low sulphur content. Although bedrock with acid producing potential is not anticipated, if encountered NPNS would follow the guidance provided by ECCC and NSE with respect to acid rock, which is to avoid where possible, and if not possible, to cap the exposed acid rock with clay and/or bury/encapsulate ripped material.

Potential for fine materials susceptible to erosion - The predominant soil unit (Pugwash Association) is a sandy loam soil, which is less likely to be subject to erosion than silty clay soils due to its drainage properties.

Effects from sedimentation from soils and surficial material will be prevented or will be mitigated in accordance with the appropriate guidelines documented in the EPP and Erosion and Sediment Control Plan developed for the project.

Potential for Karst – Based on the local geology, there is low potential for karst topography. The Malagash Formation located north of the Highway 106 roundabout has potential for limestone. However, the proposed project pipeline in this area will be installed within the existing gravel fill roadbed material (i.e., no excavation of bedrock anticipated). Subsidence along Highway 106 has not been identified.

Potential for Contaminants – NPNS has a contingency plan for its operations. As part of construction planning a contingency plan will be developed specific to the proposed project including contingency for encountering contaminants. As pipeline construction is proposed for the predominately within the road shoulder in gravel fill (clean and imported), there is limited potential for encountering contaminants along the road portion of the pipeline route.

The ETF site will be located in an undeveloped area on the NPNS facility property. The former Canso Chemicals plant is located on the adjacent property south of the NPNS facility industrial site. This adjacent operation was discontinued in the 1990s, but continues to serve as a distribution facility for NaOH. Similar to the pipeline, there is limited potential for encountering contaminants; however, NPNS' contingency plan for encountering contaminated materials during construction will apply to the construction of the ETF as well.

Mitigation associated with potential for soil contaminants in groundwater is discussed further in **Section 8.5.** Soil from the excavation area at the ETF site will be tested and either used as fill at the facility or disposed of within an approved facility.

8.3.3.3 Characterization of Residual Environmental Effects

The following **Table 8.3-1**, summarizes the effects assessment for the bedrock geology, surficial geology, and soils VEC.

Construction Phase

Construction activities interacting with bedrock geology, surficial geology, soil, or sediments include clearing, grubbing and excavation of the ETF site and any required trenching or excavation for the pipeline. Mitigation includes standard Erosion and Sediment Control Plans and Contingency Planning for unexpected geological occurrences, both to be addressed by the EPP.

Operation and Maintenance Phase

No interactions between operations or maintenance activities specific to the project and geology and soil or sediments are anticipated. Pipeline maintenance activities are anticipated to be consistent with existing highway maintenance.

8.3.4 Summary

In summary, the residual environmental effects of the project on bedrock geology, surficial geology, and soils are summarized in **Table 8.3-1** below.

Table 8.3-1: Summary of Residual Environmental Effects to Bedrock Geology, Surficial Geology, and Soils

Project Activities	Potential Effects	Mitigative Factors and Measures	Residual Effect	Signif-icance of Residual Effects
Construction				
Clearing/grubbing, excavation in project footprint area	Potential acid drainage from ARD within local bedrock types. Sedimentation due to erodibility of soils based on surficial geology. Potential to encounter contaminated soil or sediment.	Underlying Pictou Group bedrock is not known to produce ARD. Bedrock may not be disturbed depending upon the results of geotechnical investigations. Soil types in the project area not considered highly erodible. Soil and sediment sampling will be conducted prior to excavation in terrestrial environment if potential contaminants are identified and appropriate mitigation meeting regulatory requirements implemented. Effects from sedimentation from both terrestrial and marine sediment will be prevented or will be mitigated in accordance with the appropriate guidelines documented in the EPP and Sediment and Erosion Control Plan developed for the project.	Low with standard mitigation applied. Indirect, Reversible Magnitude – negligible* Duration – short term to medium term (days to month) Frequency - once Geographic extent – local (PFA) Context – Low probability to encounter sulphide bearing bedrock, underlying soils not considered highly erodible, appropriate delineation and management of contaminated soil or sediment before clearing.	Not Significant - Adverse
Operation and Maintenance				
Maintenance activities	Potential adverse effects on bedrock, surficial geology or soils, most likely from maintenance activities involving ground disturbance	Operation activities are not expected to adversely affect bedrock geology, surficial geology, or soils.	Indirect, Reversible Magnitude - negligible Duration – short-term (structure maintenance period) Frequency – infrequent (maintenance as needed) Geographic extent - site-specific (PFA) Context - operations and maintenance activities are unlikely to involve soil or sediment disturbance, if excavation is required, standard erosion and sediment control measures will be employed	Not Significant - Adverse

*Magnitude: Negligible - within normal variability of baseline conditions

Provided the recommended mitigative measures are implemented, it is not anticipated that the project will result in significant adverse residual environmental effects on bedrock geology, surficial geology, or soils. There are no expected residual effects on geology, particularly ARD as acid producing rock is not found within the project area. In the unlikely event that acid producing rock is discovered through geotechnical investigations, these can be mitigated through appropriate techniques. As such, in consideration of the environmental setting and the mitigation to be employed, the residual environmental effects of the project on bedrock geology, surficial geology, and soils during all phases of the project are rated not significant, with a high level of confidence.

8.3.5 Follow-up and Monitoring

Geotechnical investigations have already been undertaken at the ETF site. Standard soils testing was completed for chlorides, sulphates and pH which all tested in normal anticipated ranges. Geotechnical investigations will be completed for the pipeline routing where deemed necessary, as an example, within the causeway portion of the pipeline and in conjunction with non-intrusive excavation (such as HDD) at wetlands or watercourses (if undertaken).

An EPP and Sediment and Erosion Control Plan will be completed prior to project commencement.

A contingency plan will be developed for the project and will specify that if acid rock, karst or contaminants are encountered, follow-up monitoring will be undertaken to meet regulatory requirements.

Soil stabilization practices and erosion control measures will be monitored and maintained until slopes have stabilized.

8.4 Surface Water

The surface water VEC consists of freshwater - wetlands, watercourses (both mapped and unmapped), water bodies, and surface water drainage channels, that are within the project's boundaries or within the local areas outside of the project's boundaries that may be potentially affected by the project (most often as indirect effects).

The surface water VEC is linked (either directly or indirectly) to other VECs such as wetlands, aquatic habitat, the marine environment, wildlife habitat, and the groundwater environment through many natural processes and linkages. Further information on VECs related to surface water is provided for groundwater in **Section 8.5**; for freshwater fish habitat in **Section 8.6**; wetlands in **Section 8.7**; and**,** for the marine environment in **Section 8.11**.

8.4.1 Scope of VEC

The surface water VEC is limited to the freshwater (and Pictou estuary at confluence of the East, Middle and West Rivers) environment. Surface water is evaluated within the context of water quality and quantity of relevance to potential receptors such as drinking water supply, freshwater aquatic life, and potential influence of drainage (including into the marine environment). Watercourses are defined under the Nova Scotia *Environment Act* as: "the bed and shore of every river, stream, lake, creek, pond, spring, lagoon or other natural body of water, and the water therein … whether it contains water or not, and all groundwater". Work within or alteration of watercourses or wetlands is regulated by NSE.

The following guidelines, standards, and regulatory requirements related to surface water may apply to the project:

- CCME Canadian Environmental Quality Guidelines (CCME 1999):
    - Canadian Water Quality (Human Health) Guidelines, Recreational Water Quality and Aesthetics, Canadian guidelines for the protection of freshwater aquatic life (FWAL) and marine aquatic life (MAL) uses;
- Canadian Drinking Water Quality Guidelines (2012);
- *Fisheries Act* - Deleterious Substance Provisions (Section 36);
- CEPA;
- Nova Scotia *Environment Act*;
- Nova Scotia Environment Erosion and Sedimentation Control Handbook for Construction Sites, 1988 and updates (NSE 1998); and
- NSTIR Standard Specifications (NSTIR 2011).

8.4.1.1 Boundaries

Spatial boundaries for the assessment of environmental effects on the surface water VEC include the following:

- The **project footprint area (PFA)** is defined as the maximum extent of the physical area of disturbance associated with the project. The PFA will include all temporary and permanent areas of ground and marine disturbance. The PFA is defined in **Section 5.1.1**. For the surface water VEC, two distinct footprint areas are assessed: the physical footprint of the replacement ETF (referred to as the ETF footprint area), an area comprising 20.8 ha of land within the NPNS property boundary; and the land-based portion of the pipeline footprint (referred to as the pipeline footprint area) which is based on proposed disturbance during construction of Highway 106 road shoulder and associated areas required to be cleared ancillary to construction. The estimated total area of potential temporarily disturbed area during construction is 66.6 ha; and
- The **local assessment area** is the maximum area within which environmental effects from the project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence (i.e., the potential zone of influence of the project's indirect effects on contiguous features, such as changes in surface water downstream of the project footprint). For the surface water VEC, the local assessment area is to include within 500 m downstream of the proposed project footprint and within 100 m upstream at each watercourse intersected.

Temporal boundaries for the assessment of environmental effects are based on the project schedule described in **Section 5.4** and include periods of construction, operation and maintenance, and decommissioning. Construction is estimated to be approximately 21 months, beginning second quarter of 2019, commencing as soon as the EA review has been completed and the applicable permits, approvals or other forms of authorization have been obtained. Operation and maintenance will commence immediately following the construction phase and will continue to operate efficiently and safely for several decades and likely much longer with a well-maintained system. For the purpose of this EA Registration, it has been assumed that the operation and maintenance phase will begin in the fourth quarter of 2020. Decommissioning of the project would occur at the end of mill life following the completion of operations. Once the ETF or pipeline is nearing the end of a useful service life, a decommissioning plan will be developed and will be submitted for a separate review requiring NSE approval.

8.4.1.2 Significance Criteria

A significant adverse residual environmental effect on surface water is defined as one that degrades water quality through long-term (beyond natural variability) project-related (above existing background range) exceedances of the Canadian Water Quality Guidelines based on watercourse specific use. As the watercourses within the project footprint are not identified as potable water sources, the key guidelines to be referenced are CCME FWAL guidelines.

8.4.2 Existing Environment

Watercourses within the local assessment area were initially identified based on 1:10,000 mapping, high resolution imagery, NSE "Wet Areas Mapping" (WAM), predicted flow accumulation (NSDNR, 2007) and available background literature. In addition, field investigation consisted of:

- Surface water evaluation at the ETF local assessment area – October 2017 and June 2018; and
- Reconnaissance of the potential pipeline crossings of wetlands and watercourses – December 3, 2018.

The proposed project is located within East/Middle/West Pictou (WDP/1DP) primary watershed of Nova Scotia (NSE 2018). Watercourses within this primary watershed ultimately drain to the Northumberland Strait of the Atlantic Ocean.

8.4.2.1 Summary of Watercourses

Preliminary analysis for the EARD identifies watercourses and/or water features (including wetlands) that potentially intersect with the PFA (i.e. the pipeline and ETF). **Figure 8.4-1** locates watercourses and wetlands in the vicinity of the ETF footprint area. **Figure 8.4-2** shows the identified watercourses and wetlands along the pipeline route. **Appendix M** contains photographs of the watercourses, field data and laboratory certificates. **Table 8.4-1,** below provides a summary of identified watercourses and wetlands observed intersecting with the PFA.

ETF Local Assessment and Footprint Area

The proposed ETF is situated on a peninsula which is bounded to the north and east and west by Pictou Harbour comprised of the estuary areas of the Middle and East Rivers. The tertiary watershed identifier for the Abercrombie Point area is 1DP-SD8 (Shore District8). The ETF footprint portion of the project will occupy a portion of the northeast side of the NPNS property. Sub-watersheds in encompassing the ETF footprint area and surrounding local assessment area are small, with stream length less than 1 km and direct discharge to the Pictou Harbour estuary. Surface water drainage in this area flows via two unnamed tributaries to the Pictou Harbour estuary (WC1 and WC2).

Table 8.4-1: List of Watercourses (WC) and Wetlands (WL) Intersecting the Project (south to north)

WC No.	WC Name	WL No. (see Section 8.7)	Assessment Location (UTM NAD 83)	Dominant WC Type*	Located within Project Footprint Area	WC immed-iately adjacent to Project Footprint Area	WL immed-iately adjacent to Project Footprint Area
WC1	Tributary to East River	-	20T 522408 E 5055593 N	Intermittent; ditched adjacent to project footprint area	No	N/A	N/A
WC2	Tributary to East River	WL-2	20T 522183 E 5055664 N	Small Permanent; intermittent in headwater	Yes	N/A	Yes
Ephemeral Site Drainage			20 T 521858 E 5055813 N	Not defined channels but surface water flow paths from parking area	Yes	N/A	N/A
WC3	Tributary to Pictou Harbour	-	20 T 521647 E 5055792 N	Ditched upstream of project footprint area;	Yes	N/A	N/A

WC No.	WC Name	WL No. (see Section 8.7)	Assessment Location (UTM NAD 83)	Dominant WC Type*	Located within Project Footprint Area	WC immed-iately adjacent to Project Footprint Area	WL immed-iately adjacent to Project Footprint Area
				within footprint intermittent to tidal connected with Pictou Harbour			
WC4	Pictou Harbour	WL-2, WL-3 WL-4	20 T 521325 E 5056680 N	Large Permanent (estuarine/marine)	No – pipeline in causeway	Yes	WL-2: Yes WL-3: Potentially WL-4: Potentially
WC5	Tributary to Pictou Harbour	WL-3	20 T 520999 E 5057441 N	Intermittent/ditch upstream; culvert under Highway 106 to wetland drainage	No – pipeline in road shoulder	Yes	Potentially
WC6	Tributary to Pictou Harbour	WL-4	20 T 521356 E 5057513 N	Intermittent; receives ditch drainage and WL-4 drainage	No – outside of project footprint area	No	No
WC7	Tributary to Haliburton Brook	WL-5 (A-D)	20 T 521069 E 5058792 N	Ephemeral to intermittent; drainage associated with roundabout	No – pipeline will go under round-about	Yes	Potentially
WC8	Tributary to Haliburton Brook	WL-5 (A-D)	20 T 520910 E 5059083 N	Intermittent upstream of Highway 106, wetland drainage downstream to defined channel downstream of Rte 6	No – pipeline in road shoulder	Yes	Potentially
WC9	Tributary to Haliburton Brook	WL-7	20 T 521246 E 5060240 N	Small Permanent	No – pipeline in road shoulder	Yes	Potentially
WC10	Tributary to Haliburton Brook	WL-8	20 T 521432 E 5060520 N	Intermittent; receives drainage from WL-8	No – pipeline in road shoulder	Yes	Potentially
WC11	Tributary to Haliburton Brook	WL-10, WL-9	20 T 521967 E 5061335 N	Small to Large Permanent (wetland channel, but low flow)	No – pipeline in road shoulder	Yes	Potentially
WC12	Mill Brook	WL-12A, WL-11	20 T 522336 E 5061869 N	Small (upstream) to Large Permanent (downstream wetland channel, but low flow)	No – pipeline in road shoulder	Yes	Potentially
WC13A	Tributary to Mill Brook	WL-12B, WL-13	20 T 522577 E 5062212 N	Intermittent upstream but large ponded wetland flow downstream	No – pipeline in road shoulder	Yes	Potentially
WC13B	Tributary to Mill Brook	WL-12B, WL-13	20 T 522817 E 5062564 N	Intermittent wetland drainage	No – pipeline in road shoulder	Yes	Potentially

WC No.	WC Name	WL No. (see Section 8.7)	Assessment Location (UTM NAD 83)	Dominant WC Type*	Located within Project Footprint Area	WC immed-iately adjacent to Project Footprint Area	WL immed-iately adjacent to Project Footprint Area
WC14	Tributary to Mill Brook	WL-17, WL-16, WL-15, WL-14	20 T 523323 E 5063285 N	Intermittent to permanent backwater flooding between wetlands	No – pipeline in road shoulder	Yes	Potentially
WC15	Tributary to Caribou Harbour	WL-18	20 T 523955 E 5064206 N	Intermittent potentially ditched	No – pipeline in road shoulder	Yes	Potentially
WC16	Tributary to Caribou Harbour	-	20 T 524076 E 5064837 N	Intermittent, steep	No – pipeline in road shoulder	Yes	Potentially

UTM = Universal Transverse Mercator; NAD = North American Database; WC = watercourse; WL = wetland
*Dominant watercourse type is either Large Permanent (> 5m wetted with), small permanent (<5m wetted width), intermittent streams cease flowing for weeks or months each year, and ephemeral channels (flow only for hours or days following rainfall/snow melt). For wetland type, see **Section 8.7**.

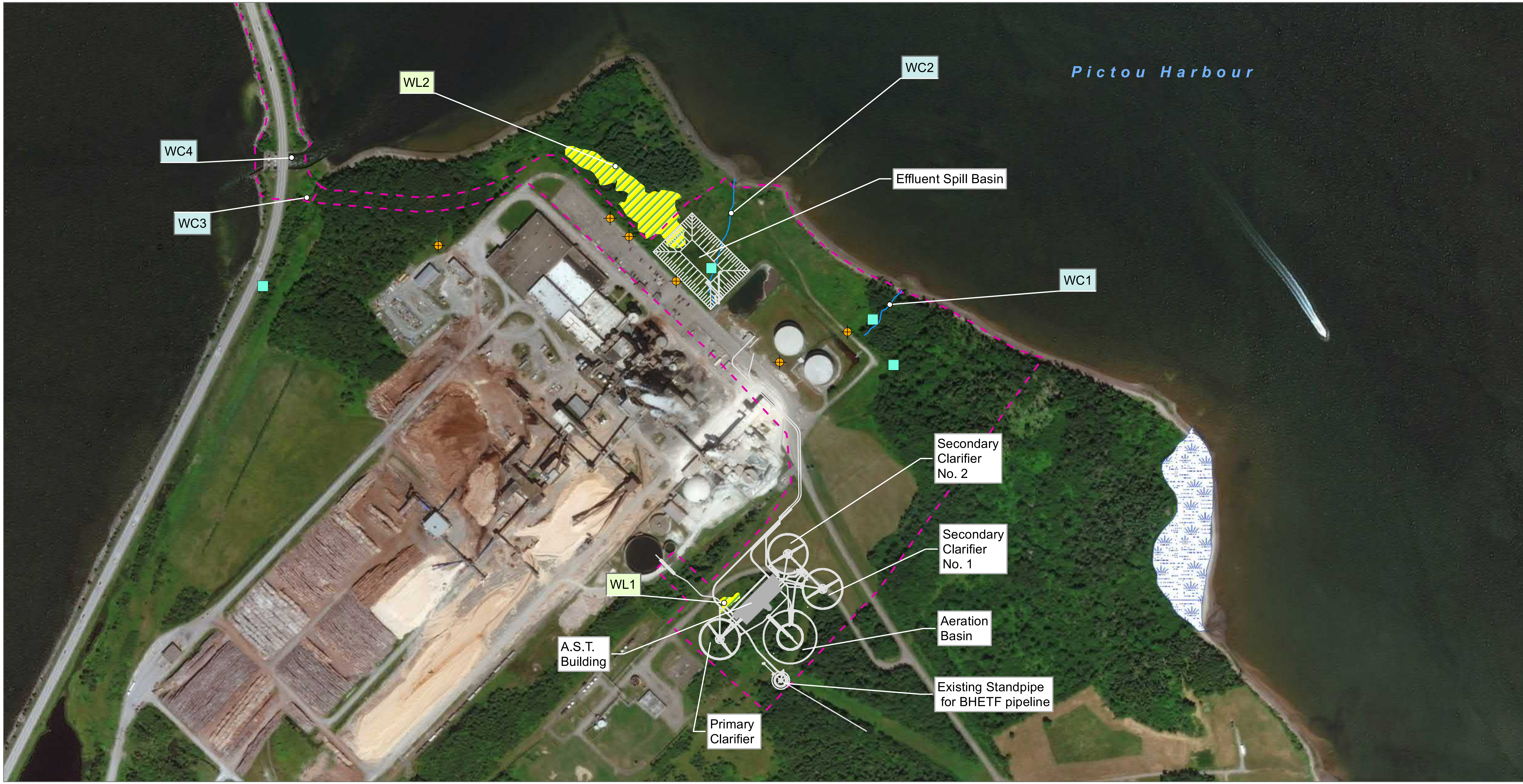
The proposed ETF footprint will interact directly with the watercourse WC2 and potentially with WC1 related to pipe staging area. Interactions with wetlands are discussed in **Section 8.7**.

<u>*Abercrombie Point sub-watershed (1DP-SD8)*</u>

- **WC1** - WC1 (referred to as East Brook in NPNS monitoring) is a small, seasonal drainage located on NPNS property. WC1 receives flow from road ditches, flow from forest to the east of the watercourse, and NPNS facility non-contact water. NPNS facility non-contact water discharges into WC1 ephemerally from a concrete culvert that daylights adjacent to the WC1 and from the southern perimeter of the NPNS property (via underground piping), including runoff from the adjacent Canso Chemicals property (via a natural spring); and
- **WC2** - primarily receives storm water drainage from the NPNS facility and parking area and outflow from a field-identified wetland (WL-2).

Pipeline Local Assessment Area

The proposed pipeline extends from the ETF facility along NPNS property to then cross the Pictou Harbour causeway, travel adjacent to Highway 106 to the Northumberland Ferries marine terminal, and discharge into the Northumberland Strait. This route crosses three tertiary surface water watersheds. On the Abercrombie Peninsula (from approximate chainage 0+000 to 1+100), the pipeline will be within the same tertiary watershed as the ETF footprint (1DP-SD8). The pipeline route then crosses the Pictou Harbour estuary at the confluence of the West, Middle, and East Middle Rivers. Subsequent to the Pictou Harbour estuary crossing, the project is located within two smaller watersheds: 1DP-SD3, which



Approximate Project Footprint Area*
Field Identified Wetland (October 2017)
Generalized Preliminary Project Layout
Watercourse
NPNS Surface Water Monitoring Location
Wetland (NS Topgraphic Database)
Groundwater Sample Location (Monitor Well)

0 50 100 200 Meters

*Precise Project Footprint to be determined following completion of detailed design

Northern Pulp Nova Scotia Corporation

Replacement Effluent Treatment Facility
Environmental Assessment

ETF Aquatic Features, Wetlands, and Sample Locations
Figure 8.4-1

NORTHERN PULP
NOVA SCOTIA CORPORATION
A PAPER EXCELLENCE COMPANY

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY Northern Pup Nova Scotia, NSDNR, GeoNova, NSDNR, ESRI

MAP CREATED BY: SCM
MAP CHECKED BY: AB
MAP PROJECTION: NAD 1983 UTM Zone 20N

PROJECT: 17-6461

Date: 2019-01-30

Northern PulpNova Scotia
Effluent Treatment System Replacement Project

Aquatic Features and Wetlands
Figure 8.4-2

	Approximate Project Footprint Area*		NSDNR Database Wetland	WL#	Wetland ID
	Roads		NS Topographic Database Wetland	WC#	Watercourse ID
	Watercourse		Tertiary Watersheds (NSE Watershed Dataset) (SD= Shore Drainage)		

MAP DRAWING INFORMATION:
DATA PROVIDED BY Northern Pup Nova Scotia, NSDNR, GeoNova, NSDNR, ESRI

MAP CREATED BY: SCM
MAP CHECKED BY: AB
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 500 1,000 2,000 Meters

*Precise Project Footprint to be determined following completion of detailed design

PROJECT: 17-6461

Date: 2019-01-30

extends along the southern and northern portion of the proposed pipeline (approximate chainage 2+750 to 4+000 and 7+500 to 11+500); and 1DP-SD4, within the central portion of the pipeline route (approximate chainage 4+000 to 7+500).

Abercrombie Peninsula sub-watershed (1DP-SD8)

From where the pipeline exits the NPNS property (approximate chainage 0+750) to where it exits the Abercrombie Peninsula via the Pictou Causeway (Highway 106) (approximate chainage 1+200), surface water drains directly to the East River estuary (i.e., WC1 and WC2, described above) and to the Pictou Harbour. Surface water drainage to the Pictou Harbour occurs ephemerally over steep forested banks along the north side of the NPNS property and via:

- **WC3** – This watercourse originates as a ditch along the east side of Highway 106 that drains into the Pictou Harbour to the southeast of the causeway channel. The ditched section of WC3 is likely ephemerally flowing. From the ditched section that is adjacent to Highway 106, the watercourse runs down slope towards the Pictou Harbour, collecting debris and suspended sediments and creates a defined channel. The drainage of WC3 to the Pictou Harbour appears to have intermittent flow and be tidally influenced with the potential for fish access during high tides and/or periods of high flow.

Pictou Harbour

From approximate chainage 2+750 to 4+000, surface water drains directly to the Pictou Harbour estuary via WC4:

- **WC4** – is the location of the pipeline crossing the Pictou Harbour along the Pictou Causeway where flow is channeled through an opening at the northern tip of Abercrombie point.

Southern 1DP-SD3 sub-watershed

On the southern portion of the Pictou mainland, drainage areas are small and watercourses are expected to be less than 1 km long.

- **WC5** - collects outflow from the west side of the PFA and flows southeast. WC5 crosses under Browns Point Road via culverts and flows through a ditch near Jitney Trail with eventual drainage through wetland 3 (WL-3) and into the Pictou Harbour estuary; and
- **WC6** - flows east of the PFA and is a potential outlet for wetland 4 (WL-4). WC6 receives inputs from a ditch along the Jitney trail, as well as drainage from the adjacent farm prior to passing under the Jitney Trail via a culvert and into the Pictou Harbour.

Central 1DP-SD4 sub-watershed

The central watershed is drained by Haliburton Brook. The Highway 106 and associated proposed PFA (approximate chainage ~4+000 to 7+500) are located within the middle portion of this subwatershed. Small tributaries (**WC7 to WC11**) extending less than 1 km upstream (east of Highway 106) drain farm areas and wetlands. Drainage occurs along Highway 106 through ditching and culverts in the direction of Haliburton Brook. The main Haliburton Brook is a moderate size watercourse that extends over 7 km to the west of the local assessment area. Over 600 m downstream of Highway 106, the Haliburton Brook and its tributaries join within a large stillwater run area. It is expected that tidal influence from the Pictou Harbour estuary area extends at least as far upstream as Route 6. Just over 1 km downstream of Route 6, Haliburton Brook crosses under Highway 376 and enter the Pictou Harbour estuary at the mouth of the West River.

Northern 1DP-SD3 sub-watershed

The northern portion of the proposed pipeline from approximate chainage 7+500 to 11+500 crosses the Mill Brook sub-watershed and small sub-watersheds with direct discharge to Caribou Harbour (Northumberland Strait). Two tributaries that flow to Mill Brook (i.e., **WC13, and WC14**), along with the Mill Brook (**WC12**), were field identified (December 2018) to cross the proposed pipeline route. Mill Brook tributaries extend 1 to 2 km upstream (to east) of Highway 106 and join Caribou Harbour over 2.5 km downstream (to west) of Highway 106. The majority of the watercourses identified in the field along the pipeline route are small channels that drain (from farms and wetlands) along or under Highway 106 via culverts. WC16 drains directly to Caribou Harbour and may receive some drainage from WC15.

8.4.2.2 Surface Water Quality

Water Quality at ETF Watercourses

The surface water data set for the ETF local assessment area consists of quarterly data collected between 2012 and 2017 (Dillon 2017). The NPNS Mill Monitoring Network, surface water monitoring includes sample collection from the three stations established in late 2012 in the northeast area of the ETF, all of which are on unnamed tributaries: one is considered up-gradient/upstream and two are down gradient/downstream of proposed ETF activities. An additional sample location is from the NPNS Industrial Landfill Network and occurs upstream of the intersection of the pipeline with WC3, along the east side ditch of Highway 106. The NPNS monitoring point (referred to for the EARD as WC3-upstream), is located approximately 75 m south (upstream) of the proposed pipeline route and approximately 100 m down-gradient of the landfill. Surface water data for the NPNS Industrial Landfill Network have been collected semi-annually to quarterly since the late 1990's. A description of surface water stations associated with the NPNS Mill Monitoring Network and the relevant NPNS Industrial Landfill Network are presented in **Table 8.4-2,** and shown on **Figure 8.4-1** (referenced previously).

Table 8.4-2: NPNS Surface Water Station Descriptions

Location in Relation to Project	Sampling Frequency	Description
Along tributary to WC1	Quarterly	Unnamed tributary referred to as East Brook; prior to Mill non-contact water discharge point*
Along WC1 downstream of project	Quarterly	Unnamed tributary referred to as East Brook; below Mill non-contact water discharge point*
WC2 Within proposed Spill Basin footprint	Quarterly	Unnamed tributary referred to as North Brook; receives water from the Mill car wash

Location in Relation to Project	Sampling Frequency	Description
Along WC3 – upstream of proposed pipeline	Quarterly	Highway 106 drainage ditch prior to discharge into Pictou Harbour. Receives drainage from north section of Landfill 1 and Highway 106.

Note:
* Mill non-contact water discharge point refers to a concrete culvert that daylights adjacent to the East Brook and contains water from the southern perimeter of the Mill property (via underground piping), including runoff from the adjacent Canso Chemicals property (via a natural spring).

These four locations have been sampled quarterly for general inorganic chemistry, metals, and TSS. Grab samples were collected following standard protocols from the NPNS stations along WC1 and WC2 on December 11, 2018 for general inorganic chemistry, TSS, and metals analysis by an accredited laboratory. Exceedances of the applicable CCME FWAL guidelines for iron occurred, which is typical for watercourses in this region given the local geology and acidic precipitation.

Water Quality Along the Pipeline Route

Surface water quality was assessed on December 3, 2018 through in-situ metered measurements for temperature, pH, conductivity, dissolved oxygen (DO), and flow. Water samples were collected in watercourses along the proposed route and analysed for basic parameters (general chemistry, metals, and total suspended solids - TSS). The water samples were taken as grabs following Dillon sampling protocols and analyzed by an accredited laboratory. **Appendix M** provides the analytical data. A summary of exceedances of the applicable CCME FWAL guidelines is provided in **Table 8.4-3**, below.

Analytical data for freshwater watercourses were compared to the applicable CCME WQG for Freshwater Aquatic Life (FWAL), and watercourses with a direct marine connection were additionally compared to the applicable CCME WQG for Marine Aquatic Life (MAL). As is typical for watercourses in the bedrock of the area, the pH for many watercourses is below the applicable CCME FWAL guideline of 6.5 to 9.0 units. As well, exceedances of FWAL guidelines for aluminum and iron occur, which is typical for watercourses in this region given the local geology and acidic precipitation. In addition, exceedances of cadmium, chromium, copper, lead and zinc were reported in the grab sample from WC3. The sample collected at the WC3 proposed pipeline location was observed to be influenced by tidal condition and from water from the “downstream” Pictou Harbour area. The field visit occurred subsequent to a rain event and melt and considerable turbidity was observed. The water sample had a high TSS (120 mg/L). The elevated metals within this sample were likely attributable to the TSS.

Exceedances of chloride, cadmium, lead, and zinc were reported above the applicable CCME FWAL guideline in one or more watercourses intersecting the PFA. In comparison to the applicable CCME WQG for marine watercourses, concentrations in exceedances of the cadmium were reported for watercourses WC3 and WC5 and chromium in WC3. The laboratory-reported pH for WC16 was below the recommended range for marine water, noting that the field-measured pH was within the recommended range.

Table 8.4-3: Summary of Water Chemistry for Watercourses Intersecting with the Project Footprint (CCME FWAL Guideline Exceedances in Bold)

	Units/ Date	CCME WQG Freshwater	CCME WQG Marine	WC1 upstream	WC1 down-tream	WC2	WC3 upstream	WC3 downstream	Ephemeral Site Drainage	WC5	WC6	WC7	WC08	WC09	WC10	WC11	WC12	WC13A	WC13B	WC14	WC15	WC16
				12-Dec-18	12-Dec-18	12-Dec-18	12-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18
Laboratory Results																						
Hardness (CaCO3)	mg/L	---	---	160	160	250	200	140	-	170	63	-	27	7.7	7.4	8.6	20	14	18	25	17	32
Nitrate (N)	mg/L	2.94	45.25	0.12	0.11	0.086	ND	0.058	-	0.22	0.11	-	0.11	<0.050	<0.050	<0.050	0.066	0.054	0.052	<0.050	0.052	0.073
Alkalinity	mg/L	---	---	110	110	280	210	130	-	110	41	-	20	<5.0	<5.0	<5.0	14	5.7	11	8.8	<5.0	16
Dissolved Chloride (Cl-)	mg/L	120	---	82	81	**200**	90	92	-	90	**140**	-	46	19	15	7.8	16	12	49	120	45	68
Colour	TCU	variable[e]	variable[e]	5.9	6.2	5.5	71	210	-	14	24	-	48	140	150	190	76	130	42	62	160	120
Nitrite (N)	mg/L	0.06	---	ND	ND	0.012	ND	<0.010	-	<0.010	<0.010	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Ammonia (N)	mg/L	variable[d]	---	0.13	0.072	ND	0.15	<0.050	-	<0.050	<0.050	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.057	<0.050	<0.050
pH	pH	6.5-9	7.0-8.7	7.79	7.91	7.94	7.52	7.42	-	7.63	7.44	-	7.03	**4.83**	**4.75**	**5.14**	6.56	**5.81**	6.69	**6.29**	**5.40**	6.82
Total Suspended Solids	mg/L	variable[f]	variable[f]	ND	ND	ND	3.8	120	-	6.8	4	-	3	2.4	<1.0	<1.0	<1.0	<2.0	2	1.2	3.5	6.4
Dissolved Sulphate (SO4)	mg/L	---	---	60	59	74	31	17	-	63	18	-	5.6	<2.0	<2.0	<2.0	<2.0	<2.0	4	9	<2.0	8.3
Turbidity	NTU	variable[g]	variable[g]	0.18	0.26	0.93	14	40	-	9.2	4.5	-	3.2	1.1	0.38	0.84	0.66	3	5.3	1.7	2.9	2.2
Conductivity	µS/cm	---	---	590	600	1300	710	540	-	600	550	-	200	86	76	46	86	60	190	420	170	250
Total Aluminum (Al)	µg/L	5-100[i]	---	11	14	9.2	84	**5300**	-	**310**	**120**	-	**220**	**260**	**220**	**180**	89	**230**	**280**	**190**	**400**	**250**
Total Arsenic (As)	µg/L	5	12.5	ND	ND	ND	1.1	3.6	-	<1.0	<1.0	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Barium (Ba)	µg/L	---	---	66	68	180	130	190	-	71	39	-	32	21	16	38	54	42	67	41	31	39
Total Beryllium (Be)	µg/L	---	---	ND	ND	ND	ND	<1.0	-	<1.0	<1.0	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Bismuth (Bi)	µg/L	---	---	ND	ND	ND	ND	<2.0	-	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Boron (B)	µg/L	1,500	---	ND	ND	59	ND	<50	-	<50	<50	-	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Total Cadmium (Cd)	µg/L	0.04-0.37[a]	0.12	ND	ND	0.026	0.035	**0.23**	-	**0.43**	0.041	-	0.032	**0.05**	0.019	0.033	<0.010	0.018	0.017	0.025	**0.056**	0.037
Total Calcium (Ca)	µg/L	---	---	58000	58000	81000	69000	44000	-	59000	22000	-	8600	2100	1900	2300	6000	3500	4500	7000	4700	9600
Total Chromium (Cr)	µg/L	1[b]	1.5[b]	ND	ND	ND	ND	**7.4**	-	<1.0	<1.0	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Cobalt (Co)	µg/L	---	---	ND	ND	ND	1.9	5.3	-	0.63	<0.40	-	<0.40	0.54	0.41	<0.40	<0.40	<0.40	<0.40	<0.40	0.45	<0.40
Total Copper (Cu)	µg/L	2-4[a]	---	ND	ND	ND	ND	**12**	-	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Iron (Fe)	µg/L	300	---	ND	ND	**340**	**1400**	**8400**	-	**520**	150	-	260	**420**	**380**	**780**	300	**420**	280	240	**490**	**360**
Total Lead (Pb)	µg/L	1-7[a]	---	ND	ND	ND	ND	**7.5**	-	1.2	<0.50	-	0.53	0.53	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**1.6**	<0.50
Total Magnesium (Mg)	µg/L	---	---	3500	3600	11000	5400	6600	-	6700	2100	-	1300	610	680	680	1200	1200	1500	1800	1200	2000
Total Manganese (Mn)	µg/L	---	---	20	72	980	3400	1300	-	500	15	-	29	150	100	240	64	44	50	66	140	81
Total Molybdenum (Mo)	µg/L	73	---	ND	ND	ND	ND	<2.0	-	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Nickel (Ni)	µg/L	25-150[a]	---	ND	ND	ND	ND	11	-	2.2	<2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Phosphorus (P)	µg/L	---	---	ND	ND	ND	ND	500	-	<100	<100	-	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Total Potassium (K)	µg/L	---	---	1200	1300	5200	7100	12000	-	4700	1400	-	1100	170	<100	<100	550	360	850	860	410	730
Total Selenium (Se)	µg/L	1	---	ND	ND	ND	ND	<1.0	-	<1.0	<1.0	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

	Units/ Date	CCME WQG Freshwater	CCME WQG Marine	WC1 upstream	WC1 down-tream	WC2	WC3 upstream	WC3 downstream	Ephemeral Site Drainage	WC5	WC6	WC7	WC08	WC09	WC10	WC11	WC12	WC13A	WC13B	WC14	WC15	WC16
				12-Dec-18	12-Dec-18	12-Dec-18	12-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18	3-Dec-18
Total Silver (Ag)	µg/L	0.25	7.5[c]	ND	ND	ND	ND	<0.10	-	<0.10	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Sodium (Na)	µg/L	---	---	55000	56000	160000	64000	55000	-	50000	79000	-	28000	11000	7600	3500	8500	6300	28000	66000	24000	34000
Total Strontium (Sr)	µg/L	---	---	160	160	220	150	110	-	220	66	-	35	9.1	8.1	11	16	10	16	18	14	22
Total Thallium (Tl)	µg/L	0.8	---	ND	ND	ND	ND	<0.10	-	<0.10	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Tin (Sn)	µg/L	---	---	ND	ND	ND	ND	<2.0	-	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Titanium (Ti)	µg/L	---	---	ND	ND	ND	2.4	64	-	4.6	2.3	-	6.4	4.6	2.3	2.5	<2.0	4	7.2	2.4	4.9	5.2
Total Uranium (U)	µg/L	15	---	0.41	0.45	0.74	0.54	0.36	-	0.28	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Vanadium (V)	µg/L	---	---	ND	ND	ND	ND	11	-	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Zinc (Zn)	µg/L	7[d]	---	ND	ND	ND	7.1	68	-	57	5.3	-	8.2	6.1	<5.0	5.9	<5.0	<5.0	<5.0	<5.0	8.9	6.8
Field Parameters																						
temperature	°C	---	---	0.1	0.1	1.7	0.1	5.3	7.1	3.0	5.0	4.8	3.8	3.3	1.7	1.1	1.5	1.5	3.7	3.2	3.4	4.1
pH		6.5-9	7.0-8.7	7.6	7.6	7.5	7.9	7.9	8.1	7.8	7.4	6.4	6.5	4.5	4.3	5.0	6.5	6.2	6.0	6.4	5.8	7.2
Conductivity	µS/cm	---	---	760	740	1570	920	367	248	364	345	419	127	54	46	26	54	35	111	254	105	101
Dissolved Oxygen	mg/L	---	---	-	-	-	-	8.7	11.7	12.5	12.6	9.4	11.5	11.6	10.6	8.3	10.6	10	10.8	10.7	11.8	12.4

Notes

Canadian Ministers of the Environment (CCME) Water Quality Guidelines (WQG) for the Protection of Aquatic Life, Freshwater and Marine

Highlight an exceedance to the freshwater WQG

Bold an exceedance to the marine WQG

All samples were compared to the freshwater WQGs and WC2, WC3, WC5, WC6 and WC16 have been additionally compared to the marine WQGs.

Field parameters collected with YSI Professional Plus Handheld multimeter (for data recorded on 3 Dec, 2018) or HI98129 Combo pH/Conductivity/TDS Tester (for data recorded on 12 Dec, 2018).

a) based on hardness

b) The guidelines for trivalent and hexavalent chromium are 8.9 and 1.0 µg/L, respectively for freshwater long term exposure and 56 and 1.5 µg/L, respectively for marine long term exposure (FWAL 1997). Total chromium is reported by the lab and compared to the more stringent guidelines (1.0 µg/L and 1.5 µg/L for freshwater and marine, respectively).

c) based on a short term exposure scenario

d) field pH and temperature dependant

e) The mean absorbance of filtered water samples at 456 nm shall not be significantly higher than the seasonally adjusted expected value for the system under consideration (CCME, 1999).

f) For clear flow, maximum increase in TSS of 5 mg/L from background levels for longer term exposures (e.g., inputs lasting between 24 h and 30 d). For high flow, maximum increase in TSS of 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L. Should not increase more than 10% of background levels when background is ≥ 250 mg/L (CCME, 1999).

g) For clear flow, maximum increase in turbidity of 2 NTUs from background levels for a longer term exposure (e.g., 30-d period). For high flow or turbid waters, maximum increase in turbidity of 8 NTUs from background levels at any one time when background levels are between 8 and 80 NTUs. Should not increase more than 10% of background levels when background is > 80 NTUs.

h) The guideline shown is for dissolved zinc, based on a long term exposure scenario and is for surface water of 50 mg/L hardness, pH of 7.5 and 0.5 mg/L DOC. Please see Guideline Technical Document for conversion information (CCME 2018).

i) based on pH

8.4.3 Impact Evaluation/Effects Assessment

The environmental effects assessment is based on the existing environment as documented above in relation to the project description and mitigation as required to minimize environmental effects from the development and operation of the project. For each of these effects, proposed mitigation, and predicted residual effects were determined. The predicted residual effect assumes that each of the recommended mitigation measures is implemented. The significance of the residual effect is based upon an evaluation of the effect's magnitude, geographic extent, duration/frequency, reversibility and ecological context. Potential accidental effects or malfunctions are considered in **Section 10**.

Surface water is considered from the perspective of water quality and quantity in relation to other VECs. No potable surface water supplies were identified in relation to the project but a groundwater wellfield is discussed in **Section 8.5**. Potential impacts to fish habitat are addressed in subsequent sections regarding fish and fish habitat (**Section 8.6**). Impacts to wetlands are discussed in **Section 8.7**. Marine waters are discussed in **Section 8.11**.

8.4.3.1 Potential Environmental Effects

Key interactions between the project and surface water with the potential to result in both direct and indirect adverse effects to surface water include:

- Construction activities such as clearing, grubbing and potentially grading may result in sediment or other contaminant, if encountered, entering watercourses and/or drainage ditches;
- Surface drainage patterns may be altered during the construction of the project;
- WC3 is crossed by the project footprint and may be affected by construction activities;
- The ETF footprint (spill basin) will require reconfiguration of the stormwater drainage in WC2; and
- Potential reconfiguration of WC1 may be required of the agricultural drainage ditches and the headwaters of WC1 in relation to the pipe staging areas.

8.4.3.2 Mitigation

Aside from the WC2 drainage within the spill basin area and potentially WC1 in the potential pipe staging area, work at the ETF footprint area does not cross watercourses. Key mitigation to be implemented includes erosion and sedimentation controls to prevent site runoff from entering watercourses as provided in **Section 5.7**.

For the pipeline footprint area, standard pipeline construction activities are designed to avoid circumstances that result in diversion and/or unnatural retention of water along the construction footprint by following recommendations from various industry and provincial guidelines (CAPP et al. 2012). The following key mitigative factors and mitigation measures were applied to the assessment of this VEC:

- Where possible, the pipeline will be installed over top of the existing watercourse crossings (i.e., culverts and cross drain). However, where this method is not technically feasible, HDD or similar non-contact crossing methods will be employed unless an alternate method is approved by applicable provincial (NSE) and/or federal approvals (DFO);

- WC3 will be crossed using trenchless technology unless otherwise approved by NSE/DFO;
- Work will follow environmental management planning and standard mitigation as outlined in **Section 5.7**;
- A new drainage ditch at the proposed ETF spill basin site will be constructed to replace the one currently located within the footprint of the project;
- Utilization of erosion and sediment control procedures as noted in **Section 5.7.2.3**; and
- Deleterious substances are not anticipated within the proposed excavation area; however, project work will include a stop-work contingency if a contaminant is encountered.

8.4.3.3 Characterization of Residual Environmental Effects

A summary of residual environmental effects are discussed below.

Construction Phase

Direct watercourse interaction will occur in relation to the realignment of the drainage ditch (WC2) at the proposed ETF spill basin and potentially the agricultural ditching and headwaters of WC1. The stormwater drainage will be relocated following NSE watercourse alteration approval process if required. Watercourses (as defined by NSE) encountered along the pipeline route will be crossed either above the existing road culvert, or if required, crossing will occur underneath the watercourse using a trenchless technology such as HDD or boring. If not technologically feasible, additional follow-up assessment and permitting is required.

Some crossings of undefined drainage channels and ditches may occur and work may occur within 30 m of a watercourse. Potential changes in water quality due to erosion and/or sediment generation will be mitigated by standard erosion and sediment control measures, and a construction monitoring program.

Operation and Maintenance Phase

Operation and maintenance activities at the proposed ETF facility will be similar to existing NPNS activities and stormwater runoff during operation will be monitored as part of follow-up and within the Mill Monitoring Network. Operation and maintenance activities along the proposed roadside pipeline will reflect existing highway maintenance activities undertaken by NSTIR (such as road salting and roadside vegetation maintenance) and no significant interaction is anticipated with the project.

8.4.4 Summary

Table 8.4-4, summarizes the effects analysis for surface water including a summary of the potential, associated mitigation measures, and the determination of residual effect.

Table 8.4-4: Surface Water Effect Analysis

Activities	Potential Effects	Mitigative Factors and Measures	Residual Effects	Significance of Residual Effects
Construction				
Site preparation vegetation clearing, grubbing and grading	Degradation of water quality Alteration of natural surface water flow patterns	Environmental management planning and standard mitigation as outlined in Section 5.7. Comply with NSE conditions of approval for clearing within 30 m of watercourses. Implementation of EPP, which shall include erosion and sediment control, buffer zones, stormwater management plan, and spill prevention and emergency response plan. Project Environmental Inspector will monitor the implementation of the EPP mitigation during all critical phases of construction and repair, if warranted. Maintain drainage across the construction ROW during all phases of construction; and not cause ponding of water or unintentional channelization of surface water flows. Restrict the removal of riparian plants to appropriate setbacks from surface waters.	Localized alteration of natural surface drainage patterns until trench settlement is complete Negligible with standard mitigation applied. Direct and Indirect, Reversible Magnitude - negligible Duration – one to two years Frequency – daily until complete Geographic extent – within 500 m of "watercourse crossings" Context – footprint within areas previously disturbed (highway or stormwater drainage)	Not Significant - Adverse
Construction of the Spill Basin and Staging Area	Alteration of a stormwater drainage channel	Relocation of the drainage and meeting NSE requirements including approvals.	Negligible with standard mitigation applied. Direct, Irreversible Magnitude - negligible Duration – long term (project duration) Frequency – daily until alteration complete Geographic extent – specific to WC2/WC1 Context - existing stormwater drainage feature	Not Significant - Adverse

Activities	Potential Effects	Mitigative Factors and Measures	Residual Effects	Significance of Residual Effects
Construction of ETF and Construction and installation of effluent pipeline (Pipeline trench backfilling, watercourse and wetland crossings (HDD or tunneling), pipe testing and pipeline commissioning)	Reduction in surface water quality Changes to stormwater runoff and potential impact to water quantity to nearby watercourse/wetlands	Ensure all necessary approvals, licences and permits required for a particular activity are obtained prior to the commencement of the activity. Environmental management planning and standard mitigation as outlined in Section 5.7. Implementation of EPP. An erosion and sediment control plan for the project to be developed and erosion and sediment control measures to be implemented including those in Section 5.7. Avoid instream crossing of NSE defined watercourses or conduct additional assessment and follow NSE/DFO approval process, as applicable.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude - negligible Duration – long term (project duration) Frequency – daily until complete Geographic extent - site-specific Context - footprint within areas previously disturbed (highway or stormwater drainage)	Not Significant - Adverse

As identified in the table above, there are no situations where there is a high probability of occurrences of long or extended-term residual environmental effects on surface water quality of high magnitude, or high probability of occurrences of an irreversible residual environmental effect of high magnitude. With the implementation of the identified mitigation measures, the residual environmental effects of the project on surface water during all phases of the project are rated not significant, with a high level of confidence.

8.4.5 Follow-up and Monitoring

Given the lack of substantive interaction of the project with surface water, the high level of confidence of the significance prediction, and the implementation of known mitigation that is effective at preventing environmental effects to surface water, no follow-up measures are proposed nor required to verify the environmental effects predictions or the effectiveness of mitigation, beyond compliance monitoring.

However, several surface water monitoring programs exist at the NPNS mill and will be continued and expanded upon as follows. A surface water monitoring program will be developed and maintained over the life of the project in accordance with requirements stipulated by NSE. Baseline monitoring will be performed prior to project commencement. The NPNS Mill Monitoring Network was established in 2012 and will incorporate additional monitoring stations as required to monitor surface water through the duration of the project.

Parameters analyzed from each of the monitoring station locations will be in accordance to the requirements of NSE. Monitoring locations will be selected based on potential inputs to surface water. It is anticipated that the baseline surface water monitoring program will include, at a minimum, analysis of TSS, general chemistry and metals over three seasons. Baseline has been established at the ETF site and a winter data set was collected along the approximate pipeline footprint area. Additional monitoring is proposed as noted in **Section 8.5**.

During construction, additional monitoring required to achieve environmental compliance will be outlined in the EPP. The Construction Monitoring Program will be developed in consultation with NSE and will include monitoring of surface water (pH and TSS) during storm events. Watercourse monitoring will be conducted as part of the visual inspection of the construction of the project by a specialist. The banks and approach slopes of watercourses within 10 m of the footprint will be monitored for bank stability, morphology, soil erosion, invasive species, soil productivity, revegetation, and the effectiveness of erosion control measures. All watercourses crossed will be revisited as necessary following construction to ensure that they are stabilized. Reclamation surveys for watercourses will also include an evaluation of the success of riparian vegetation re-established.

8.5 Groundwater

Groundwater is the water found in the cracks and spaces in soil and rocks, generally at depth but can also be found at surface under flowing artesian conditions (e.g., springs). Groundwater was selected as a VEC because it contributes to drinking water aquifers in potable areas and may discharge to surface water and aquatic habitat. Groundwater quality and quantity in relation to potable water supplies can be influenced by many factors, such as:

- The degree of development in the vicinity of a water supply well (e.g., domestic and industrial);
- The distance to local surface water bodies (and whether these are freshwater or marine);
- The integrity of the well which can degrade over time without proper maintenance (well heads should be protected and wells should be adequately sealed to avoid surface water infiltration around the well casing); and
- Proximity to potential sources of contamination (e.g., highway runoff, septic fields, storage tanks).

The following section is an overview of the existing environment as it pertains to groundwater, an evaluation of potential impacts as a result of the project, the significance of potential impacts, and a plan for follow-up and monitoring (as appropriate) for the project.

8.5.1 Scope of VEC

Groundwater is assessed in relation to potential groundwater users and to aquatic habitat that may receive groundwater flow via groundwater discharge to surface water. In general, the following provincial and federal regulatory guidance governs the assessment of groundwater in Nova Scotia:

- Atlantic Risk-Based Corrective Action (RBCA) for Petroleum Impacted Sites in Atlantic Canada, User Guidance Version 3 (January 2015) (Atlantic RBCA 2015) for potential health and environmental issues involving petroleum hydrocarbon spills, including as Risk-Based Screening Levels (RBSLs) for evaluating petroleum hydrocarbons in groundwater;
- CCME Canadian Environmental Quality Guidelines (CCME 1999 and updates) including community water supplies, recreational water quality, and Canadian water quality guidelines for the protection of aquatic life and agricultural water uses;
- Health Canada Guidelines for Canadian Drinking Water Quality (February 2017 Summary Table and updates; Health Canada 2017) for drinking water quality parameters, including health-based guidelines and aesthetic objectives, as well as operational guidance values for water treatment. These guidelines are most applicable for water being withdrawn and used as potable water;
- Nova Scotia *Environment Act* (amended 2017):
    - *Activities Designation Regulations* (2016), includes water withdrawals and watercourse alterations;
    - *Contaminated Sites Regulations* (2013) and Ministerial Protocols, including provincial Tier 1 Environmental Quality Standards (EQS) for notification (and/or remediation) with respect to metals, petroleum hydrocarbons, polycyclic aromatic hydrocarbons, volatile organic compounds, pesticides and other contaminants in groundwater and Tier 2 Pathway Specific Standards for remediation levels for applicable pathways;

- *Well Construction Regulations* (2007); and
- Nova Scotia *Water Resources Protection Act* (2000).

8.5.1.1 Boundaries

The spatial boundaries in regard to groundwater are affected by the hydraulic properties of the aquifer(s), flow direction(s), project activities (construction, operation, or decommissioning), and potential receptors.

- The **project footprint area (PFA)** is defined as the maximum extent of the physical area of disturbance associated with the project. The PFA will include all temporary and permanent areas of ground and marine disturbance. The PFA is defined in **Section 5.1.1**.In the following discussion, the ETF footprint area has been differentiated from the pipeline footprint area. The ETF footprint area, on NPNS property, is an area where groundwater is not used for potable purposes. The pipeline footprint area as detailed herein is located in a potable area and crosses the Town of Pictou's source water area.
- The **local assessment area** includes a 1 km buffer from the property encompassing the project footprint area and applies to the broader regional groundwater resources (i.e., well beyond the project footprints) to determine if they are potentially interacting with the proposed ETF footprint area and/or pipeline footprint area.

Temporal boundaries for the assessment of environmental effects on the environment include periods of construction, operation and maintenance, and decommissioning. Construction is estimated to be approximately 21 months, beginning second quarter of 2019, commencing as soon as the EA review has been completed and the applicable permits, approvals or other forms of authorization have been obtained. Operation and maintenance will commence immediately following the construction phase and will continue to operate efficiently and safely for several decades and likely much longer with a well-maintained system. For the purpose of this EA Registration, it has been assumed that the operation and maintenance phase will begin in the fourth quarter of 2020. Decommissioning of the project would occur at the end of mill life following the completion of operations. Once the ETF or pipeline is nearing the end of a useful service life, a decommissioning plan will be developed and will be submitted for a separate review requiring NSE approval.

8.5.1.2 Significance Criteria

A significant adverse residual environmental effect on groundwater is defined as one where a potable water supply was significantly depleted by the project or where the water quality was degraded by the project beyond existing conditions and to the extent that there are new exceedances to the Canadian Drinking Water Quality Guidelines (CDWQG) confirmed by at least two rounds of water quality monitoring. This would also be the case where the project causes a groundwater contribution to a surface water habitat that degrades the habitat beyond existing conditions and to the extent that there are new exceedances to the applicable CCME FWAL or MAL guidelines (as applicable and where baseline is currently within guidelines) as confirmed by at least two rounds of water quality monitoring.

8.5.2 Existing Environment

For the purposes of the EA registration, potable water or surface water data was obtained from available historical results for the area (via Nova Scotia Department of Natural Resources' Groundwater Atlas (web-based interactive map), regional water resource reports, municipal water supply wells, private wells).

Regional Setting

The majority of groundwater in the Pictou and Abercrombie area comes from water found within one of the two major bedrock aquifer units, that is, either the Cumberland Group (Malagash Formation) or the Pictou Group (undivided) (See **Section 8.3**). For groundwater from wells completed within the Cumberland Group, formerly identified as Riversdale Group, (sedimentary) bedrock is typically good quality with a moderate hardness (Hennigar 1968). Half of samples analyzed by Gibb and McMullin (1980) from this group were of a sodium chloride water and the other half were of a calcium bicarbonate water with a higher dissolved solids content at greater depths. For groundwater from wells completed within the Pictou Group, groundwater is generally of variable quality, with moderate hardness and potentially high iron concentrations, as well as high sodium and chloride content indicative of potential salt water contamination (Hennigar 1968). Pictou Group water was classified as a calcium sulphate and calcium bicarbonate water, with moderate total dissolved solids (TDS) concentrations and water classified as moderately hard to hard (Gibb and McMullin 1980).

Along the pipeline route, Late Carboniferous Malagash Formation bedrock is encountered north of the Town of Pictou (in the area of Division Road W, where Highway 106 curves towards the northeast). This formation is generally described as a braided stream sandstone, mudstone, rare coal and lacustrine limestone (100-400 m thick).

A structural feature due to intermittent uplift of the highlands after the Acadian orogeny exists in this area known as the Scotsburn Anticline. The Scotsburn Anticline, for which folding presents the youngest rocks along the limb of the fold and oldest rocks at the core, is a northeast plunging structure (Gibb and McMullin 1980). Historical mapping (including Gibb and McMullin 1980) shows the hinge line reaching across Highway 106 and into the Pictou Group bedrock; however, the provincial mapping presented in **Figure 8.5-1** (which is based on 1:500,000 scale), does not show the same level of detail, with only a fault appearing west of the Claremont and Millsville Formations. The importance of this structural feature in relation to groundwater is that, since the layers of bedrock dip downwards along the limbs of the fold, there is potential for a preferential pathway for groundwater migration along the bedrock layers. Similarly, the presence of a fault in the rock would also provide a preferential pathway for groundwater to follow the orientation of the fault, which may not necessarily be vertical.

During the drilling and logging of a test well at Abercrombie (in Pictou Group bedrock to 63 m depth), it was apparent that fractures were the main source of water (Gibb and McMullin 1980). While the specific location of this well is unknown, the reported depth does not match those drilled at NPNS facility which is located at Abercrombie Point.

ETF Facility Local Setting

The NPNS facility is situated on a peninsula, bounded to the north, east and west by Pictou Harbour and the Middle and East Rivers of Pictou Harbour. The former Canso Chemicals plant is located on the adjacent property south of the NPNS facility. There are residential homes and farmland to the southeast along the main access road into the site; however, there are no known potable wells within 500 m of the ETF site.

Water for the NPNS site is sourced from the Middle River. There are two production wells on the NPNS site that are used for non-potable purposes (i.e., the Scalehouse well and the Construction Gate well) which have been routinely sampled as part of a monitoring program since the late 1990s. A search of the provincial well log database indicates that up to three industrial wells have been drilled on the property over time (i.e., two drilled in the mid-1960s and one in the late 1980s for Scott Maritimes). The first two wells were drilled to 152.4 m and 143.3 m depth, with bedrock encountered at 6.1 and 0.91 m (respectively) and static water levels at 5.5 m depth. It is assumed that these two wells represent the production wells. The third well was drilled to a much shallower depth of 30.5 m depth, with bedrock encountered at 6.1 m and static water level at 6.1 m depth This well was used in the Tree Length Processing Facility in the mill woodyard which has since been decommissioned. Although pumping tests were conducted for each well, the estimated well yield was not provided on the logs.

Geologically, the NPNS site is blanketed by reddish brown silty, sandy, clay till. Thickness varies from a thin veneer of less than one metre to a covering greater than 7 metres. Underlying bedrock, referred to as the Late Carboniferous Pictou Group (undivided), is a sedimentary sequence consisting of interbedded mudstone, siltstone, sandstone, conglomeritic sandstone, and minor coal seams (Dillon 2012).

Groundwater occurs near surface, generally within 1 to 3 m. The shallow flow system mirrors surface topography, with recharge occurring in localized highs and discharge in low-lying areas. A watershed divide intersects the far eastern portion of the NPNS site in a general north-south direction. Groundwater flow east of the divide is in a southeasterly direction towards the East River, while groundwater flow west of the divide is in a west-northwest direction towards the Middle River. Both of these rivers discharge to Pictou Harbour. Overall, groundwater flow across the NPNS site including the proposed ETF footprint area is predominantly westward to northwestward and towards the harbour.

Groundwater Information within 1 km of NPNS Site

According to the Groundwater Atlas, the NPNS Site and the ETF footprint area are located within the East/Middle/West (Pictou) Watershed (NSE designation 1DP, sedimentary bedrock), with flow direction generally towards the Northumberland Strait. Although a watershed divide has been noted for the site (based on site observations), the Groundwater Atlas does not identify a secondary watershed for the Abercrombie area. A search of available well logs (within approximately 1 km of the NPNS property boundaries) was undertaken via the Groundwater Atlas and the query generated 39 well logs, for which each log represented a drilled well (vs. a dug well).

Of the 39 well logs, only some of which contained civic addresses, one address (cited as Caribou Island) appeared to be outside the area of interest and four wells were owned by NPNS (the three identified as industrial use as noted in the previous section and one domestic well in the community of Loch Broom) and were, therefore, excluded from the following discussion.

Data for the remaining 34 wells are summarized in **Table 8.5-1,** below. These represent 26 wells for domestic water use, two wells for commercial, one well noted as other (with an address of Country Villa Park), and five wells for which the water use was not defined (including two wells drilled at the adjacent Canso Chemicals property to 45.7 and 38.1 m depth).

Table 8.5-1: Well Log Summary within 1 km of NPNS Property

	Well Depth (m)	Casing Depth (m)	Depth to Bedrock (m)	Static Water (m)	Well Yield (L/min)
Min	19.8	5.5	3.0	-0.03	3.2
Max	85.3	26.2	15.2	11.9	340.5
Average	**36.9**	**14.6**	**8.0**	**6.1**	**55.5**

The well records indicated that the Country Villa Park well and one other domestic well contained the highest well yields, both at 340.5 litres per minute (L/min). These two wells were installed to 36.5 m and 25.9 m depth and cased into bedrock, encountered at 6.1 and 4.3 m depth, respectively.

In relation to potential outliers, it is noted that if these two wells were removed from the data set, the highest well yield would be 204 L/min and the average would become 36 L/min. Overall, the data review infers that wells in the area are generally shallow, high producing wells (based on the average well yield) drawing water from a sedimentary bedrock aquifer.

It is noted that the ETF site is located within a non-municipally serviced potable groundwater area (i.e., potable water wells may be drilled to supply water for individual properties). However, the closest residential well is greater than 500 m from the site and it has been assumed that the adjacent Canso Chemicals site (where two wells were installed in the 1970s) does not contain a viable potable water source. Therefore, there are no known groundwater receptors within 500 m of the proposed ETF footprint area (Dillon 2011).

Pipeline Route Setting

Information for potable groundwater along and adjacent to the pipeline footprint area was obtained through a search of the Groundwater Atlas (which includes well logs), as well as regional water resource reports and the municipal wells for the Town of Pictou.

According to the Groundwater Atlas, the pipeline route is also located within the East/Middle/West (Pictou) Watershed (NSE designation 1DP, sedimentary bedrock). North of Haliburton Road, the secondary watershed is NSE designation 1DP-SD4 (sedimentary bedrock) with flow towards Haliburton Brook, while the remaining area (i.e., south of Haliburton Road, east of the Town of Pictou and generally north of Caribou Road) is contained within the NSE designation 1DO-5 secondary watershed (sedimentary bedrock). Flow directions in this watershed would vary, but generally be towards the closest surface water body, whether that is land based or marine for areas along the coast.

Well Logs

A search of available well logs (within approximately 500 m on either side of the pipeline route) was undertaken via the NS Groundwater Atlas and the query generated 121 well logs, for which each log represented a drilled well (vs. a dug well). Of the 121 well log records, only some of which contained civic addresses, two addresses (cited as Lyons Brook and Granton Abercrombie Road) appeared to be outside the area of interest and one well (on Haliburton Road) was installed for a heat pump (i.e., non-potable purpose) and were, therefore, excluded from the following discussion. In addition, two wells were installed for municipal water use and, since the Town of Pictou wellfields are discussed further below, these were also excluded from the current discussion.

A summary of the details for the remaining 116 (drilled) well logs is presented in the **Table 8.5-2,** below. These represent 98 wells for domestic water use, 3 wells for commercial use, two wells for “public (not municipal)” use, three wells for industrial purposes, and 10 wells for which the water use was not defined.

Table 8.5-2: Well Log Summary Along Pipeline Route

	Well Depth (m)	Casing Depth (m)	Depth to Bedrock (m)	Static Water (m)	Well Yield (L/min)
Min	15.8	5.2	1.2	-0.03	4.5
Max	106.6	32.0	29.5	41.9	454
Average	**36.6**	**13.7**	**8.9**	**6.8**	**38.6**

Of note, the well with the highest yield (454 L/min) was an industrial well drilled to 106.6 m depth located in Caribou. If this well was removed from the data set, the deepest well would be 92.9 m depth, the highest yield would be 272 L/min, and the average yield would be 35 L/min.

Overall, the data review infers that wells in the area are generally shallow, high producing wells (based on the average well yield), drawing water from a sedimentary bedrock aquifer.

Municipal Wells

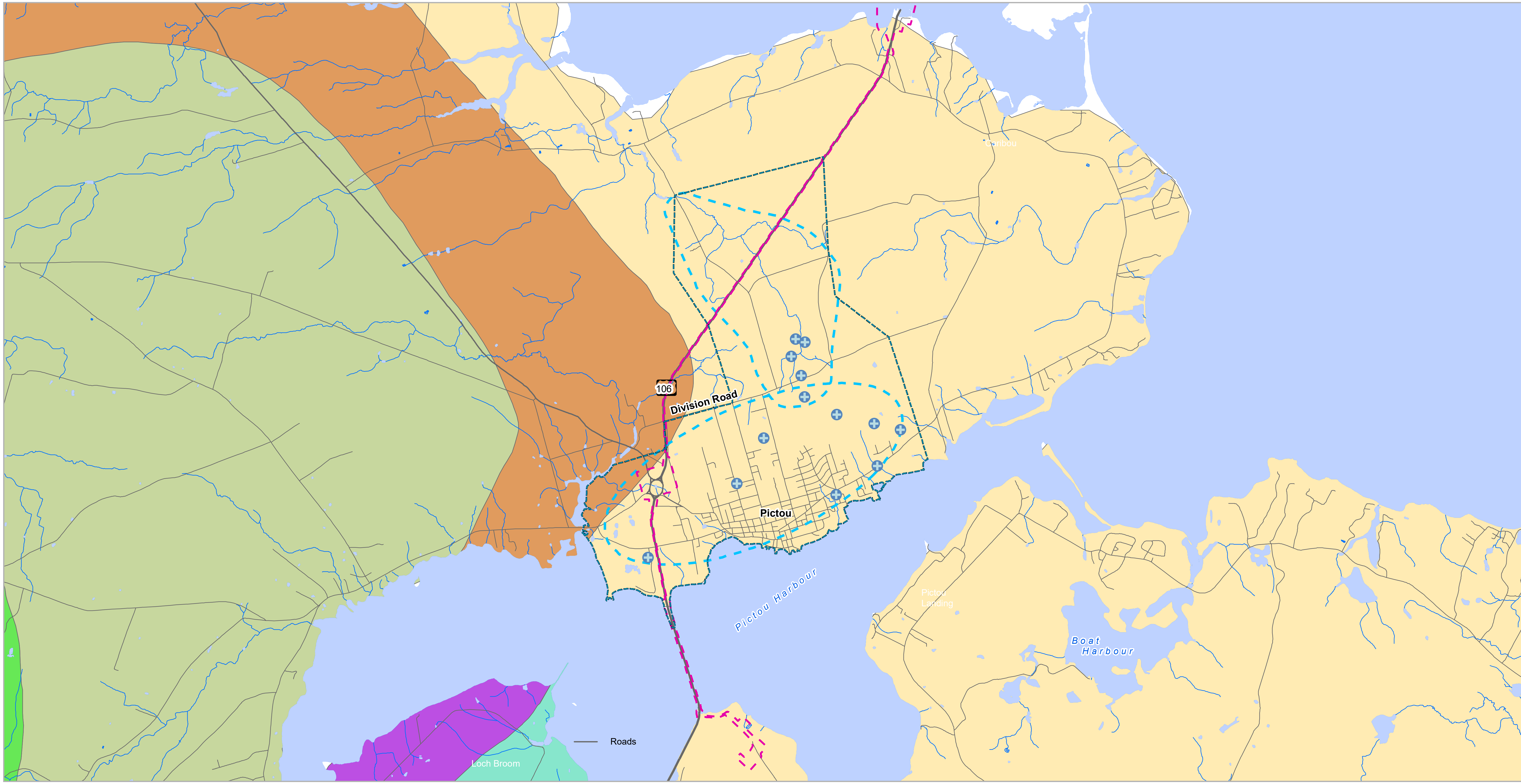
According to the Source Water Protection Plan (SWPP) for the Pictou and Caribou wellfields (October 2017), the Town of Pictou's drinking water comes from 13 drilled wells (i.e., the Pictou or Town wellfield comprised of eight wells and the Caribou wellfield comprised of five wells) that supply water to a population of 4,400 people. The Pictou wells are identified as #11, #12, #14, #15, Public Works, Exhibition, M&M, and Beaches Road. The Caribou wells are identified as #8, #10, Division Road, Smith Grant, and Footes Lane. The wells are shown on **Figure 8.5-1**.

Pumping test information available through the NS Groundwater Atlas (the majority of which was undertaken in the 1970s) is summarized in **Table 8.5-3** below. This represents data from nine wells identified as being in the community of Pictou (including an Old Footes Lane well and a New Footes Lane well that would belong to the Caribou wellfield) and seven locations (two of which were surficial test wells) in the community of Caribou. Based on geological mapping, it is assumed that each of these wells/test holes is in the Pictou Group bedrock (described as interbedded mudstone, siltstone, sandstone, conglomeritic sandstone, and minor coal seams).

Table 8.5-3: Summary of Pumping Test Information for Municipal Wells

Aquifer and # of Wells		Well Depths (m)	Static Water Level (m)	Transmissivity (apparent m^2/day)	Long Term Yield (Q20, L/min)
Surficial (2)	-	6.7 to 8.23	1.0 to 1.9	7.4 to 178	181*
Bedrock (14)**	Min	12.2	0.5	3.7	105
	Max	188	50.7	149	682
	Average	**90.6**	**15.6**	**48.0**	**340**

Notes:
* Yield only provided for one of the surficial wells
** Pumping test data is not necessarily available for each of the production wells, some wells are not specifically named (e.g., identified as test hole or test well). One Caribou bedrock well (Test Well No. 1) appears to have been tested two times in 1978.



Northern Pulp Nova Scotia Corporation
Replacement Effluent Treatment Facility
Environmental Assessment

Groundwater Environment
Figure 8.5-1

NORTHERN PULP
NOVA SCOTIA CORPORATION
A PAPER EXCELLENCE COMPANY

Approximate Project Footprint Area*
Town of Pictou Wells
Pictou and Caribou Wellfields
Pictou Source Water Protection Committee Delineated Boundary
Pictou Group, No Formation L#P
Cumberland Group, Boss Point Formation, L#Cbp
Cumberland Group, Malagash Formation, L#Cm
Cumberland Group, Middle River Formation, L#Cmr
Cumberland Group, New Glasgow Conglomerate, L#Cng
Cumberland Group, Stellarton Formation, L#Cs
Cumberland Group, Claremont and Millsville Formations, L#Cc
Watercourse
Roads

DILLON
CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NRCan, DFO,
Pictou / Caribou Source Water Protection Plan (Town of Pictou)

MAP CREATED BY: SCM
MAP CHECKED BY: AB
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 0.5 1 2 km

N E S W

*Precise Project Footprint to be determined following completion of detailed design

PROJECT: 17-6461

Date: 2019-01-30

Water chemistry for these wells sourced from the NS Groundwater Atlas (found by cross-referencing the Municipal Well layer and the Well Water Chemistry layer) is summarized in **Table 8.5-4** below in regard to the major cations and anions, as well as total dissolved solids and pH. As noted above, potential salt water contamination is a concern for the well field (Hennigar 1968), with some wells affected by salt water intrusion (Gibb and McMullin 1980). Therefore, the CDWQG have also been presented to aid the discussion of water quality. It is important to note that concentrations for metals provided included arsenic, uranium, iron, and manganese, and that arsenic and uranium concentrations were low and well below their respective health-based CDWQGs.

Table 8.5-4: Summary of Water Chemistry for Municipal Wells

	Sodium	Calcium	Chloride	TDS	pH	Iron	Manganese
Range of observations	6 - 297	6 – 94	8 - 561	124 - 1,100	6.0 - 8.3	10 - 1,100	5 - 1,490
CDWQG	200	--	250	500	7.0 – 10.5	300	50
No. of Samples outside CDWQG	3	NA	3	1	1	3	11

Notes:
All concentrations are in milligrams per litre (mg/L), except for iron and manganese which are in micrograms per litre (µg/L) and pH which is unitless.
TDS – total dissolved solids
CDWQG – denotes Canadian Drinking Water Quality Guideline (Health Canada 2017). For the parameters shown above, the guidelines are based on aesthetic objectives.
NA – not applicable

As expected, the most common exceedance observed in groundwater was for manganese. Similar to iron, the CDWQG for manganese is based on aesthetics, in that high levels can stain laundry and plumbing fixtures and impart an objectionable taste to the water. The pH was only below the recommended range in one sample, the remaining samples were at a pH of 7 to 8.3, with the average being 7.5. Therefore, groundwater is considered to be generally pH-neutral. A review of hardness values, which ranged from 84 to 411 mg/L but generally above 100 mg/L, indicates that the water for the majority of samples would be classified as hard to very hard.

For the Public Works well, which is located near the highway (where the application of road salt may be an issue), calcium, chloride and manganese levels were relatively high (i.e., compared to the other wells). Chloride was below and manganese above the CDWQG. There is no CDWQG for calcium. For the #12 Well and Beeches Road Well, which are located near the coast, sodium, calcium, chloride, hardness, TDS, and/or iron were relatively high. Sodium and chloride were above the CDWQG in both wells, along with TDS (available for the Beeches Road Well only) and iron in the #12 Well. Similar to calcium, there is no CDWQG for hardness.

The source water area is noted as any lands inside the Town of Pictou boundaries and those lands north of the Town included in an area shown on Figure 1 of the SWPP. The area north of the Town includes lands that intersect with and cross Highway 106 and the pipeline route (i.e., approximately 500 m south of Central Caribou Road and Priests Road), and extends approximately 2 km north of Central Caribou Road along Highway 106 (see **Figure 8.5-1**).

The SWPP identified risks that may arise through various activities or land uses, such as agriculture, industrial and commercial activities, and transportation/road maintenance, and provided recommendations for risk management. Under the headings "Acquisition of Land" and "Designation as a Source Water Protection Area" in the SWPP, it was noted that "*the acquisition of land by the Town gives direction ownership and control of portions of the source water area to the Town*" (with reference made to Figure 3 of the SWPP), while "*designation is not being considered as a management option*". For Industrial/Commercial Activities, the importance of education in relation to the prevention of accidental release of substances into the environment that can adversely affect water quality was highlighted and the following recommendation made:

"Develop an information/education package targeted at commercial and industrial users in the watershed area that introduces the Source Water Planning initiative and discusses potential contaminants associated with industrial/commercial activities such as petroleum storage, fuel spills, chemical storage, the use of pesticides, etc. The package should highlight the various best management practices for fuel storage, spill cleanup, chemical storage, etc. Proper disposal of substances that could potentially affect groundwater quality should be explained. The information package should include existing publications that discuss issues such as spraying. (See Appendix IV: Industrial/Commercial Best Management Practices References and Appendix V: Emergency Response Planning)"

For transportation/road maintenance, the main risks identified in the SWPP were associated with road construction/maintenance, accidental spills of petroleum products or other contaminants, and the management of road salt contamination. One of the critical risk areas identified included proximity to wellheads. Recommendations to manage these risks are summarized as follows: establish high profile signage along public access routes indicating the presence of the Water Supply Area and to use caution; develop an awareness program for transport companies including contact numbers for Emergency Response; employ contingency/emergency response plan for spill response and containment; and continue to monitor salt levels and evaluate alternatives.

Existing NPNS Groundwater Sampling Network

There are two groundwater monitoring networks currently operated at the NPNS site. The oldest network (consisting of surficial, shallow bedrock, and deep bedrock wells) was established in relation to the two closed and one operational industrial landfill present on the site. This network is known as the Industrial Landfill Monitoring Network and is currently comprised of 27 monitoring wells at 12 locations (including up gradient and down gradient of the landfills). Scheduled groundwater monitoring, in compliance with NSE requirements for the management of industrial waste, has been conducted in association with operational Landfill 3 since 1989.

In 2012, a second monitoring network was established in relation to the operational portion of the NPNS site. This one, referred to herein as the NPNS Monitoring Network, is closest to the ETF footprint area.

The NPNS Monitoring Network consists of six (surficial) monitoring wells that have generally been sampled semi-annually since 2012. Although these wells have not been topographically surveyed, it has been assumed that, for the northern and eastern portions of the NPNS site, groundwater flow would be towards the north and east, respectively, towards Pictou Harbour. Existing baseline groundwater quality is well established. A summary of recent findings is noted below.

For the six NPNS Monitoring Network wells sampled semi-annually in 2017 (with the exceptions of MW12-5 and MW12-6 that were not located during the September 2017 event), exceedances of the CDWQG included: manganese in the majority of samples; sodium, chloride and/or TDS at three locations; turbidity at three locations; iron at one location; and low pH at one location. The 2017 concentrations were generally consistent with previous results, with the exceptions of marginally higher TDS (both events) and sodium (in September) in MW12-4, as well as turbidity in MW12-3 (in April). It is noted that, although comparison has been made to drinking water quality guidelines that assume the water will be consumed, this is not the case as groundwater at the NPNS property is not used for potable purposes.

Exceedances of manganese, TDS, turbidity, and iron, as well as low pH, are generally common in monitoring well samples in Nova Scotia, while elevated sodium and chloride are typically not. The CDWQG are in effect for these parameters for aesthetic reasons only (e.g., taste, staining of household fixtures or clothing, scaling of plumbing pipes). The limit for turbidity is also health-based; however, this generally only applies to chlorinated (i.e., treated) water supplies.

Based on data collected to date for the NPNS Monitoring Network wells, chloride appears to be generally increasing (albeit marginally) at one down gradient location. No other trends are evident in the NPNS Monitoring Network wells. As previously reported, since some of the NPNS monitoring wells contain higher chloride, sodium, and TDS concentrations, the proximity of the wells to Pictou Harbour (i.e., the potential for ocean spray (infiltration from surface), salt water intrusion into the groundwater aquifer and/or the presence of a saltwater-freshwater interface) and/or their location (within a parking area or adjacent roadways that are salted during the winter months and an area that potentially receives limited recharge) must be taken into consideration.

Total petroleum hydrocarbons (TPH)/benzene, toluene, ethylbenzene and xylenes (BTEX) analysis (conducted annually) indicated non-detectable concentrations in the four NPNS Monitoring Network well samples collected in September 2017. Historically, for well MW12-6, detectable concentrations of

Modified TPH (with lab resemblance to weathered fuel) had been observed at relatively low levels on two occasions; and, during the initial sampling event (2012), toluene had been detected in MW12-1 at a concentration marginally above the detection limit and the Modified TPH concentration was non-detect.

Polycyclic aromatic hydrocarbon (PAH) analysis (conducted annually) on select NPNS Monitoring Network wells (i.e., all except MW12-3) indicated detectable concentrations in two of the three samples collected in September 2017. That is, MW12-2 at 0.058 µg/L Total PAH (represented by 2 compounds), and MW12-4 at 0.53 µg/L Total PAH (represented by 10 compounds). The only PAH compound with a CDWQ guideline is benzo(a)pyrene at 0.04 ug/L, and the concentrations in the three NPNS Monitoring Network well samples were below laboratory detection limits and, therefore, below the CDWQG.

For the NPNS Monitoring Network wells, the highest indicator parameter concentrations have been associated with MW12-4, MW12-5, and MW12-6. These three wells, in particular, are located in proximity to the harbour and their location (for the reasons listed above) must be taken into consideration. Indicator parameters in MW12-2, with the exceptions of hardness and specific conductance, were generally similar to the background (surficial) wells of the Industrial Landfill Monitoring Network. Hardness in MW12-3 (April 2017) was also similar to background. For the remaining parameters and/or NPNS wells, indicator parameter concentrations were higher than background. Monitoring wells near the ETF footprint area are shown on **Figure 8.4-1, Section 8.4**. Periodic exceedance of a guideline is not necessarily a cause for concern and, therefore, data trends are also assessed (particularly for indicator parameters, such as, chloride, specific conductance and hardness). Based on a relatively limited data set (i.e., up to eleven samples collected to date), trending has not been apparent, with the potential exception of gradually increasing chloride at one location relatively close to Pictou Harbour as detailed above.

8.5.3 Impact Evaluation/Effects Assessment

The environmental effects assessment was conducted based on the data as noted in the existing environment section and their potential to interact with the project. Potential effects of accidents or malfunctions such as release of treated effluent from an operational pipeline are discussed in **Section 10**.

8.5.3.1 Potential Environmental Effects

Without mitigation, the project could cause potential environmental effects to groundwater as summarized below.

<u>ETF Footprint Area</u>

Potential physical effects from construction work will be limited to the duration of the proposed construction period. Once constructed and operational, the presence of the ETF should not affect groundwater. Potential effects during construction of the replacement ETF could include:

- Damage to the existing groundwater monitoring system; and
- Temporary and localized lowering of the water table during construction of in-ground features (e.g., footings, clarifiers).

Pipeline Footprint Area

Potential physical effects from construction work will be limited to the duration of proposed construction period. Once constructed, the presence of the pipeline should not affect groundwater. Potential construction effects during construction of the pipeline could include:

- Damage to nearby wells during pipe excavation; and
- Introduction of construction-related surface water contaminants into groundwater supplies.

8.5.3.2 Mitigation

Federal and provincial guidelines are in place for the protection of groundwater and will be adhered to throughout all phases of the project. Guidelines were listed in **Section 8.5.1** above. It is noted that the current provincial guidance is the Nova Scotia *Contaminated Sites Regulations* (NSCSRs) and Ministerial Protocols (rather than Atlantic RBCA). If concentrations of a potential contaminant are found to be above the applicable provincial Tier 1 EQS (and these are not considered background), then notification to NSE is required.

ETF Footprint Area

The existing NPNS groundwater monitoring network will be protected from disturbance to the extent possible during construction (via placement of jersey barriers and/or cement crocks as necessary) and updated as required once the construction is complete.

During construction, localized temporary lowering of the local water table may be required to construct portions of the ETF (e.g., the clarifiers) that will be constructed below the water table. To mitigate the potential impact on groundwater, dewatering will be limited to the immediate area and duration in order to safely excavate and complete construction of components that will be placed below the water table. Pumped groundwater will be tested and then released appropriately.

For the current NPNS monitoring program, provincial Tier 1 EQS do not apply as the site operates under Industrial Approval requirements. However, if a spill were to occur on site during construction of the ETF, then NPNS would need to follow the NSCSRs to address the spill.

Pipeline Footprint Area

In light of the pipeline route crossing over the Town of Pictou's source water area, additional mitigative measures during construction of the pipeline will include:

- Lining the trench with an impermeable (or low conductivity) material so that, if a leak occurred, it would be contained and prevent vertical infiltration;

- The pipe will be constructed of >2 inch thick HDPE which combines strength and flexibility to withstand stresses as well as being resistant to corrosion;
- The pipeline will be constructed with fusion technology to eliminate most, if not all, jointed sections.
- Having a system in place to detect leaks (or a significant drop in pressure) during operation and maintenance; and
- Inclusion of the Pictou watershed area in the mill ERCP, including contacting the Pictou Water Utility, property owners with potable water wells along the pipeline route, and other stakeholders.

8.5.3.3 Characterization of Residual Environmental Effects

The environmental effects of the project on groundwater are assessed in this section, for both the construction phase and the operation and maintenance phase.

Construction Phase

ETF Footprint Area

Potential interactions with groundwater resources from construction activities in relation to the ETF footprint area and the various land-based components associated with the ETF (e.g., clarifiers, effluent cooling system, AST basin, treatment building) include the potential for the clarifiers to be installed below the local groundwater table. If local groundwater levels were to pose an issue, the groundwater table would need to be temporarily lowered (likely through excavation dewatering) as part of construction. Following construction the water table will rebound to its natural condition. If groundwater is encountered during construction, it would be tested and then released appropriately. Other components are anticipated to be above the groundwater table. No residual effects are anticipated to the groundwater from the construction of the ETF.

As noted above, groundwater at the NPNS site occurs near surface, generally within 1 to 3 m. The shallow flow system mirrors surface topography, with recharge occurring in localized highs and discharge in low-lying areas. A watershed divide intersects the far eastern portion of the site (near the eastern side of Landfill 3) in a general north-south direction. Groundwater flow east of the divide is in a southeasterly direction towards the East River, while groundwater flow west of the divide is in a west-northwest direction towards the Middle River. Both of these rivers discharge to Pictou Harbour. In relation to human receptors, there are no known groundwater receptors within 500 m of the site (Dillon 2011). Ecological receptors would include aquatic habitat that may receive groundwater flow via groundwater discharge to surface water (i.e., the East River).

Pipeline Footprint Area

Potential interactions with groundwater resources from construction activities in relation to the pipeline footprint area and the various land based activities (e.g., excavation of trench, sedimentation control, control of surface water runoff) include the potential for the pipeline to be installed below the local groundwater table. If local groundwater levels were to pose an issue, the groundwater table may need to be lowered via temporary dewatering or other means prior to construction of a particular section or consideration may need to be given to elevation of the pipeline as a whole (i.e., above or below ground). If groundwater is encountered during construction, it would be tested and then released appropriately. No residual effects are anticipated to the groundwater from the construction of the pipeline.

As noted above, information from drilled wells along the pipeline route indicates that, on average, groundwater is found about 7 m below ground and, with the exception of a few areas near surface where the static water levels were generally 1.8 m and above. In contrast, the average water level in the municipal wells was 16 m below ground. Groundwater flow directions along the pipeline route would vary, but generally be towards the closest surface water body, whether that is land based or marine for areas along the coast, and generally following topography.

Operation and Maintenance Phase

ETF Footprint Area

Once the ETF is operational, limited potential groundwater effects are expected during the routine operation and maintenance of the ETF and various land-based components (e.g., clarifiers, effluent cooling system, AST basin, treatment building).

As part of NPNS's Industrial Approval for the operation of the facility, it is anticipated that the groundwater monitoring network will be modified to reflect the new infrastructure. As monitoring well locations cannot be finalized until the location of infrastructure is complete, network upgrades will occur during the operation and maintenance phase to aid in future assessment of changes in groundwater quality over time. This network, which would be installed post-construction, should consist of both shallow and deep monitoring wells installed at up gradient and down gradient locations. The parameters to be tested during baseline water sampling should be similar to the parameters currently tested in groundwater at the mill site. Then, based on the results of operational monitoring, the program should be re-evaluated periodically and amended as appropriate (for example, there is no need to test for organic parameters that are consistently non-detect).

Pipeline Footprint Area

Routine project operation and maintenance activities of the pipeline are not anticipated to interact with the groundwater VEC along the pipeline route.

8.5.4 Summary

In summary, the residual environmental effects of the project on groundwater are summarized in **Table 8.5-5** below.

Table 8.5-5: Summary of Residual Environmental Effects Related to the Groundwater VEC

Activities	Potential Effects	Mitigative Factors and Measures	Residual Effects	Significance of Residual Effects
Construction				
Construction activities (machinery)	Excavation may expose additional points of entry to the aquifer	-Conduct post construction monitoring.	Negligible with standard mitigation applied. Direct and Indirect, Irreversible Magnitude - negligible Duration – permanent Frequency - low Geographic extent - site-specific (ETF footprint area) Context - Developed area with no residential wells within 500 m of ETF footprint area.	Not Significant -Adverse
Construction activities (machinery) at ETF site	Damage to existing monitoring wells	-If a monitoring well is in the way, recommend decommissioning to avoid creating a conduit. -If monitoring well is out of the way, place barriers around monitoring wells for protection. -If minor damage occurs, have monitoring wells repaired as necessary.	Negligible with standard mitigation applied. Direct and Indirect, Irreversible Magnitude - negligible Duration – temporary until repaired/replaced Geographic extent - site-specific (ETF footprint area) Context – Monitoring wells are part of an evolving network at the property.	Not Significant -Adverse
Excavation of footings, clarifiers at ETF site	Groundwater discharge	Dewatering to confirm groundwater quality if discharge to the environment occurs, and undertake appropriate mitigation including disposal at approved facility if applicable.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude - negligible Duration – short term Frequency - low Geographic extent - site-specific (ETF footprint area) Context - Developed area with no residential wells within 500 m.	Not Significant -Adverse
Spill pond construction	Groundwater in the vicinity of a wetland will be affected	The wetland alteration will be conducted under an NSE approval with appropriate compensation (see **Section 8.7).**	Negligible with standard mitigation applied. Direct, irreversible Magnitude - low Duration – permanent Frequency – low Geographic extent - site-specific (area of spill pond) Context – Wetland approval process.	Not Significant –Adverse
Construction and installation of pipeline over land	Excavation may expose additional points of entry to the aquifer	Conduct pre- and post-construction monitoring to ensure no alterations to groundwater from the	Negligible with standard mitigation applied. Direct and Indirect, Irreversible Magnitude - negligible	Not Significant –Adverse

Activities	Potential Effects	Mitigative Factors and Measures	Residual Effects	Significance of Residual Effects
		construction process. The pipeline will primarily be constructed within the road shoulder gravel fill (no bedrock excavation anticipated). Surface water quality mitigation as noted in **Section 8.4**.	Duration – short to long term Frequency - low Geographic extent – over the length of the pipeline Context - Developed area with individual water wells and municipal wellfields/source water area for Town	
Operation and Maintenance				
ETF operations – road use and maintenance	Potential for surface water contaminants to enter local groundwater	Mechanical mowing only. Appropriate erosion and sediment control as noted for water quality. No potable wells near site.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude - negligible Duration – short term (maintenance duration) Geographic extent - site-specific Context – existing facility	Not Significant - Adverse

Provided the recommended mitigative measures are implemented, it is not anticipated that the project will result in significant adverse residual environmental effects on groundwater. As noted above, the closest residential well is greater than 500 m from the ETF; a watershed divide intersects the far eastern portion of the site (near the eastern side of Landfill 3) in a general north-south direction; and groundwater flow east of the divide is in a southeasterly direction towards the East River. Therefore, it is unlikely that groundwater from the project area would affect residential water supplies.

It is important to note that, as demonstrated by the summary of water quality for municipal wells above, there are exceedances to the CDWQG based on current conditions. Therefore, water quality being above a particular guideline is not a cause for concern in and of itself, but should be seen as an indicator that would suggest a potential influence from the treated effluent. Trends in water quality over time would be more important considerations. In consideration of the above, the nature of the project, its environmental setting, and planned mitigation, the residual environmental effects of the project on groundwater during all phases of the project are rated not significant, with a high level of confidence.

8.5.5 Follow-up and Monitoring

Given the high level of confidence in the prediction above, no follow-up is required to verify the environmental effects predictions or the effectiveness of mitigation. However, routine monitoring of groundwater elevations and quality will continue, in addition to other potential enhancements to the groundwater program, as follows. The existing network of monitoring wells associated with the NPNS monitoring program has been and will continue to be used to monitor groundwater at the NPNS site before and after the ETF is constructed.

The groundwater table may be confirmed using piezometers or shallow monitoring wells prior to project initiation if required for construction of the clarifiers at the ETF site. In particular, existing groundwater data from monitoring wells down gradient from the proposed land-based PFA will be used to establish background conditions for groundwater prior to the initiation of the project. The routine groundwater monitoring program for the NPNS facility will be maintained over the life of the project in accordance with the monitoring requirements stipulated by NSE. The monitoring wells selected for routine sampling throughout the life of the project will include both up gradient and down gradient wells and the monitoring well data will be compared to baseline and background conditions (i.e., utilizing the Industrial Landfill Monitoring Network background wells), and analyzed for significant changes and fluctuations.

NPNS will develop a surface water monitoring program to monitor runoff within the pipeline footprint both during and subsequent to construction in areas where surface water can infiltrate to groundwater. As part of this program the frequency of monitoring and parameters to be assessed will be identified in consultation with NSE, particularly with respect to surface waters that could infiltrate to groundwater within the municipal groundwater watershed areas identified within the SWPP and more populated residential neighborhoods along the un-serviced portion of the pipeline footprint.

8.6 Freshwater Fish and Fish Habitat

The potential environmental effects of the project on freshwater fish and fish habitat (hereinafter referred to as the freshwater fish VEC, for brevity) are assessed in this section.

8.6.1 Scope of VEC

Freshwater fish and fish habitat is considered for freshwater and estuarine watercourses which support habitat for fish. Habitat for freshwater fish ecosystem components maintaining viable fish populations, are regulated by DFO, and constitute project VECs due to their importance to the public, First Nations, stakeholders, and regulatory agencies. The freshwater fish VEC is closely related to surface water (discussed in **Section 8.4**), as well as to wetlands (**Section 8.7**). Marine fish and marine fish habitat are considered in **Section 8.12**. Commercial, recreational, and Aboriginal (Indigenous)(CRA) fisheries are addressed in **Section 8.14** and **Section 8.15**.

Fish habitat is protected under the *Fisheries Act* (2012) which defines habitat as "*spawning grounds and any other areas, including nursery, rearing, food supply and migration areas, on which fish depend directly or indirectly in order to carry out their life processes*". Death of fish or causing "serious harm to fish that are part of a commercial, recreational, or Aboriginal fishery" (including death of fish or any permanent alteration to, or destruction of, fish habitat) is subject to federal approval under the *Fisheries Act*. The deposition of a deleterious substance is also prohibited under Section 36(3) of the *Fisheries Act*. Based on the Nova Scotia EA guidance (NSE 2009), the freshwater fish VEC also considers priority species and associated habitats that include the following:

- Species listed as Endangered, Threatened, or Special Concern (including Schedule 1) under the federal SARA, which are considered herein to be SAR;
- Species listed as Endangered, Threatened, or Vulnerable under the NS ESA, which are also considered herein to be SAR; and
- COSEWIC listings as Endangered, Threatened, or Special Concern and SOCC status as At Risk or Sensitive under Nova Scotia's general status assessment process.

Additionally, the following were assessed:

- Species with AC CDC Provincial Species conservation status ranks (Sub-national/provincial "S Rank" of extremely rare (S1), rare (S2), or uncommon (S3)), which are considered herein to be SOCC; and
- Significant Species and Habitat as identified in the provincial database.

8.6.1.1 Boundaries

Spatial boundaries for the assessment of environmental effects on the freshwater fish VEC include the following:

- The **project footprint area (PFA)** is defined as the maximum extent of the physical area of disturbance associated with the project. The PFA will include all temporary and permanent areas of ground and marine disturbance. The PFA is defined in **Section 5.1.1** For the freshwater fish VEC, two distinct footprint areas are assessed: the physical footprint of the replacement ETF (referred to as the ETF footprint area), an area comprising 20.8 ha of land within the NPNS property boundary; and the land-based portion of the effluent pipeline footprint (referred to as the pipeline footprint area) which is based on proposed disturbance during construction of Highway 106 road shoulder and associated areas required to be cleared ancillary to construction. The estimated total area of potential temporarily disturbed area during construction is 66.6 ha; and

- The **local assessment area** (LAA) is the maximum area within which environmental effects from the project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence (i.e., the potential zone of influence of the project's indirect effects on the freshwater fish VEC). For freshwater fish VEC, the local assessment area includes the extent of potential surface water impacts as noted in **Section 8.4** (i.e., 100 m upstream and 500 m downstream of the project footprint area along watercourses/wetlands, as well as adjacent riparian habitat beyond the high water mark of a watercourse or wetland).

Temporal boundaries for the assessment of environmental effects on the environment include periods of construction, operation and maintenance, and decommissioning. Construction is estimated to be approximately 21 months, beginning second quarter of 2019, commencing as soon as the EA review has been completed and the applicable permits, approvals or other forms of authorization have been obtained. Operation and maintenance will commence immediately following the construction phase and will continue to operate efficiently and safely for several decades and likely much longer with a well-maintained system. For the purpose of this EA Registration, it has been assumed that the operation and maintenance phase will begin in the fourth quarter of 2020. Decommissioning of the project would occur at the end of mill life following the completion of operations. Once the ETF or pipeline is nearing the end of a useful service life, a decommissioning plan will be developed and will be submitted for a separate review requiring NSE approval.

8.6.1.2 Significance Criteria

A significant adverse residual environmental effect on the freshwater fish VEC is one where project-related activities directly cause a contravention of the NS ESA, the federal *Fisheries Act* and/or SARA. Contraventions of the *Fisheries Act* include unapproved actions that result in: fish mortality; permanent alteration to or destruction of fish habitat of a scale, duration, or intensity that causes "serious harm" to fish that are part of a CRA fishery; unauthorized obstruction of free passage of fish; or deposition of a deleterious substance as defined under the Act. Additionally, a significant adverse residual environmental effect on the freshwater fish VEC is one where the population of a species is sufficiently affected by the project to cause a decline in abundance and/or change in distribution beyond which natural recruitment (reproduction and immigration from unaffected areas) would not return the population to its former level within at least one generation.

8.6.2 Existing Environment

A general description of the regional surface water setting, watersheds and of watercourses intersecting the PFA was provided in **Section 8.4**. The naming convention established for these previously unnamed watercourses is provided in the previous sections and is also used in this section. Refer to **Section 8.4, Figure 8.4-1** and **8.4-2** for watercourse locations intersecting the PFA.

8.6.2.1 Assessment Methods

To evaluate the freshwater habitat and expected fish species and their life stages present within the local assessment area, including the potential for fish SAR and/or SOCC, a review of the following existing data and information sources (as of fall 2018) was conducted:

- A site-specific AC CDC report (AC CDC 2018a) including priority species and significant or managed areas;
- The receiving water study (Stantec 2017, 2018; see **Appendix E**);
- Listed species by COSEWIC;
- Listed species under the federal SARA (and identified Critical habitat);
- Listed species under the NS ESA;
- Priority species as ranked species by the Nova Scotia General Status of Wild Species;
- Nova Scotia provincial Significant Habitat database;
- Publicly-available Geographic Information Systems (GIS) map layers and databases including the provincial landscape viewer; and
- Google Earth Satellite and "Street View" imagery.

The potential for priority fish species was based on AC CDC (2018a) species identified as having been historically observed within 5 km of the PFA (or within the sub-watershed) and comparison of the local assessment area habitats with potential habitat requirements for the identified species. **Appendix N** lists the potential at-risk species "short-listed" for the local assessment area, their likely habitat, preferred investigation period, and priority status. It is noted that fall 2017 to summer 2018 field investigations were undertaken at the replacement ETF site, but an alternate pipeline route was selected in the fall of 2018 (see **Section 5**) and due to the timing of route selection, only a preliminary reconnaissance visit was undertaken. Investigations included:

- Habitat evaluation at the ETF local assessment area – October 2017, June 2018; and
- Reconnaissance of the approximate pipeline footprint area – December 3, 2018.

The investigation within the ETF local assessment area provides a reasonable level of confidence of the likelihood of freshwater fish habitat including for priority species. However, as only field reconnaissance of the pipeline footprint area was possible at this time, a conservative assessment was made on the potential for freshwater fish and their habitat and it was assumed that such species may be present where potential habitat is present in the pipeline local assessment area. Additional assessment is planned for summer of 2019.

During the fish habitat field assessments located on the ETF property, habitat data were collected as adapted from the Reconnaissance (1:20,000) Fish and Fish Habitat Inventory for British Columbia: Standards and Procedures (Resource Inventory Committee 2001) and in accordance with DFO protocols.

Investigations included the visual examination of fish habitat descriptors. The data collected included information on the following:

- Substrate (types and percentages);
- In-stream cover (types and percentages);
- Wetted and channel width (where applicable);
- Approximate water depth (including pools);
- Morphology;
- Unique watercourse characteristics (e.g., bars, islands, pattern);
- Crown closure;
- Water quality (pH, temperature, and conductivity);
- Bankside vegetation; and
- Photographs and UTM locations.

A qualitative assessment was made on potential habitat for overwintering, rearing, and spawning. The quality of spawning habitat is based on water flow, water quality, and the extent and coverage of suitable substrates. The quality of rearing habitat is based on the types and amount of in-stream cover, in-stream, vegetation, and water flow. Overwintering habitat quality is based on the presence or absence of deep pools or ponds (≥ 50 cm) and the potential for year-round water flow. The potential for fish presence year-round is based on the water quality measurements (e.g., dissolved oxygen and pH); habitat quality at the time of the assessment; quality of overwintering and spring/summer habitat; and the upstream and downstream connectivity to other fish-bearing watercourses or waterbodies.

Field reconnaissance and water chemistry data collection for predicted watercourse crossings along the pipeline route was conducted on December 3, 2018. The data collected included information on the following:

- Water quality (pH, temperature, conductivity, and dissolved oxygen);
- Water chemistry samples (e.g., general inorganic chemistry, metals, and TSS);
- Photographs and UTM locations;
- Observations of watercourse flow and substrate; and
- Identification of flow direction and source (e.g., wetlands).

8.6.2.2 Regional Setting

Due to the potential for fish movement and migration, the fish habitat regional setting includes the complete watercourses intersecting the proposed PFA from headwaters downstream to the marine environment. As described in the surface water VEC (**Section 8.4**), the PFA (excluding the Pictou Harbour causeway and the marine outfall) is within headwaters of small secondary or tertiary watersheds that flow typically less than 2 km to either to Pictou Harbour or to the Northumberland Strait. Potential for fish habitat within the local assessment area is dependent primarily on sufficient size and flow characteristics of the watercourse, and on the ability of fish to access the local assessment area (i.e., suitable fish passage from downstream habitat). Fish movements include those of anadromous (fish spawning in freshwater but living in marine environments as part of their life stages), catadromous fish (fish spawning in marine environments but living in freshwater as part of their life stages), and fish that move between marine and fresh water (e.g. sea run trout) or travel within a watercourse as part of seasonal habitat use. The regional setting for freshwater fish includes the Pictou Harbour, Caribou Harbour, marine and estuarine environments as well as watercourses draining the project footprint as identified in **Section 8.4** and illustrated in **Figures 8.4-1** and **8.4-2**. Although not within the freshwater portions of the East, Middle, and West Rivers that flow into Pictou Harbour, there is potential for fish present in these rivers to also be present in smaller watersheds where suitable habitat is present. In general, tributaries which flow to East River, Middle River, and West River are shallow and fast flowing, with substrates of gravel and cobble with good to excellent riparian vegetation for cover (Miles 1983). The freshwater environments of the East River, Middle and the West River support habitat for salmonids (i.e., Atlantic salmon, brook trout, and brown trout), various species of cyprinids (minnows), and American eel (Cairns et al. 2012). In relation to fish movements, of particular interest to the PFA are the Haliburton Brook tributaries, which drain to the West River.

Adjacent to the PFA (i.e., within the local assessment area of the ETF and Pictou causeway), the East River and West River both have estuarine characteristics as they enter Pictou Harbour. In general the harbour (marine/estuarine) habitat is dominated by species that reflect the transitionary and lower energy/sheltered nature. Estuaries are generally considered highly ecologically productive environments; however, the East and West River estuaries and the Pictou Harbour itself have been impacted by centuries of development and settlement (Cuttell 1998). The estuary environment of the East River and West River are important to the life cycle of varying fish species, including a variety of diadromous fish species (including SAR) that migrate through the Pictou Harbour to their spawning grounds in the East and West River. It is anticipated that the subtidal and intertidal areas within the local assessment area adjacent to the ETF footprint area are occasionally frequented by migratory juvenile and adult marine fish including Atlantic salmon. A wide variety of marine, diadromous, and freshwater fish species live or complete part of their life cycle within the watercourses within the Pictou Harbour to Caribou Harbour regional area (see **Section 8.12** for marine fish species). Scientific names are provided in **Table 8.6-1,** below. Typical scattered invertebrates and estuarine macrophytes also occur within the local assessment area, downstream of the PFA.

Potential Fish Species **-** Based on available background information, typical fish species that may enter freshwater areas in the local assessment area include: Atlantic salmon (O'Neil et al. 2000), American eel (Cairns et al. 2012), brook trout, and brown trout (MacMillan 2014). In an assessment conducted by DFO in 2008, typical fish species captured during electrofishing assessments of tributaries to Middle River and East River consisted of Atlantic salmon, brown trout, and cyprinids (i.e., shinners, dace and chub) (MacMillan et al. 2008). White sucker and various sticklebacks may also be anticipated to occur widely.

A list of typical freshwater using fish species known or presumed to occur within the local assessment area is presented in **Table 8.6-1**. Potential priority fish species are discussed further in **Section 8.6.2.4** below.

Table 8.6-1: Fish Species Anticipated Using Freshwater Habitats in Local Assessment Area

Fish	Species	Priority Status+	Relevant Habitat Information**
Anadromous Fish			
Atlantic salmon*	*Salmo salar*	S. Gulf of St. Lawrence pop. COSEWIC Special Concern; provincial S1/-	Adults enter freshwater to spawn (usually fall). Spawn on gravel beds in shallow rapidly flowing water. Juveniles move downstream to brackish water in May-June.
Blueback Herring	*Alosa aestivalis*	provincial S4/Sensitive	Enter streams to spawn in June – lakes and quiet reaches. Adults return to sea. Eggs hatch and juveniles to brackish water in late Aug.-Sept.
Gaspereau*	*Alosa pseudoharengus*	provincial S3/Sensitive	Enter streams to spawn in June – lakes and quiet reaches. Adults return to sea. Eggs hatch and juveniles to brackish water in late Aug.-Sept.
Rainbow smelt	*Osmerus mordax*	provincial S5/Secure	Adults leave marine habitats in the fall to winter in estuaries/lakes. Following spring thaw move into shallow freshwater streams to spawn, then return to sea.
Striped bass*	*Morone saxatilis*	S. Gulf of St. Lawrence pop. COSEWIC Special Concern; provincial S2S3N/May be at risk	Adults leave seas to spawn and enter rivers above head of tide in June.
Catadromous Fish			
American eel *	*Anguilla rostrata*	COSEWIC Threatened; provincial S2/Secure	Adults (females) in lakes and streams, males in estuaries. Fall migration to marine spawning area.
"Freshwater" Fish			
Banded killifish	*Fundulus diaphanus*	provincial S5/Secure	Freshwater widely distributed. Spawns in weedy shallows in the summer.
Brook trout*	*Salvelinus fontinalis*	provincial S3/Sensitive	May be sea run. Spawn in fall in shallow gravel bottomed streams or other oxygenated areas. Adults in cool well-oxygenated lakes and streams.
Brown bullhead	*Ameiurus nebulosus*	provincial S5/Secure	Quiet weedy, mud-bottomed lakes and streams. Spawn in spring in sandy shallows.
Brown trout (introduced)	*Salmo trutta*	provincial SNA/Exotic	May be sea run. Spawn in fall in shallow gravel bottomed streams.
Chain pickerel	*Esox niger*	provincial SNA/Exotic	Invasive species of lakes and streams.
Common shiner	*Luxilus cornutus*	provincial S5/Secure	Occurs in streams and lakes. Spawns in shallow running water in the spring to early summer.
Creek chub	*Semotilus atromaculatus*	provincial S5/Secure	Occurs in streams and lakes. Spawns in streams in the spring.
Lake chub	*Couesius plumbeus*	provincial S5/Secure	Occurs in streams and lakes. Spawns in streams in the spring.
Northern redbelly dace	*Phoxinus eos*	provincial S5/Secure	Prefers acidic waters. Spawns among aquatic plants in summer.
Pearl dace*	*Margariscus*	provincial S3/Sensitive	Inhabits boggy lakes and streams including in Pictou Co.

Fish	Species	Priority Status+	Relevant Habitat Information**
	margarita		
Smallmouth bass	*Micropterus dolomieui*	provincial SNA/Exotic	Prefer clear rocky lakes. Spawn in shallows in June to early July.
Stickleback (Three spine)	*Gasterosteus aculeatus*	provincial S5/Secure	Fresh and brackish habitats. Spawns in spring.
Stickleback (Four spine)	*Apeltes quadracus*	provincial S5/Sensitive	Marine and lakes and streams. Spawns late spring or early summer.
Stickleback (nine spine)	*Pungitius pungitius*	provincial S5/Secure	Widely distributed fresh and salt water. Spawns in summer.
White perch	*Morone americana*	provincial S5/Secure	Fresh and salt water. Spawns in shallows in June.
White sucker	*Catostomus commersonii*	provincial S5/Secure	Occurs in streams and lakes, preferring bottom areas in shallow water. Spawns in the spring in shallow areas where water flows swiftly over a gravel bottom.
Yellow perch	*Perca flavescens*	provincial S5/Secure	Lakes and quiet streams. Spawn in shallows in May.

**Data Sources: Stantec (2017) and Gilhen (1974).
*Priority fish species – see Section 8.6.2.4 below
+Status as of December 2018
S-ranks:
S1 Extremely rare in province; S2 Rare in the province; S3 Uncommon in the province; S4 Widespread, common and apparently secure in province; S5 Widespread, abundant and secure in the province. General Status - "Sensitive" indicating they are potentially susceptible to human activities or natural events "May be at Risk" therefore considered here to be of high conservation concern within the province. "Undetermined" indicating that there is currently insufficient data, information, or knowledge available to evaluate its status.

Potential seasonal sensitivities of freshwater fish in the local assessment area are summarized in **Table 8.6-2,** below.

Table 8.6-2: Seasonal Sensitivity of "Freshwater" Fish Species Potentially Occurring in Local Assessment Area

Common Name	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
American Eel					1	1,2		2	2			
White Sucker												
Mummichog/Killifish												
Various "Minnow" Species												
Yellow Perch/White Perch												
Rainbow Smelt												
Gaspereau												
Atlantic Salmon (Gulf pop.)												
Brook Trout												
Brown Bullhead												

Spawning

Eggs/Sacfry or juvenile in substrate

Source: Gilhen (1974)

Notes: 1 = Juvenile elvers move shoreward with peak migration in late April to late June (COSEWIC 2012) 2. Spring seasonal downstream movements of adults or fall seasonal movements of adults upstream; and/or migrations to spawning areas

8.6.2.3 Freshwater Habitat Characteristics and Potential Fish Species

Freshwater aquatic habitats intersecting the approximate PFA were preliminarily assessed on December 3, 2018. Most watercourses observed were small intermittent to permanent drainages ranging from approximately 0.5 m to 10 m in width (with the exception of the Pictou Harbour estuary [WC4]), typical depths ranging from 0.1 m to 0.5 m (deeper in wetland areas), and generally have undisturbed riparian cover. The majority of these watercourses appear to be located in headwater areas and are primarily associated with wetland habitat (Refer to **Section 8.4**, **Figures 8-4-1** and **8-4-2**). Watercourses within the local assessment area near the ETF footprint area flow directly to Pictou Harbour. Watercourses along the approximate pipeline footprint area include those flowing directly to Pictou Harbour and to Caribou Harbour, and those dominated by two freshwater sub-watersheds: Haliburton Brook (WC7 to WC11) and Mill Brook (WC12 to WC14). These watercourses include:

- WC1, WC2, WC3, WC5, WC6 – flowing to Pictou Harbour estuary areas;
- WC4 – the Pictou Harbour estuary;
- WC7 to WC11 - flowing to Haliburton Brook (and eventually to the West River estuary);
- WC12 to WC14 - flowing to Mill Brook (and eventually Caribou Harbour of the Northumberland Strait); and
- WC15 and WC16 – flowing directly to Caribou Harbour of the Northumberland Strait.

Habitat characteristics of watercourses along the PFA are summarized in **Table 8.6-3,** along with identification of potential fish species that may occur within local assessment area for each watercourses identified as intersecting with the PFA (see **Section 8.4**, **Figures 8.4-1** and **8.4-2**).

Table 8.6-3: Watercourse Fish Habitat Potential Adjacent to the Project Footprint Area (Note: the project footprint is not anticipated to interact directly with fish habitat except for WC2)

ID and Name	Character	Potential Fish Habitat adjacent to the Project Footprint Area?
WC1, Unnamed Tributary to East River	• Intermittent flow drainage channel varying from an agricultural and road ditch in the upper reaches to steep ravine (likely partially manmade) in the lower reaches. At the intersection with the East River estuary, a large barrier beach and driftwood obstruction prevents fish access except at times of extreme flow.	Not fish habitat
WC2, Unnamed Tributary to East River	• Small semi-permanent drainage channel with intermittent flow in the head water. Steam flow with a mix of riffle and run sections. The width of the assessed area was 0.5-1 m (wet) and ~ 2 m (bankfull) and 15-30 cm depth. • Collects drainage from NPNS facility and parking lot as well as WL-2.	Yes – "minnow" rearing/feeding/ spawning. Potential brook trout and American eel**
WC3, Unnamed Tributary to East River	• Ditched upstream of project footprint area; within footprint intermittent to tidal. Connected with Pictou Harbour. The width of the assessed location was 0.5-2 m (wet) and ~2 m (bankfull) and depth was approximately 10-30 cm.	Primarily feeding and passage potential.
WC4, Pictou Harbour	• Large Permanent (estuarine/marine) with fish habitat.	Diadromous and marine fish, including Atlantic salmon and striped bass. See Section 8.12. As well as sea run trout
WC5, Unnamed Tributary to Pictou Harbour	• Intermittent/ditch upstream; culvert under Highway 106 to wetland drainage.	Not fish habitat
WC6, Unnamed Tributary to Pictou Harbour	• Intermittent; receives ditch drainage and WL-4 drainage.	Not fish habitat
WC7/7A, Unnamed Tributary to Haliburton Brook	• Ephemeral to intermittent; drainage associated with roundabout.	Not Fish Habitat
WC8, Unnamed Tributary to Haliburton Brook	• Small permanent watercourse with riffle/run/pool flow. The width of the assessed location was 2-3 m (wet) and ~3 m (bankfull) and depth was approximately 15-40 cm.	Yes – "minnow" rearing/feeding/ spawning. Potential brook trout and American eel**
WC9, Unnamed Tributary to Haliburton Brook	• Small permanent watercourse with riffle/run/pool flow. The width of the assessed location was 2-3 m (wet) and ~3 m (bankfull) and depth was approximately 15-40 cm.	Yes – "minnow" rearing/feeding/ spawning. Potential brook trout and American eel**
WC10, Unnamed Tributary to	• Intermittent; receives drainage from WL-8.	Not fish habitat

ID and Name	Character	Potential Fish Habitat adjacent to the Project Footprint Area?
Haliburton Bk		
WC11, Unnamed Tributary to Haliburton Brook	• Drainage channel. Small to large permanent (wetland channel, but low flow). Approximate width of the assessed area was 4-5 m (wet) and 5 m (bankfull) and 20-60 cm depth.	Yes – "minnow" rearing/feeding/ spawning. Potential brook trout and American eel**
WC12, Mill Brook	• Small (upstream) to large (downstream) permanent watercourse channel through a wetland with beaver chew present. Approximate width of the assessed area was 4-5 m (wet) and 5 m (bankfull) and 20-60 cm depth.	Yes – "minnow" rearing/feeding/ spawning. Potential brook trout and American eel**
WC13A/13B, Unnamed Tributary to Mill Brook	• Intermittent upstream but large ponded wetland flow downstream. WC13B is intermittent wetland drainage.	Not fish habitat
WC14, Unnamed Tributary to Mill Brook	• Intermittent to permanent backwater flooding between two wetlands.	Not fish habitat
WC15, Unnamed Tributary to Caribou Harbour	• Intermittent, potentially ditched.	Yes – "minnow" rearing/feeding/ spawning. Potential brook trout and American eel**
WC16, Unnamed Tributary to Caribou Harbour	• Intermittent, steep with culvert potentially blocking fish access. Discharge is directly into Caribou Harbour. Approximate width of the assessed area was 1-2 m (wet) and 2-3 m (bankfull) and 5-20 cm depth.	Limited potential for American eel**.

Notes:
** Priority fish species – see Section 8.6.2.4 below

Of these watercourses: WC2, WC3, WC4, WC8, WC9, WC11, WC12, WC15, and WC16 were observed to have potential freshwater fish habitat and particularly the capacity to include brook trout and American eel. Refer to **Section 8.6.2.2** above for further information on potential fish species in the local assessment area. Refer to **Section 8.4** for a summary of key water quality parameters for all watercourses with exceedances to the applicable CCME FWAL guidelines and a summary of field parameters.

Each of the watercourses with potential freshwater fish habitat identified is discussed further in this section below.

Unnamed Tributary to East River (WC2) - WC2 is a small, semi-permanent watercourse that originates from a wetland (WL-2), as well as receiving storm drainage from a concrete culvert that drains the NPNS car wash area and discharges non-contact storm water. WC2 also receives a channelized drainage input from the parking area located on the north side of the NPNS facility. This narrow, incised channel was assessed as fish habitat (October 2017 and June 2018).

WC2 was at a mid-level water stage at the time of the June 2018 assessment and the channel pattern observed was sinuous. The morphology of this watercourse consisted primarily of runs and small pools; however, much of the channel is choked with emergent vegetation such as cattails (*Typha* spp.), rushes (*Juncus* spp.), and blueflag iris (*Iris versicolor*). The substrate was composed of boulders (5%), cobbles (10%), large gravels (20%), small gravels (25%), and fines (40%). The relative high proportion of fines composing the substrate is likely the result of runoff from upstream stormwater. Both the left and right banks were composed primarily of fines and alternated from sloped to undercut (note: right and left bank designations are based on upstream facing perspective). In-stream cover is provided by abundant in-stream and over-hanging vegetation, as well as a moderate amount of bank-undercutting.

The average channel and wetted widths along WC2 were 0.74 m and 0.50 m, respectively. Average measured water depth was approximately 0.11 m; pool depth was 0.30 m. WC2's immediate surroundings consist of open grassland with riparian vegetation consisting mostly of herbaceous species such as cattails, soft rush (*Juncus effusus*), blue flag iris, goldenrods (*Solidago* spp.), and sedges (*Carex* spp.). Nearby woody species are sparse, but speckled alder (*Alnus incana*), sweet gale (*Myrica gale*), willows (*Salix* spp.), and roses (*Rosa* spp.) are present in the area. Crown closure was estimated at 51-75%.

The aquatic habitat of WC2 had limited potential for brook trout spawning, with low but sufficient flow and suspected potential areas of gravel (based on bank observations, as the water was too deep and dark to confirm). Within the upper reaches of WL-2, potential rearing habitat was present, owing to good cover and back eddies observed. Overwintering habitat was lacking due to insufficient depth. Stormwater flow may reduce freezing conditions. Small fish, probably minnows, were observed during June 2018 surveys.
Chloride and iron were above the applicable CCME FWAL WQG when assessed in December 2018.

Unnamed Tributary to Pictou Harbour (WC3) – WC3 is an unnamed tributary to the Pictou Harbour. WC3 has a defined channel and consists of an ephemerally flowing ditch along the east side of Highway 106; when flowing, water flows northeast along a steep channelled watercourse which runs down slope towards the Pictou Harbour, collecting debris and suspended sediments. WC3 flows directly into Pictou Harbour, with the lower portion of the stream (i.e., where it discharges to Pictou Harbour) under tidal influence and intermittently flowing Fish may access this lower portion of WC3 during high tides and/or periods of high flow.

WC3 was at a high-level water stage at the time of the field reconnaissance in December 2018. The morphology of this watercourse consisted primarily of small runs and riffles. Substrate appears to be composed of small cobbles and fines; however, due to the high level of total suspended sediment (TSS) at the time of the assessment this could not be confirmed. The banks were generally composed of fines (silts and sand) and are sloped at the assessment location. There was no observed in-stream vegetative cover at the assessed location.

Both the concentrations of iron and zinc were above the applicable CCME FWAL WQG in the upstream and downstream assessment locations when sampled in December 2018. In the downstream sampling location, additional exceedances of the applicable CCME FWAL WQG included aluminum, cadmium, chromium, copper, and lead. Downstream exceedances of the applicable CCME WQG for marine water (as it reflects tidal habitat) included cadmium and chromium. It is noted that the downstream water had high TSS (120 mg/L), which likely contributed to the higher metals concentrations in the downstream sample.

Pictou Harbour Estuary (WC4) - The estuary area of Pictou Harbour is a large permanent watercourse from the confluence of East, Middle, and West Rivers. The pipeline will cross the Pictou Harbour within the Highway 106 Causeway. Water flows under the Harvey A. Veniot Causeway (Highway 106) via an approximately 25 m wide engineered dam that maintains connectivity within Pictou Harbour. Marine and diadromous fish are expected in the area including potentially Atlantic salmon, American eel and Striped bass as well as sea run trout species (see priority species **Section 8.6.2.4** below). Further information on the marine environment is provided in **Sections 8.11**, **8.12** and **8.13**.

Unnamed Tributary to Haliburton Brook (WC8) - WC8 is a small, semi-permanent watercourse that appears to originate in a forested area east of Pine Tree Road, near the Pictou Traffic Circle. Flowing east to west, WC8, is conveyed under Pine Tree Road, Highway 106 and Route 6 via concrete culverts, before finally emptying into Haliburton Brook.

WC8 was at a high-level water stage at the time of the assessment and primarily exhibited a sinuous channel pattern consisting primarily of short riffle - run sequences. The substrate appear to mostly be composed of cobble, gravels and fines, however, the relative high water limited the assessment of the substrate. Both banks were sloped and composed primarily of fines, however some boulders and bank-undercutting were observed on the left bank (note: right and left bank designations are based on upstream facing perspective). In-stream cover was abundant consisting of small woody debris, in-stream vegetation, a dense canopy of over-hanging vegetation, as well as modest bank-undercutting.

Aluminum and zinc were above the recommended CCME FWAL WQG when sampled in December 2018.

Unnamed Tributary to Haliburton Brook (WC9) - WC9 is a permanent watercourse that originates in wetland WL-7, is conveyed under Highway 106 by a concert culvert and meanders through a fringe graminoid and alder wetland before it confluences with Haliburton Brook to the south west.

WC9 was at a high-level water stage at the time of the field reconnaissance in December 2018 and the channel pattern observed was sinuous. The morphology of this watercourse consisted primarily of short runs and small pools. Substrate appears to primarily consist of cobbles; however, due to the high water level at the time of the site visit, the substrate was difficult to observe. The banks were composed primarily of fines at the assessment location and were undercut at a number of locations. In-stream cover was provided by abundant in-stream and over-hanging vegetation, as well as a moderate amount of bank-undercutting.

The surrounding environment consists of wetland WL-7, which is characterized as a shrub swamp/floodplain complex.

The laboratory and field reported pH was below the applicable CCME FWAL recommended range in December 2018. In addition, aluminum, cadmium and iron and were above the recommended CCME FWAL WQG when sampled in December 2018.

Unnamed Tributary to Haliburton Brook (WC11) – WC11 was at a high-level water stage at the time of the field reconnaissance in December 2018. This watercourse flows from east to west where it crosses the pipeline footprint area via a culvert beneath Highway 106. This is an intermediate sized, permanent wetland channel with an apparent slow flow (based on field observations). At the time of field reconnaissance in December 2018, the surface was frozen with the exception of an open area at the mouth of the culvert where water samples were collected. Based on field observations, WC11 appears to flow from WL-10 southeast towards WL-9 and then continues further to the south and west before it eventually discharges to Haliburton Brook.

The immediate surroundings within the PFA consist of WL-10, a permanently flooded birch tree dominated fen. Immediately downstream of the project footprint, WC11 flows to a shrub swamp (WL-9).

The laboratory and field reported pH was below the applicable CCME FWAL recommended range in December 2018. In addition, aluminum and iron and were above the recommended CCME FWAL WQG when sampled in December 2018.

Mill Brook (WC12) - Mill Brook (WC12) runs from southeast to northwest and is permanent watercourse that crosses the pipeline footprint area. Mill Brook provides drainage from wetlands, forests, and urban land, and eventually discharges to Caribou Harbour. Mill Brook receives drainage from WL-11 and the channel flows northwest and crosses Highway 106 via a culvert and flows into WL-12 before it confluences with WC13.

WC12 was at a high-level water stage at the time of the field reconnaissance in December 2018 and the channel pattern observed was sinuous. At the time of the field visit, the banks were partially flooded and covered with ice and snow, therefore the substrate was not assessed. The approximate channel width was 2 m, but depth could not be estimated due to ice coverage. Mill Brook's immediate surroundings within the pipeline footprint area consist of cattail-dominated marsh (WL-12A) which is partially impounded by Highway 106.

No exceedances to the applicable CCME FWAL WQG were reported in the samples collected in December 2018 for general inorganic chemistry and metals.

Unnamed Tributary to Caribou Harbour (WC15) - WC15 is a small, intermittent and partially ditched watercourse and was assessed at the culvert that conveys it beneath Highway 106, just south of Three Brooks Road Overpass structure. WC15 was at a high-level water stage at the time of the December 2018 field reconnaissance and the channel banks were flooded. At the assessment site adjacent to the Highway 106 pipeline footprint area, WC15 runs along the west side ditch of Highway 106 south to north and receives ditched run-off water from the east side of Highway 106 via a culvert flowing east to west. WC15 then flows west along the ditch of Three Brooks Road with eventual discharge assumed to be north to the Caribou Harbour.

WC15 was at a high-level water stage at the time of the reconnaissance. Cover was provided by emergent vegetation (i.e., rushes, reeds and cattails) in the drainage channels and mixed conifers and broad leaf vegetation growing on the banks. The approximate width of the watercourse ranged from 1-2 m and the average depth during the field reconnaissance was estimated to be 0.5-1 m.

The laboratory and field reported pH in December, 2018 was below the applicable CCME FWAL recommended range. In addition, aluminum, cadmium, iron, lead and zinc were above the recommended CCME FWAL WQG when sampled in December 2018.

Unnamed Tributary to Caribou Harbour (WC16) – WC16 is a small intermittent to semi-permanent watercourse that flows through a forested area in close proximity to Highway 106 (approximately 12 m west of the highway) before discharging directly into Caribou Harbour, immediately adjacent the ferry terminal. At the assessment location, WC16 emerges directly from a perched culvert approximately 15 m upstream and is very steep. Both the perched culvert and steepness of WC16 represent likely barriers to fish access and passage.

The laboratory reported pH was below the applicable CCME marine WQG range in December 2018, noting the reported field pH was within the recommended range. In addition, aluminum and iron concentrations were above the recommended CCME FWAL WQG when sampled in December 2018.

8.6.2.4 Priority Freshwater Fish Species Findings

Screening for potential priority freshwater fish species included a review of fish species listed by the AC CDC (AC CDC 2018a) and of fish species expected to be in the general and local assessment area as noted in **Section 8.6.1,** above. The AC CDC report (AC CDC 2018a) had no historic records of fish SAR or SOCC observed within a 5 km radius of the PFA. However, it is noted that priority fish species are not typically included in AC CDC data collection. Based on current information, there is no federally identified freshwater critical habitat for fish within the PFA.

The following priority freshwater/diadromous fish have potential to occur within the local assessment area:

Atlantic salmon (Southern Gulf of St. Lawrence population) - Atlantic salmon entering southern Gulf rivers typically have fall runs (with the exception of the Morell River and Margaree Rivers) (COSEWIC 2015). The East and West Rivers (Pictou) are listed Atlantic salmon rivers with historic low angling catches and assumed populations. From 2006-2010 an average of less than 150 releases and 10 grilse kept were reported for the East River; less than 60 releases and 17 grilse kept for the West River; and only less than 7 captures for the entire 1984-2011 period in the Middle River (Breau 2012). A 1996 population estimate for the East River was less than 1000 fish (O'Neil et al. 2000). Atlantic salmon habitat is not anticipated within the small freshwater watercourses in the immediate vicinity of the project footprint, but salmon are expected to be present on an occasional basis in the vicinity of the Pictou causeway section of the proposed pipeline. Prior to heading to spawning areas up river, the salmon spend time within estuary areas including the Pictou Harbour estuary. The timing of acclimation in the estuary and seaward migration of adults is not well known for any of the rivers in the study area. Additional detail on Atlantic salmon is provided within the marine section (**Section 8.12**).

American eel - Adults are known to occur in suitable habitat throughout the local assessment area (Cairns et al. 2012) and are likely to occur in areas of suitable habitat including within the PFA at WC2 and adjacent to the pipeline footprint at WC3, WC4, WC8, WC9, WC12, and WC15. As eels spawn at sea, freshwater habitat is expected to be used for elvers (young eels) and for adult foraging. American eels are also identified for marine habitat related to the project (**Section 8.12**).

Brook trout – Brook trout are anticipated to occur in most permanent watercourses in the local assessment area including sea runs to the Pictou Harbour estuary area (McMillan 2014). Potential brook trout habitat was observed within the PFA at WC2 and adjacent to the PFA within WC3, WC4, WC8, WC9, WC12, and WC15. Spawning habitat is limited within the vicinity of the PFA.

Gaspereau – Gaspereau run up rivers within the Gulf of St. Lawrence, however populations have been reduced by exploitation and passage issues (DFO 2001). Gaspereau enter freshwater to spawn in the spring (typically June) in lakes and quiet streams. Gaspereau habitat was not observed during preliminary reconnaissance in the vicinity of the PFA, other than potential for estuary/marine habitat within Pictou Harbour adjacent to WC4.

Pearl dace – This minnow species inhabits boggy lakes and streams and is known to occur in Pictou County. Although no specifically identified within the local assessment area, there is potential for this fish to occur if suitable habitat is present.

Striped bass (Southern Gulf of St. Lawrence population) – Striped bass are reported to use the eastern section of the Northumberland Strait as a migration corridor (COSEWIC 2012b). Additional detail on striped bass is provided within the marine section (**Section 8.12**). Striped bass adults leave marine habitats typically in June to spawn above head of tide. Striped bass habitat was not observed during preliminary reconnaissance in the vicinity of the PFA, other than potential for estuary/marine habitat within Pictou Harbour adjacent to WC4. Within the local assessment area, striped bass are known to congregate "upstream" of the gate under the Pictou causeway (WC4)(pers. comm. C. Kennedy).

8.6.3 Impact Evaluation/Effects Assessment

The environmental effects of the project on freshwater fish VEC are assessed in this section. Direct loss of fish habitat may occur at watercourse WC2 due to the spill basin and potential infrastructure footprint. The pipeline will be installed along the existing shoulder of Jubilee Highway 106, and will encroach within 30 m of watercourses that intersect Route 106, resulting in the potential for indirect adverse environmental effects to the aquatic environment. Where possible, the pipeline will be installed over top of the existing watercourse crossings (i.e., culverts and cross drain). However, where this method is not possible (such as at WC3), pipeline crossing methods that do not directly affect fish habitat (such as horizontal directional drilling) will be prioritized based on feasibility. These methods will limit the potential need for in-water work, and consequent environmental effects resulting from it. In watercourse work along the pipeline project footprint will only be conducted on completion of a supplementary habitat assessment at an appropriate time of year, development of appropriate mitigation including offset if required, and will be subject to provincial (NSE) and federal approvals (DFO).

8.6.3.1 Potential Environmental Effects

Without mitigation, the project could interact with freshwater fish and fish habitat in the following ways:

- Construction activities have the potential to result in the direct loss of fish habitat in areas where the project footprint encroaches on fish habitat (if required);
- Construction could also result in the indirect loss of fish habitat in areas where the presence of project-related facilities cause a change in surface water availability (e.g., a local change in drainage pattern); and
- Construction in the areas of wetlands and watercourses (including within the 30 m buffer) could increase erosion rates in proximity to aquatic receptors and affect water quality.

Once construction is complete, there are no anticipated environmental effects to freshwater fish and fish habitat during operation and maintenance of the project.

Hazardous material spills, failure of erosion and sedimentation control devices, and other potential accidents, malfunctions or unplanned events that could affect freshwater fish and fish habitat are assessed in **Section 10**.

8.6.3.2 Mitigation

Mitigation measures for the proposed project include the following:

- Work will follow environmental management planning and standard mitigation as outlined in **Section 5.7** and as identified for surface water and wetlands protection (**Sections 8.4 and 8.7**, respectively);
- Where possible, the pipeline will be installed over top of the existing watercourse crossings (i.e., culverts and cross drain). However, where this method is not technically feasible, HDD or similar non-contact crossing methods will be employed unless an alternate method is approved by applicable provincial (NSE) and/or federal approvals (DFO);
- WC3 will be crossed using trenchless technology unless otherwise approved by NSE/DFO;
- Where required (i.e., where watercourse disturbance is necessary), obtaining an authorization under Section 35(2) of the *Fisheries Act* for any project activities that would result in the loss of fish habitat or other activities that result in serious harm to fish (as determined by DFO), with appropriate offsetting;
- Construction and operation activities will comply with the conditions of watercourse alteration approvals and *Fisheries Act* authorizations (as applicable);
- In fish bearing watercourses, a fish rescue program will be implemented prior to undertaking construction activities, and fish will be removed and relocated as per DFO guidance and consultation;
- Project team and contractors will be educated on recognizing potential aquatic SAR that may occur within the PFA; and
- An Emergency Response plan for accidental spills, emergencies, incidents or storm events will be completed and detailed in the EPP, and the contractor will be required to provide spill response training to construction personnel.

8.6.3.3 Characterization of Residual Environmental Effects

Construction Phase

Construction related activities have potential to result in changes in water quality due to erosion and/or sediment generation which can be transported into surface waters. Any impacts to on-site surface waters, including wetlands and streams, will most likely be a result of erosion, sediment transport or chemical contamination from stormwater runoff. A failure of erosion and sedimentation control devices is assessed in **Section 10**.

Direct fish habitat loss will occur at WC2 which will be mitigated by obtaining and complying with a watercourse alteration approval and/or an authorization under the federal *Fisheries Act* (with appropriate offsetting), as required by NSE and DFO. Based on the approximate width and length of watercourse within the PFA an estimated 45 m^2 of fish habitat will be affected.

Operation and Maintenance Phase

Once the project is operational, no impacts are anticipated to freshwater fish and fish habitat during the operation and maintenance phase. Operation and maintenance activities at the proposed ETF facility will be similar to existing NPNS activities and stormwater runoff during operation and maintenance will be monitored as part of follow-up and within the Mill Monitoring Network. Operation and maintenance activities along the proposed roadside pipeline will reflect existing highway maintenance activities undertaken by NSTIR (such as road salting and roadside vegetation maintenance) and no significant interaction is anticipated with the project.

8.6.4 Summary

Table 8.6-4, provides a summary of the residual environmental effects of the project on freshwater fish and fish habitat. With the implementation of the identified mitigation measures, significant adverse residual effects to the surface water quality component of fish habitat are not likely to occur.

Table 8.6-4: Summary of Residual Environmental Effects on Freshwater Fish and Fish Habitats

Phase and Activities	Potential Effects	Mitigative Factors and Measures	Residual Effects	Significance of Residual Effects
Construction				
Site preparation vegetation clearing, grubbing and grading Construction of effluent treatment facility Construction and installation of effluent pipeline Pipeline trench backfilling, watercourse and wetland crossings (HDD or tunneling), pipe testing and pipeline commissioning	Indirect loss of fish habitat - suspended sediment generation and other water quality effects; and, Indirect effects in relation to hydrological changes	Implement mitigation measures as outlined in Section 5.7 (Standard) including erosion and sediment control and Section 8.4 (Surface Water) Comply with NSE conditions of approval for clearing within 30 m of watercourses	Negligible with standard mitigation applied. Indirect, Reversible Magnitude - negligible Duration – construction season plus 3-5 years Frequency - low Geographic extent - site-specific Context – existing Highway 106 road drainage and existing NPNS industrial site	Not Significant -Adverse

Phase and Activities	Potential Effects	Mitigative Factors and Measures	Residual Effects	Significance of Residual Effects
	Direct Loss of Fish Habitat	Avoid watercourse crossings where possible. Comply with NSE watercourse alteration conditions of approval for activities within 30 m of watercourses Conduct fish rescue under DFO permit for areas of direct habitat loss Comply with DFO Authorization conditions of approval for work in fish bearing watercourses including approved offset and effects monitoring Project team and contractors will be educated to recognize potential SAR that may occur within the project area	Negligible with standard mitigation applied. Direct, Irreversible Magnitude - negligible Duration – long term (duration of construction phase) Frequency - low Geographic extent - site-specific Context - existing Highway 106 road drainage and existing NPNS industrial site	Not Significant –Adverse

In light of the above, and with authorization and offsetting measures as mitigation for direct loss of fish habitat, the relocation of fish from within the PFA, and the implementation of other mitigation measures aimed at reducing or minimizing environmental effects on fish and fish habitat, the residual environmental effects of the project on freshwater fish and fish habitat during all phases of the project are rated not significant, with a moderate level of confidence. The implementation of water management features, water quality monitoring, groundwater level monitoring, and other follow-up and monitoring measures to be implemented to monitor changes to water quality or water levels arising from the project, with adaptive management measures implemented as necessary to address those changes, will improve the confidence of this prediction.

8.6.5 Follow-up and Monitoring

The following follow-up and monitoring efforts will be implanted as a part of the project:

- Field verification of fish habitat within watercourses in the vicinity of the project footprint prior to construction;
- Baseline, compliance and effects monitoring of surface water quality as described in **Section 8.4** (surface water);
- Follow-up as required to meet regulatory approvals requirements if in-stream crossing methods considered; and
- Follow-up effects monitoring of fish habitat offset, if required, to meet DFO requirements.

8.7 Wetlands

The potential environmental effects of the project on wetlands and associated habitat (hereinafter referred to as the wetlands VEC, for brevity) are assessed in this section.

8.7.1 Scope of VEC

In Nova Scotia, wetlands are defined as "land commonly referred to as marsh, swamp, fen or bog that either periodically or permanently has a water table at, near or above the land's surface or that is saturated with water, and sustains aquatic processes as indicated by the presence of poorly drained soils, hydrophytic vegetation and biological activities adapted to wet conditions" (NSE 1989). Wetlands were selected as a VEC because of their value to the Nova Scotia landscape and relationship with water resources, wildlife and wildlife habitat, and other biological and physical components addressed as VECs in this EA Registration. Wetlands are widely recognized as providing a host of ecosystem functions and benefits including, but not limited to, filtering out pollutants and heavy metals, mitigating flood events, and providing habitat to many SAR in Nova Scotia. Project activities have the potential to cause adverse environmental effects through the proposed physical destruction of wetland habitat, as well as the related destruction of terrestrial and aquatic vegetation.

Nova Scotia's wetlands have been given specific protection by the Nova Scotia Wetland Conservation Policy (NS 2011) pursuant to the Nova Scotia *Environment Act*. The Activities Designation Regulations pursuant the *Environment Act* include a requirement for an approval from NSE before any alteration of a wetland.

Priority species associated with wetlands are address within other VECs – fish (**Section 8.6**), plants (**Section 8.8**), wildlife (**Section 8.9**), and birds (**Section 8.10**).

8.7.1.1 Boundaries

Spatial boundaries for the assessment of environmental effects on wetlands include the following:

- The **project footprint area (PFA)** is defined as the maximum extent of the physical area of disturbance associated with the project. The PFA will include all temporary and permanent areas of ground and marine disturbance. The PFA is defined in **Section 5.1.1** For the terrestrial portion of the project, two distinct footprint areas are assessed: the physical footprint of the replacement ETF, an area comprising 20.8 ha of land within the NPNS property boundary; and the transmission pipeline footprint which is based on proposed disturbance during construction of Highway 106 road shoulder and associated areas required to be cleared ancillary to construction. The estimated total area of potential temporarily disturbed area during construction is 66.6 ha; and
- The **local assessment area (LAA)** is the maximum area within which environmental effects from the project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence (i.e., the potential zone of influence of the project's indirect effects on

contiguous features, such as changes in hydrology). For the wetland VEC, the local assessment area is to include the local wetland sub-watershed encompassing each wetland.

Temporal boundaries for the assessment of environmental effects on the environment include periods of construction, operation and maintenance, and decommissioning. Construction is estimated to be approximately 21 months, beginning second quarter of 2019, commencing as soon as the EA review has been completed and the applicable permits, approvals or other forms of authorization have been obtained. Operation and maintenance will commence immediately following the construction phase and will continue to operate efficiently and safely for several decades and likely much longer with a well-maintained system. For the purpose of this EA Registration, it has been assumed that the operation and maintenance phase will begin in the fourth quarter of 2020. Decommissioning of the project would occur at the end of mill life following the completion of operations. Once the ETF or pipeline is nearing the end of a useful service life, a decommissioning plan will be developed and will be submitted for a separate review requiring NSE approval.

8.7.1.2 Significance Criteria

A significant adverse residual environmental effect on wetlands is one where project-related activities result in a net loss of wetland function that cannot be compensated (as per the Nova Scotia Wetland Conservation Policy).

Potential effects to wetland priority species are assessed under separate VECs.

8.7.2 Existing Environment

The information regarding the presence and characterization of wetlands within the PFA and local assessment area was derived from several sources including existing databases and secondary information sources (i.e., desktop analysis) as well as reconnaissance-level field surveys. The methods used during the desktop analysis and field surveys are presented below in the following sections.

8.7.2.1 Regional Setting

The PFA and LAA are within the Maritime Lowlands Ecoregion and, more specifically, within the Pictou-Cumberland Lowlands Ecodistrict, which hosts undulating plains of ridges and valleys (Webb and Marshall 1999). The Ecodistrict has few lakes and streams on the lowlands that branch irregularly to form a dendritic drainage pattern as they flow northward from their source in the Cobequid Highlands. Peatlands are numerous in areas of low relief and adjacent to meandering streams. Salt marshes line some of the shallower harbours and inlets along the coast (Webb and Marshall 1999).

Within this Ecoregion, tolerant hardwood stands dominated by American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), and yellow birch (*Betula alleghaniensis*) sit on ridge tops with fertile soils. On less fertile ridges, hardwoods tend to be dominated by American beech, red maple (*Acer rubrum*), and trembling aspen (*Populus tremuloides*). Softwood forests in the area tend to be associated with

lower slopes and shallow soils. The softwood forests are dominated by red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), and white spruce (*Picea glauca*), with occasional eastern hemlock (*Tsuga canadensis*) and white pine (*Pinus strobus*) (Zelazny 2007).
Within this Ecoregion, many mixed wood and coniferous forests exist and are composed mainly of red spruce (*Picea rubens*), balsam fir, red maple, eastern hemlock (*Tsuga canadensis*), and eastern white pine (*Pinus strobus*). Within wetlands, the dominant tree types are black spruce (*Picea mariana*) and eastern larch (*Larix laricina*) at their perimeters. This Ecoregion has a history of forest fires due to the warm, dry summers and is indicated by the abundance of fire-adapted species, particularly jack pine (*Pinus banksiana*) and black spruce (Webb and Marshall 1999).

Additional details on the ecological classifications for the local assessment area are provided in **Section 8.8**.

8.7.2.2 Desktop Analysis

Review of available information to assist with the assessment of potential wetland habitat included the following sources:

- Data evaluated for priority species as outlined in **Sections 8.6**, **8.8**, **8.9** and **8.10** including a site-specific AC CDC report (AC CDC 2018a) identifying priority species and significant or managed areas;
- Nova Scotia provincial Significant Habitat database which includes the provincial wetland database (GNS 2018a and 2018b);
- Google Earth Satellite and “Street View” imagery; and
- NSDLF Provincial Landscape Viewer Wet Area Mapping and Predictive Flow Models (GNS 2018 b).

The potential for priority flora species was based on species identified by the AC CDC as having been historically observed within 5 km of the PFA (or farther if potential wide ranging species) and comparison of the local assessment area habitats with potential habitat requirements for the identified species. **Section 8.8** details the habitat types that are found within the local assessment area. Potential at-risk species “short-listed” for the local assessment area (including fish, plants, and animals/birds), their likely habitat, preferred investigation period, and priority status are detailed in **Sections 8.6, 8.8, 8.9,** and **8.10**, respectively.

8.7.2.3 Wetland Determination, Delineation and Functional Assessment Methods

Wetlands were identified based on NSDLF’s wetland database, previous assessments in the area, satellite data, and field surveys. Following the desktop analysis for the PFAand local assessment area, wetlands were assessed within the PFA by the implementation of the field methodologies (described below). It should be noted that fall 2017 to summer 2018 field investigations were undertaken at the replacement ETF footprint area and surrounding area, but as an alternate pipeline route was selected in the fall of 2018 (see **Section 5.3**) and due to the fall/winter timing of route selection, only a preliminary reconnaissance visit of the pipeline footprint area was undertaken. Investigations included:

- Habitat evaluation at the ETF footprint area – October 2017, June 2018; and

- Reconnaissance of the pipeline footprint area– December 3, 2018.

Wetlands outside of the replacement ETF footprint area (i.e., along the pipeline footprint area) were assessed primarily via a desktop review with a preliminary field reconnaissance visit. The wetland types are to be field verified during the spring to summer of 2019. Wetlands within the ETF footprint area were surveyed by Dillon biologist certified in wetland delineation and functional assessment on June 12, 2018.

Within the replacement ETF footprint area, wetlands were determined to be present if vegetative; soil and hydrologic indicators occurred following the provincial process which is based on the United States Army Corps of Engineers Wetland Delineation Manual methodology (USACE 1987). Wetland classes are based on the Canadian Wetland Classification System (NWWG 1997), and additional information was collected on wetland function. Wildlife habitat, species at risk (SAR), and species of conservation concern (SOCC) are based on background data, vegetation, bird, and wildlife (including herptiles) assessments presented in other sections of this EA Registration. Assessment of hydrological and surface water function is based on watershed character.

Wetland Determination and Delineation

The field wetland determination and delineation methods described below are based upon established protocols for wetland delineation, as outlined by the United States Army Corps of Engineers Wetland Delineation Manual (USACE 1987). Wetland determination and delineation is focused on establishing the wetland-upland edge, and is based upon the presence of positive indicators for three parameters:

- hydric soils;
- hydrophytic vegetation; and
- wetland hydrology.

A positive indicator must typically be present for all three parameters in order to definitively identify the boundary (edge) of a wetland. Sample points for these three parameters are typically established at representative locations within the wetlands being assessed.

Upon positive wetland determination (i.e., positive indicators identified for soils, hydrology and vegetation), a wetland edge condition is established based on the indicators identified at the three-parameter sample points. This edge condition is then used to navigate around the perimeter of the wetland, which is georeferenced using a handheld geographical positioning system (GPS) unit (3 to 5 m accuracy).

In order to assure the accuracy of the boundary being delineated, additional soil samples are often made using a soil auger at regular intervals during the delineation. By doing so, the presence of hydrology and hydric soil indicators is able to be confirmed, and continually corroborated with the observation of wetland vegetation and topographic relief, all of which assist in the delineation of the wetland-upland edge condition.

The following defines the wetland parameters:

Hydric Soils - Hydric soil conditions are formed when an area of land is exposed to flooding or saturation for a sufficient length of time during the growing season such that an anaerobic (or oxygen-free) environment is created within the soil matrix. These anaerobic conditions may reveal themselves in a number of ways, but often through the formation of redox (reduction-oxidation) features within the soil matrix, the development of organic soils (i.e., peat), or the creation of hydrogen sulphide (rotten-egg odour), among many other indicators. Interpretation of soil profiles, their associated colours, textures and the presence/absence of any hydric soil indicators provides the basis for judgment of whether or not any given soil is a hydric soil (USDA 2010).

Soil sampling is performed to a depth of at least 50 cm (or to point of refusal, such as bedrock) to identify conditions in wetland soils. Soil horizons are documented in terms of their texture, thickness, colour (Munsell value/chroma/hue) and presence of hydric soil indicators (when applicable). Hydric soil indicators are determined as per *Field Indicators of Hydric Soils in the United States* (USDA 2010). Wetland Delineation Data Sheets were used to record data collected in the field. The data sheets provide the detailed soil information for each sample point, as well as list the various possible hydric soil indicators.

Hydrophytic Vegetation - Hydrophytic vegetation arises in areas of land where saturation or inundation is of a sufficient duration so as to exert a controlling influence on the plant community derived therefrom. In such areas, plant species which are adapted to high-moisture environments tend to dominate. In order for a given area to classify as a wetland, hydrophytic vegetation should account for the majority (>50%) of the sample sites' total vegetation (USACE 1987).

For every plant species, there is a wetland indicator status which may be interpreted as that species' estimated probability of occurring within a wetland (USACE 1987). If the majority of plant cover in the sample area is comprised of species with facultative (FAC), facultative wetland (FACW), or obligate (OBL) statuses, then the positive indicator for hydrophytic vegetation is met. If the majority of plant cover in the sample area is comprised of species with a facultative upland (FACU) or upland (UPL), then the area sampled is unlikely to be subject to wetland processes and is probably not a wetland. Wetland indicator statuses for plant species were determined as per United States Department of Agriculture (USDA) Region 1 (Nova Scotia and New Brunswick) listings for interpreting USDA Wetland Indicator Statuses. Species encountered at each of the sample locations were analyzed at three strata (tree, shrub, and herbaceous) and were documented in terms of their percent (%) cover within a given plot size (10 m, 5 m and 2 m radius, respectively) and their wetland indicator status (FAC, FACW, and OBL). Wetland indicator status definitions are provided in **Table 8.7-1** below.

Table 8.7-1: Wetland Indicator Status and Their Definitions

Indicator Status	Definition	% Occurrence in Wetlands
Obligate (OBL)	Almost always occur under natural conditions in wetlands.	99%
Facultative Wetland (FACW)	Usually occur in wetlands, but occasionally found in non-wetlands.	67-99%
Facultative (FAC)	Equally likely to occur in wetlands and non-wetlands.	34-66%
Facultative Upland (FACU)	Usually occur in non-wetlands, but occasionally found in wetlands.	1-33%
Upland (UPL)	Can occur in wetlands in other regions, but almost always occur in non-wetlands of the specified region.	1%

Source: Adapted from Lichvar et al. (2012)

Wetland Hydrology - Both in the soil pits prepared, and over the greater area of the wetland, observations were made concerning the presence of a hydrological regime, which would sustain wetland processes. Taken into consideration were: the site context, site location, and the microtopography of the wetland area.

Primary hydrology indicators (of which at least one must be present) include surface water, a high water table, soil saturation, and sediment deposits, among many other others (USACE 1987). Secondary indicators (of which two are required, in the absence of a primary indicator) include surface soil cracks, drainage patterns, moss trim line, and drift or sediment deposits, among many others.

Functional Assessment: Wetland Ecosystem Services Protocol-Atlantic Canada (WESP-AC)

WESP-AC represents a standardized approach to the way wetland functional assessment data are collected and interpreted to indirectly yield relative estimates of a wide variety of important wetland functions and their associated benefits.

WESP-AC generates scores (0 to 10 scale) and ratings (“Lower”, “Moderate”, or “Higher”) for a variety of wetland functions using visual assessments of weighted ecological indicators. The number of indicators that is applied to estimate a particular wetland function depends on which function is being assessed. The indicators are then combined in a spreadsheet using logic-based, mathematical models to generate the score and rating for each wetland function and benefit (Adamus 2018). Together they provide a profile of “what a wetland does.”

For each function, the scores and ratings represent a particular wetland’s standing relative to those in a statistical sample of non-tidal wetlands previously assessed in the province (121 for Nova Scotia) (Adamus 2018). **Table 8.7-2,** provides a list of various functions, their definitions, and potential benefits.

Table 8.7-2: Benefits of Wetland Functions Scored by WESP-AC

Function	Definition	Potential Benefits
Hydrologic Functions:		
Water Storage and Delay	The effectiveness for storing runoff or delaying the downslope movement of surface water for long or short periods.	Flood control, maintain ecological systems
Stream Flow Support	The effectiveness for contributing water to streams especially during the driest part of a growing season.	Support fish and other aquatic life
Water Quality Maintenance Functions:		
Water Cooling	The effectiveness for maintaining or reducing temperature of downslope waters.	Support cold water fish and other aquatic life
Sediment and Retention Stabilization	The effectiveness for intercepting and filtering suspended inorganic sediments thus allowing their deposition, as well as reducing energy of waves and currents, resisting excessive erosion, and stabilizing underlying sediments or soil.	Maintain quality of receiving waters. Protect shoreline structures from erosion.
Phosphorous Retention	The effectiveness for retaining phosphorus for long periods (>1 growing season).	Maintain quality of receiving waters.
Nitrate Removal and Retention	The effectiveness for retaining particulate nitrate and converting soluble nitrate and ammonium to nitrogen gas while generating little or no N_2O (a potent GHG).	Maintain quality of receiving waters.
Organic Nutrient Transport	The effectiveness for producing and subsequently exporting organic nutrients (mainly carbon), either particulate or dissolved.	Support food chains in receiving waters.
Ecological (Habitat) Functions:		
Fish Habitat	The capacity to support an abundance and diversity of native fish (both anadromous and resident species).	Support recreational and ecological values.
Aquatic Invertebrate Habitat	The capacity to support or contribute to an abundance or diversity of invertebrate animals which spend all or part of their life cycle underwater or in moist soil. Includes dragonflies, midges, clams, snails, water beetles, shrimp, aquatic worms, and others.	Support salmon and other aquatic life. Maintain regional biodiversity.
Amphibian and Reptile Habitat	The capacity to support or contribute to an abundance or diversity of native frogs, toads, salamanders, and turtles.	Maintain regional biodiversity
Waterbird Feeding Habitat	The capacity to support or contribute to an abundance or diversity of waterbirds that migrate or winter but do not breed in the region.	Support hunting and ecological values. Maintain regional biodiversity.
Waterbird Nesting Habitat	The capacity to support or contribute to an abundance or diversity of waterbirds that nest in the region.	Maintain regional biodiversity.
Songbird, Raptor, and Mammal Habitat	The capacity to support or contribute to an abundance or diversity of native songbird, raptor, and mammal species and functional groups, especially those that are most dependent on wetlands or water.	Maintain regional biodiversity.
Native Plant Habitat and	The capacity to support or contribute to a diversity of native, hydrophytic, vascular plant species, communities, and/or functional	Maintain regional biodiversity and food

Function	Definition	Potential Benefits
Pollinator Habitat	groups, as well as the pollinating insects linked to them.	chains.
Public Use and Recognition*	Prior designation of the wetland, by a natural resource or environmental agency, as some type of special protected area. Also, the potential and actual use of a wetland for low-intensity outdoor recreation, education, or research.	Commercial and social benefits of recreation. Protection of public investments.

*Considered a benefit rather than a function of wetlands
Source: Adamus (2018)

8.7.2.4 Results of Field Assessment of Wetlands Within the ETF Footprint Area

Wetlands located within the ETF footprint area are identified in **Table 8.7-3,** below. Wetland delineation data sheets and wetland photos are provided in **Appendix O**. The locations of wetlands within the ETF footprint area are shown on **Figure 8.4-1** in **Section 8.4**.

Table 8.7-3 : Summary of Results of Field Assessment of Wetlands Within the ETF Footprint Area

Wetland	Wetland Type	Key Wetland Functions[1]	Rare Plants	Total Delineated Area (ha)	Area (ha) of Wetland to be Potentially Affected by the Project activities[3]
Wetland #1 (WL-1)	Wet meadow	Note [2]	No	0.036	0.036
Wetland #2 (WL-2)	Shrub swamp	Surface water detention Resident fish habitat Aquatic invertebrate habitat Amphibian and turtle habitat Waterbird feeding habitat Waterbird nesting habitat Songbird, raptor and mammal habitat	No	0.75	0.12
Total Wetland Area				0.786	0.156

Notes:
1. Key wetland functions are those functions that scored as 'higher' during the WESP-AC. Refer to detailed WESP-AC results in **Appendix O**.
2. The WESP-AC functional assessment for this wetland did not identify higher scoring functions. The functions for this wetland scored low and moderate.
3. Wetland area affected includes both direct footprint and likely area of impaired function.

Further information on these wetlands is provided below.

Wetland 1 (WL-1) – 0.036 ha Wet Meadow

Based on the results of the field assessment, Wetland WL-1 is characterized as a 0.036 ha seasonally flooded and permanently saturated wet meadow that is generally flat and located on at the toe of a gentle slope. There is no inlet stream and outflow appears to be temporary through the ditch along the adjacent roadway. This wetland does not have a treed overstory. The shrub layer was dominated by willow (*Salix bebbiana*). The herbaceous understory layer was dominated by woolgrass (*Scirpus cyperinus*), field horsetail (*Equisetum arvense*), and common marsh bedstraw (*Galium palustre*). All of the dominant species in the vegetation community identified at Wetland WL-1 are wet adapted based on their indicator status (i.e., FAC, FACW, OBL) (USACE 1987); therefore, this wetland is considered to have a "hydrophytic" or wet adapted vegetation community. There were no flora SAR or SOCC observed during the desktop or field delineations of this wetland. The wetland also had wet soil indicators in the form of a thick organic layer at the surface that is slower to decompose due to wet conditions that occur in this wetland on a seasonal basis and a H_2S odour. The wetland had several hydrology indicators including, surface water present, a high water table and saturation of soil as well as a sparsely vegetated concave surface, aquatic fauna, a H_2S odour (mentioned above), surface soil cracks, stunted and stressed vegetation. The origin of the wetland was likely a shrub swamp that has naturalized into a wet meadow following clearing and ditching.

Wetland 2 (WL-2) – 0.75 ha Shrub Swamp

Based on the results of the field assessment, Wetland WL-2 is characterized as a 0.75 ha shrub swamp that is permanently saturated, seasonally flooded and is generally flat (i.e., basin position). No stream inflow was observed and a seasonal outflow channel exists east of the wetland and drains north to the Pictou Harbour. The overstory (trees) within the wetland was dominated by white pine (*Picea glauca*) and American mountain-ash (*Sorbus americana*); as well, the overstory also consisted of red maple (*Acer rubrum*). The shrub layer was dominated by broadleaf cattail (*Typha latifolia*) and also contained field horsetail (*Equisetum arvense*), woolgrass (*Scirpus cyperinus*), cinnamon fern (*Osmunda cinnamomea*), sweet pea (*Lathyrus* sp.), Valerian (*Valeriana officinalis*), and common marsh bedstraw (*Galium palustre*). The vegetation community identified at Wetland WL-2 (shrub swamp) is comprised of greater than 50% wet adapted vegetation species based on their indicator status (i.e., FAC, FACW, OBL) (USACE 1987); therefore, this wetland is considered to have a "hydrophytic" or wet adapted vegetation community. There were no flora SAR or SOCC observed during the desktop or field delineations of this wetland. The wetland also had wet soil indicators in the form of a thick organic layer at the surface that is slower to decompose due to wet conditions, and a H_2S odour was observed, indicating decomposition of organic material in a low oxygen environment. The origin of the wetland appears to be natural but it is likely that the hydrology and drainage have been altered by the construction of the adjacent parking lot and associated stormwater inputs from the NPNS facility.

8.7.2.5 Results of Field Reconnaissance of Wetlands Adjacent to the Pipeline Footprint Area

The proposed location of the effluent pipeline changed following the completion of the wetland program for the ETF footprint area during the summer of 2018. As such, a significant portion of the PFA (i.e., the pipeline footprint area) has not been surveyed in detail for wetlands. A desktop assessment methodology was first used to identify wetlands present or potentially present within the pipeline local assessment area as noted in **Section 8.7.2.2** above.

Following the desktop analysis, a reconnaissance-level field survey of the pipeline footprint and immediately adjacent habitat was conducted in December 2018. The primary objective of this effort was to confirm the presence and characterization of desktop identified wetlands. A secondary objective was to locate and characterize any previously unidentified wetland areas that may interact with the project footprint. Full delineations and evaluation of wetland functions for the wetlands adjacent to the pipeline footprint area was not possible since the revised alignment for the pipeline was only defined in the fall of 2018, when wetland delineation/functional evaluation would have been uncertain (i.e., it was too late in the growing season to accurately delineate wetland boundaries or accurately identify plants, especially SAR and SOCC). Full wetland delineations and functional assessments for wetlands adjacent to the pipeline footprint area will be conducted in the spring and summer of 2019.

None of the wetlands observed adjacent to the pipeline footprint area will be directly altered by the project. Wetlands identified adjacent to the PFA including those intersecting or adjacent to the proposed pipeline footprint area are identified in **Section 8.4** and are discussed within this section. The location of wetlands adjacent to the pipeline footprint area are shown on **Figure 8.4-2** in **Section 8.4**. Representative photos of each wetland observed during the December 2018 reconnaissance visit can be found in **Appendix O**.

8.7.2.6 Summary of Wetland Types

The section below contains basic wetland definitions and broadly describes the identified wetlands of those types within the ETF footprint area or adjacent to the pipeline footprint area.

Swamps (Shrub and Treed) - The term “swamp” is used to refer to forested or wooded wetlands and peatlands (i.e., swamps occur on mineral soils as well as on peat). A swamp can be defined as a treed swamp (forested wetland) or a shrub swamp (thicket). The essential features of a swamp are the relative dominance of tall woody vegetation, typically more than 30% cover, the wood-rich peat laid down by this woody vegetation, and the influence of minerotrophic groundwater, either over mineral or organic soils. They may be seasonally or permanently flooded with as much as 30 cm of water. The water table within a swamp is often below the major portion of the ground surface during most of the growing season. The ground surface is often heavily hummocked, which can create an aerated zone of substrate above the average summer groundwater level. It is in this aerated (or partly aerated) zone of substrates above the water table where the root growth of trees and shrubs occurs. Swamps are not as wet as marshes, fens, or open bogs, but they are comparable to treed bogs. They are common along the drier portions of floodplains and riparian areas of rivers and streams. Nutrient regimes of swamps are highly variable and pH levels range from around 4.5 to above 7.0. In shrub swamps, shrubs tend to occupy more than 50% of the habitat, with sedges as the typical ground cover. Grasses, sedges, or rushes commonly occupy most open areas. In treed swamps, trees dominate but there are usually several other strata of vegetation, including shrubs, forbs, ferns, and graminoids. Trees and many shrubs grow on slightly drier areas, while marsh emergents and ferns occupy vernal pools that develop within swamps. Along with treed bogs and fens, wooded swamps are among Nova Scotia’s most common forested wetlands.

Eleven swamps appear to exist adjacent to the PFA (i.e., WL-2, WL-4, WL-5A, WL-5B, WL-5C, WL-5D, WL-6, WL-7, WL-9, WL-16, and WL-18).

Bogs (Open or Treed) - A bog is a peatland which can be characterized by a variety of shapes and sizes. Bogs may be treed (black spruce and tamarack are common) or treeless, and they are usually covered with Sphagnum moss spp. and ericaceous shrubs, such as leatherleaf, sheep laurel, rhodora, and Labrador tea. Herbaceous species such as cranberry, crowberry, pitcher-plant, and cotton-grass are more common in open bogs. The surface of a bog can often be raised or level with the surrounding terrain and they are typically unaffected by runoff water or groundwater from the surrounding upland mineral soils. Precipitation, fog and snowmelt are the primary water sources and, thus, all bogs are ombrogenous. Generally, the water table is elevated and can be found at or slightly below the bog surface. As precipitation does not contain dissolved minerals and is mildly acidic, the surface waters of bogs are consequently low in dissolved minerals and acidic. Furthermore, because organic acids form during decomposition of the peat, bog water is rather acidic, usually between pH 4.0 and 4.8 (Gorham and Janssens 1992).

Some of the larger NSDLF identified wetlands are bogs, and an estimated four bogs exist adjacent to the pipeline footprint area (i.e., WL-8, WL-14, WL-15, and WL-17).

Fens - A fen is a peatland characterized by ground and surface water movement and a fluctuating water table. A fen's vegetation is more diverse than in bogs and is closely related to the relative depth of the water table and water chemistry. As such, the composition of vegetation can reflect wide regional geographic variations. However, in general, wetter fens are dominated by graminoid vegetation and some bryophytes, whereas shrubs are more prominent in drier fens where the water table is lower. Trees appear on the driest fen sites where microtopographic features such as hummocks can provide even drier habitats above the water table. Surface water is the primary water source of fens and flow can be directed through channels, pools, and other open water bodies, often forming characteristic surface patterns. The surface waters of fens are much richer in dissolved minerals than bogs and are minerotrophic. Fens with lower concentrations of dissolved minerals are often dominated by Sphagnum spp. mosses and ericaceous shrubs. Trees, if present, are usually black spruce. Fens with higher concentrations of dissolved minerals are typically dominated by sedges and brown mosses (such as Drepanocladus sp.). Drier, mineral rich fens can contain shrubs such as Betula spp., Salix spp., and *Larix laricina*.

Some of the larger NSDLF identified wetlands are fens and an estimated three fens exist adjacent to pipeline footprint area (i.e., WL-11, WL-12B, and WL-13).

Marshes - Marshes are shallow-water wetland with water levels that fluctuate daily, seasonally or annually, occasionally drying up or exposing sediments. Marshes can receive their water from the surrounding watershed as surface runoff, stream inflow, precipitation, and groundwater discharge, as well as from longshore currents, storm surges, and tidal action. High nutrient levels give rise to high vascular plant productivity and high decomposition rates at the end of the growing season. Marshes that are seasonally dry or exposed to high energy currents or tides usually accumulate little organic matter, but wetter, more stable and permanently saturated marshes, such as in lakeshore embayment and groundwater-fed basin marshes, can accumulate organic material to depths around 50 cm. Emergent aquatic plants (macrophytes) such as rushes, reeds, grasses and sedges, as well as floating and submerged aquatic macrophytes and non-vascular plants such as brown mosses, liverworts and macroscopic algae, are typical of marshes. Deep, shallow and shoreline marshes are typically non-tidal and freshwater, whereas salt marshes are tidal and saline.

Two marshes were identified adjacent to the pipeline footprint area (i.e., WL-10 and WL-12A).

Saltmarshes - Saltmarshes are vegetated wetlands that are flooded regularly by tidal water, or influenced by salt spray or seepage, making the water and soil saline or brackish. Tidal channels and ponds may be present. Salt-water cordgrass (*Spartina alterniflora*) and other saline tolerant grasses and sedges often dominate low marshes, which are flooded regularly. High marshes are often flooded salt marsh during extreme tides and are typically dominated by salt meadow cordgrass (*Spartina patens*). These are extremely productive wetlands that provide many critical environmental, societal, and economic functions and services.

Only one small saltmarsh was observed adjacent to the pipeline footprint area (i.e., WL-3).

Wet Meadows - Wet meadow wetlands can be seen as the driest of shallow marshes and will often transition into shrub or wooded swamps. These wetlands are usually dominated by sedges and grasses and surface water is typically absent by late summer.

Only one small wet meadow type wetland exists within the ETF footprint area (i.e., WL-1).

Vernal Pools - Vernal pools these are small (typically less than 0.5 ha), shallow wetlands that lack a permanent inlet or outlet and often dry out completely by mid-summer. Wet areas that are greater than 100 m^2 are not considered wetlands by the Nova Scotia Wetland Conservation Policy, and therefore receive no legal protection. However, though small, vernal pools provide breeding habitat for many species of frogs, salamanders, and insects as well as feeding and drinking sites for birds, mammals, turtles, and other wildlife. At least two vernal pools were observed within NPNS property adjacent to the pipeline footprint area and it is likely more are present adjacent to the Highway 106 portion of the pipeline footprint area. This will be confirmed in the spring to summer of 2019.

Table 8.7-4, below, provides a preliminary assessment of potential wetland functions for wetlands observed, to be confirmed following the detailed field delineation and functional evaluation to be conducted in spring and summer of 2019.

Table 8.7-4: Preliminary Key Wetland Functions by Wetland Within or Adjacent to the Project Footprint Area[1,2]

No.	Associated with which Footprint Area?	Dominant Wetland Type	Relative Size[3]	Landscape Position	Landform	Flow Path	Water Regime	Origin	Disturbed?	Surface Water Detention	Streamflow Maintenance	Sediment Retention	Shoreline Stabilization	Fish Habitat	Waterfowl Habitat	Other Wildlife Habitat	Community Use	Carbon Sequestration	Nutrient Transformation
WL-1	ETF	Wet Meadow	Small	Terrene	Basin	Isolated	Seasonally flooded	Likely created	Salt and nutrient input from adjacent road.	●						●			
WL-2	ETF	Shrub Swamp	Small	Terrene	Basin	Through flow	Semi-permanently flooded	Natural	Artificial drainage/ditching; Salt and nutrient input from adjacent parking lot.	●		●				●			●
WL-3	Pipeline	Saltmarsh	Small	Estuarine	Fringe	Through flow	Irregularly Flooded	Natural	Partially infilled by past construction of roads/causeway.			●	●	●	●	●			
WL-4	Pipeline	Shrub Swamp	Moderate	Terrene	Slope/Fringe	Through flow	Seasonally flooded	Natural	Artificial drainage/internal ditching; Salt and nutrient input from nearby roads.	●		●				●			
WL-5A	Pipeline	Shrub Swamp	Small	Terrene	Basin	Outflow	Seasonally flooded	Likely created	Salt and nutrient inputs from adjacent roads.	●		●				●			
WL-5B	Pipeline	Shrub Swamp	Moderate	Lotic	Basin	Through flow	Semi-permanently flooded	Natural	Salt and nutrient inputs from adjacent roads.	●	●	●			●	●			
WL-5C	Pipeline	Shrub Swamp	Small	Lotic	Basin/Fringe	Through flow	Seasonally flooded	Natural	Salt and nutrient inputs from adjacent roads.	●		●		●		●			
WL-5D	Pipeline	Shrub Swamp	Small	Lotic	Basin/Fringe	Through flow	Seasonally flooded	Natural	Salt and nutrient inputs from adjacent roads.	●	●			●		●			
WL-6	Pipeline	Shrub Swamp	Small	Terrene	Basin	Outflow	Saturated	Likely created	Impounded by roadway; Salt and nutrient inputs from adjacent Hwy 106.	●						●			
WL-7	Pipeline	Shrub Swamp/ Floodplain	Moderate	Lotic	Floodplain	Through flow	Seasonally flooded	Natural	Salt and nutrient inputs from adjacent Hwy 106.	●		●		●	●	●			

No.	Associated with which Footprint Area?	Dominant Wetland Type	Relative Size[3]	Landscape Position	Landform	Flow Path	Water Regime	Origin	Disturbed?	Surface Water Detention	Streamflow Maintenance	Sediment Retention	Shoreline Stabilization	Fish Habitat	Waterfowl Habitat	Other Wildlife Habitat	Community Use	Carbon Sequestration	Nutrient Transformation
WL-8	Pipeline	Open Bog	Large	Terrene	Basin	Outflow	Saturated	Natural	Partially impounded by Hwy 106; ATV-rutting	●	●				●	●		●	●
WL-9	Pipeline	Shrub Swamp	Small	Lotic	Basin	Through flow	Seasonally flooded	Natural	Salt and nutrient inputs from adjacent Hwy 106.	●		●				●			
WL-10	Pipeline	Fen	Large	Lotic	Basin/Fringe	Through flow	Permanently flooded	Natural	Salt and nutrient inputs from adjacent Hwy 106.	●	●	●		●	●	●		●	●
WL-11	Pipeline	Fen	Large	Lotic	Basin/Fringe	Through flow	Permanently flooded	Natural	Partially impounded by Hwy 106; Salt and nutrient inputs from adjacent Hwy 106.	●	●	●		●	●	●		●	●
WL-12A	Pipeline	Marsh	Large	Lotic	Basin	Through flow	Permanently flooded	Natural	Partially impounded by Hwy 106; Salt and nutrient inputs from adjacent Hwy 106.	●	●	●		●	●	●			
WL-12B	Pipeline	Fen	Moderate	Lotic	Basin/Fringe	Through flow	Permanently flooded	Natural	Salt and nutrient inputs from adjacent Hwy 106.	●	●	●		●	●	●		●	●
WL-13	Pipeline	Fen	Large	Lotic	Basin/Fringe	Through flow	Permanently flooded	Natural	Partially impounded by Hwy 106; Salt and nutrient inputs from adjacent Hwy 106.	●	●	●		●	●	●		●	●
WL-14	Pipeline	Treed Bog	Large	Terrene	Basin	Isolated	Saturated	Natural	Salt and nutrient inputs from adjacent Hwy 106	●						●		●	●
WL-15	Pipeline	Treed Bog	Large	Terrene	Basin	Outflow	Saturated	Natural	Salt and nutrient inputs from adjacent Hwy 106	●						●		●	●
WL-16	Pipeline	Shrub Swamp	Small	Terrene	Basin	Through flow	Saturated	Natural	Partially impounded by Hwy 106; Salt and nutrient inputs from adjacent Hwy 106.	●		●				●			

No.	Associated with which Footprint Area?	Dominant Wetland Type	Relative Size[3]	Landscape Position	Landform	Flow Path	Water Regime	Origin	Disturbed?	Surface Water Detention	Streamflow Maintenance	Sediment Retention	Shoreline Stabilization	Fish Habitat	Waterfowl Habitat	Other Wildlife Habitat	Community Use	Carbon Sequestration	Nutrient Transformation
WL-17	Pipeline	Treed Bog	Large	Terrene	Basin	Isolated	Saturated	Natrual	Salt and nutrient inputs from adjacent Hwy 106.	●						●		●	●
WL-18	Pipeline	Shrub Swamp	Small	Lotic	Basin	Through flow	Seasonally flooded	Likely created	Partially impounded by Hwy 106 and Three Brooks Rd; Salt and nutrient inputs from adjacent Hwy 106.	●		●		●		●			

Notes:

1. Due to limited field data available, delineation of the wetlands and actual wetland size could not be conducted. In addition, key wetland functions could not be assessed through WESP-AC and are based on typical functions performed by the wetland type.
2. See Sections 8.6, 8.8, 8.9 and 8.10 with respect to potential priority species within wetlands adjacent to the pipeline footprint area.
3. Relative size: small less than 0.5 ha; medium 0.5-2 ha; large over 2 ha. Actual sizes to be determined following the completion of the wetland delineation and functional evaluations in spring to summer of 2019.

8.7.3 Impact Evaluation/Effects Assessment

The environmental effects assessment was conducted for wetlands identified in the ETF footprint area based on field surveys conducted in 2017 and 2018, and for wetlands adjacent to the pipeline footprint area based on existing baseline data, imagery interpretation, and a December 2018 reconnaissance survey. Potential accidental effects or malfunctions are considered in **Section 10**.

8.7.3.1 Potential Environmental Effects

The project is expected to interact with wetlands throughout the construction phase of the project. The primary impacts to wetlands will occur within the ETF footprint area and will include the direct loss of wetland area and function (i.e., Wetlands #WL-1 and #WL-2). These wetlands will be subjected to project activities such as site clearing, grubbing and the construction of infrastructure. However, all remaining wetlands adjacent to the pipeline footprint are only anticipated to be subject to indirect effects due to impairment of wetland function as the intent of pipeline design is to avoid physically altering wetlands along the route and instead constructing the pipeline primarily within the road shoulder of Highway 106, wherever possible. For these wetlands located outside the PFA, but within the local assessment area (e.g., wetlands adjacent to the PFA), potential indirect impacts related to surface water quality are anticipated, potentially impairing wetland function. These include sediment deposition, potential contaminant spills, potential nutrient loading (e.g., from hydroseeding), or changes to natural wetland pH.

More specifically, the project may interact with wetlands in the following ways:

- The construction phases of the project will result in the direct loss of approximately 0.156 ha (0.036 ha of WL-1 and 0.12 ha of WL-2) of wetland area within the footprint of the replacement ETF and associated spill basin; remaining portions of WL-2 (0.24 ha) may be subject to indirect effects of the project;
- The construction phases of the project may result in the indirect effects to wetlands adjacent to the pipeline footprint within the local assessment area;
- Construction activities (e.g., excavation and infilling) that may occur up-gradient of wetlands have the potential to alter natural drainage patterns and increase erosion rates, potentially affecting wetland function;
- Vegetation removal has potential to affect adjacent wetlands and wetland function through habitat loss, the introduction of exotic or invasive species, soil compaction, increased erosion rates, and sedimentation; and
- Re-vegetation and hydroseeding of disturbed project areas may impact wetlands during site reclamation following construction through the introduction of exotic or invasive species and the potential for nutrient loading.

No interaction is anticipated between the project and wetlands during the operation and maintenance phase, as no further ground disturbance is anticipated during that phase and no new indirect effects beyond those that arose during the construction phase are expected. Effects to wetlands during the decommissioning phase would be similar to those during construction, given the similar potential interactions as a result of ground disturbing activities.

8.7.3.2 Mitigation

Mitigation is identified for each interaction and/or effect in relation to wetlands in an attempt to prevent the interaction from occurring if possible, or to reduce the severity, magnitude, geographic extent, frequency, or duration of the interaction. Best management practices (based on industry guidelines and regulatory guidance documents) have been identified as appropriate mitigative strategies.

Where possible, wetlands have been avoided and the design minimizes the project footprint in wetland areas following the guidance in the Nova Scotia Wetland Conservation Policy. However, in addition to the standard mitigation measures that were outlined in **Section 5.7**, the following additional mitigation measures specific to the wetlands VEC include the following:

- Wetlands will be clearly identified before and during construction and a 30 m buffer zone (subject to modification with respect to existing road right-of-way) will be maintained around wetlands whenever possible;
- All wetland removals or alterations will be mitigated through wetland permitting and compensation activities, as determined in consultation with NSE and the approval process;
- Whenever possible, vegetation clearing activities using heavy machinery will be conducted during winter months on frozen ground to minimize soil compaction, rutting, sedimentation and vegetative disturbance within wetlands;
- When practical, manual clearing of vegetation using hand operated tools and machinery will be conducted, particularly where ground conditions are not suitable for heavy machinery;
- Efforts will be made to maintain as much mature trees along the edges of the site; in particular, existing buffers surrounding wetlands located on NPNS property will be maintained to the extent possible;
- Surface water drainage will be designed to minimize changes to existing hydrological regimes within the local assessment area;
- All construction equipment will be properly cleaned and free of leaks prior to mobilizing to site to avoid chemical contamination or the potential introduction of invasive species to wetlands; and
- Cleared areas should be re-seeded or otherwise re-vegetated as soon as possible in order to reduce erosion and sedimentation of adjacent habitats. Any hydroseeding activities shall use the NS Highway Seed Mix, unless otherwise approved.

8.7.3.3 Characterization of Residual Environmental Effects

The following is a characterization of the residual environmental effects as they pertain to the project phases.

Construction Phase

Unavoidable direct wetland loss of 0.156 ha is anticipated for those wetlands located within the ETF footprint area (i.e., Wetlands WL-1 and WL-2). This is an unavoidable loss to accomplish the project, which will occur during construction and persist through the life of the project. However, no direct loss of wetland area is anticipated for any of the remaining wetlands located adjacent to the pipeline project footprint since the pipeline will be constructed largely within the disturbed road shoulder or will otherwise avoid direct wetland alteration. The project has been designed and developed to minimize the area of disturbance of the PFA to that which is required to meet the project objectives and to minimize the net loss of wetland area and/or function. Wetland alteration will be undertaken within the context of NSE approval requirements and fulfillment of compensation obligations for "no net loss". The wetland compensation plan will be developed prior to disturbance following Nova Scotia Wetland Conservation Policy and in consultation with NSE.

With the proper implementation of proposed mitigation measures, impacts to wetlands as a result of construction of the project are not anticipated to be significant.

Operation and Maintenance Phase

The operation and maintenance of the replacement ETF and pipeline, including their presence and periodic maintenance activities is not expected to interact with the wetland VEC beyond existing interactions related to Highway 106 and operations at the existing NPNS facility, as no further ground disturbance is anticipated during that phase and no new indirect effects beyond those that arose during the construction phase are expected.

With the proper implementation of proposed mitigation measures, impacts to wetlands as a result of operation and maintenance of the project are not anticipated to be significant.

8.7.4 Summary

Table 8.7-5, provides a summary of the residual environmental effects of the project on the wetlands VEC.

Table 8.7-5: Summary of Residual Environmental Effects Related to Wetlands VEC

Phase and Activities	Potential Effects	Mitigative Factors and Measures	Residual Effects	Significance of Residual Effects
Construction				
Clearing (and grubbing) of the ETF footprint area.	Direct loss of wetland area and function; and, Indirect loss of wetland function via reduced surface water quality	Wetland alteration approval and compensation plan to achieve 'no net loss' of wetland area or function developed in conjunction with NSE. Standard mitigation as outlined in Section 5.7 including best management practices related to erosion and sediment control.	Negligible with correct mitigation applied. Direct and Indirect, Irreversible Magnitude – low Duration – permanent Frequency - once Geographic extent – small (limited to project footprint area) Context – existing development	Not Significant - Adverse
Pipeline construction, preparation and associated activities.	Indirect loss of wetland function via reduced surface water quality	Standard mitigation as outlined in Section 5.7 including best management practices related to erosion and sediment control.	Negligible with correct mitigation applied. Indirect, Irreversible and Reversible Magnitude - negligible Duration – short term (limited to period of construction of pipeline) Frequency - daily Geographic extent – pipeline ROW Context – existing development	Not Significant - Adverse
Site reclamation (re-vegetation and hydroseeding)	Nutrient loading affecting wetland vegetation communities and potentially introducing invasive species	Standard mitigation as outlined in Section 5.7. Following the contractors' EPP and applicable guidelines and regulations and use the NS Highway Seed Mix, unless otherwise approved.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude - low Duration – long term if invasive species introduced Frequency – daily Geographic extent – wetland specific Context – probably existing introduced species prevalent in disturbed portions of pipeline footprint	Not Significant -Adverse

*Magnitude: Negligible - within normal variability of baseline conditions

Based on the above, with planned mitigation, authorization (with compensation), and environmental protection measures, the residual environmental effects of the project on wetlands during all phases of the project are rated not significant, with a moderate level of confidence.

The implementation of regulatory requirements, additional delineation of wetland features and evaluation of wetland function adjacent to the pipeline footprint area in follow-up, water management, water quality monitoring, wetland function monitoring and other follow-up and monitoring measures to be implemented to monitor changes to wetland function arising from the project, with adaptive management measures implemented as necessary to address those changes, will improve the confidence of this prediction.

8.7.5 Follow-up and Monitoring

Additional work will be undertaken in the spring and summer of 2019 to confirm the location and sensitivities of wetlands located adjacent to the proposed pipeline footprint. If sensitivity is identified beyond that currently observed, additional mitigation will be implemented in consultation with NSE to address project interactions.

Follow-up will be conducted to assess the success of wetland compensation for the proposed wetland alterations. In addition, the degree of disturbance in wetlands adjacent to the proposed PFA will be assessed prior to and subsequent to construction activities. The condition of the disturbed portions of wetlands will be compared to the conditions of any undisturbed portions of the same wetlands located adjacent to the pipeline footprint. Criteria assessed will be a comparison of grade, substrate composition, surface water presences/absence, water quality and hydrophytic vegetation re-establishment to those observed on adjacent undisturbed wetland portions. The results of this comparison will be used to measure the effectiveness and efficiency of mitigation measures and to assist in the determination and maintenance of wetland function.

8.8 Flora/Floral Priority Species

The potential environmental effects of the project on terrestrial habitat and flora (plant) priority species and associated terrestrial habitat (hereinafter referred to as the plants and vegetation VEC, for brevity) are assessed in this section.

8.8.1 Scope of VEC

The plants and vegetation VEC focuses on priority flora (plant) species that rely on the PFA to meet their habitat needs. Terrestrial habitat and priority flora species has connections to other VECs such as wildlife and wildlife priority species (refer to **Section 8.9**) and wetlands (refer to **Section 8.7**) as components of overall habitat.

Following the Nova Scotia Guide to *Addressing Wildlife Species and Habitat in an EA Registration Document* (NSE 2009), the focus for the purposes of this EA registration is on priority species and habitats. Terrestrial habitat and priority flora species was selected as a VEC as priority species are valued by the public and various interest groups, and may have formal regulatory protection (under provincial and/or federal legislation). Priority species are often susceptible to changes in the environment and may be indicators of ecosystem health and regional biodiversity. Potential for interactions was identified between terrestrial habitat and priority flora species and proposed project activities.

Based on the Nova Scotia EA guidance (NSE 2009), the plants and vegetation VEC considered priority species and associated habitats that included the following:

- Species listed as Endangered, Threatened or Special Concern (including Schedule 1) under the federal SARA of which are considered for the purpose of this EA Registration as SAR;
- Species listed as Endangered, Threatened or Vulnerable under the Nova Scotia ESA, which are also considered for the purpose of this EA Registration as SAR; and
- COSEWIC listed as Endangered, Threatened or Special Concern and SOCC At Risk or Sensitive under Nova Scotia's general status assessment process.

Additionally, the following were assessed:

- Species with AC CDC Provincial Species conservation status ranks (Sub-national/provincial "S Rank" of extremely rare (S1), rare (S2), or uncommon (S3), which are considered for the purpose of this EA Registration as SOCC; and
- Significant Species and Habitat as identified in the provincial database.

The relationship of native vegetation with other ecosystems components is that it provides: protection of gene pools for future use; protection of native plant and wildlife species and their habitats; preservation of climax ecosystems and native biodiversity; and conservation of representative samples of different habitats characteristic of the region.

8.8.1.1 Boundaries

Spatial boundaries for the assessment of environmental effects on terrestrial habitat and priority flora species include the following:

- The **project footprint area (PFA)** is defined as the maximum extent of the physical area of disturbance associated with the project. The PFA will include all temporary and permanent areas of ground and marine disturbance. The PFA is defined in **Section 5.1.1**. For the plants and vegetation VEC, two distinct footprint areas are assessed: the physical footprint of the replacement ETF, an area comprising 20.8 ha of land within the NPNS property boundary; and the transmission pipeline footprint which is based on proposed disturbance during construction of Highway 106 road shoulder and associated areas required to be cleared ancillary to construction. The estimated total area of potential temporarily disturbed area during construction is 66.6 ha; and
- The **local assessment area** is the maximum area within which environmental effects from the project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence (i.e., the potential zone of influence of the project's indirect effects, such as dust on the plants and vegetation VEC). As priority flora species may have species specific sensitivities to indirect effects, a conservative buffer of 1 km from the project footprint area is applied as the local assessment area. It is anticipated that beyond that distance, indirect pathways such as dust arising from the project would not be distinguishable from existing levels (see **Sections 8.1 and 8.2**).

Temporal boundaries for the assessment of environmental effects on the environment include periods of construction, operation and maintenance, and decommissioning. Construction is estimated to be approximately 21 months, beginning second quarter of 2019, commencing as soon as the EA review has been completed and the applicable permits, approvals or other forms of authorization have been obtained. Operation and maintenance will commence immediately following the construction phase and will continue to operate efficiently and safely for several decades and likely much longer with a well-maintained system. For the purpose of this EA Registration, it has been assumed that the operation and maintenance phase will begin in the fourth quarter of 2020. Decommissioning of the project would occur at the end of mill life following the completion of operations. Once the ETF or pipeline is nearing the end of a useful service life, a decommissioning plan will be developed and will be submitted for a separate review requiring NSE approval.

8.8.1.2 Significance Criteria

A significant adverse residual environmental effect on the plants and vegetation VEC is one where the population of a priority flora species is sufficiently affected to cause a decline in abundance and/or change in distribution, beyond which natural recruitment (reproduction and immigration from unaffected areas) would not return the population to its former level within several generations. Additionally, a significant adverse residual environmental effect would include a contravention of the SARA, NS ESA, and/or the Nova Scotia *Wildlife Act* provisions.

8.8.2 Existing Environment

To provide information on potential occurrences of priority flora and associated within the local assessment area, a review of the following existing data and information sources, current to fall 2018, was conducted:

- A site-specific AC CDC report (AC CDC 2018a), including priority species and significant or managed areas;
- Available background information;
- Listed species by COSEWIC;
- Listed species under the federal SARA (and identified Critical habitat);
- Listed species under the NS ESA;
- Priority species as ranked species by the Nova Scotia General Status Ranks of Wild Species;
- Nova Scotia provincial Significant Habitat database;
- Protected Areas (GNS 2018a);
- Ecological Land Classification for Nova Scotia (Neily et al. 2017); and
- Forest Ecosystem Classification for Nova Scotia (Neily et al. 2013).

The potential for priority flora species was based on species identified within 5 km of the PFA and comparison of the LAA habitats with potential habitat requirements for the identified species. **Appendix N** lists the potential at-risk species "short-listed" for the local assessment area, their likely habitat, preferred investigation period, and priority status. It is noted that fall 2017 to summer 2018, field investigations were undertaken at the replacement ETF footprint site, but an alternate pipeline route was only selected in the fall of 2018 (see **Section 5**) and due to the fall/winter timing of route selection, only a preliminary reconnaissance visit was undertaken. Additional field work in the pipeline footprint will be conducted in spring and summer of 2019 as noted in **Section 8.8.5** below. Investigations within the project footprint area with respect to priority plant species included:

- Habitat evaluation at the ETF footprint – October 2017, June 2018; and
- Reconnaissance of the pipeline footprint – December 3, 2018.

Field surveys were conducted of the ETF footprint area on the NPNS property in early October 2017 and June 2018 and provided a baseline plant list for that area (**Appendix P**). These surveys were conducted on foot by a qualified plant specialist, visually searching for significant plant habitats, as well as vascular and non-vascular priority flora. Industrial land uses dominate the NPNS property and the location of the proposed ETF is mostly already cleared. No old growth forest habitat was identified within the vicinity of the proposed ETF footprint.

The reconnaissance of the pipeline footprint consisted of a biologist interpretation of habitats on the NPNS property and adjacent to Highway 106 that was visible during the winter season.

8.8.2.1 General Terrestrial Habitats Present

Ecological Land Classification

Nova Scotia's Ecological Land Classification (ELC) (Neily et al. 2017), provides systematic grouping of ecological and biophysical features with shared characteristics. The hierarchical levels include EcoDistrict (map scale 1:250000) and EcoSection (map scale 1:50000). EcoElements and Forest Groups are components of EcoSections. The following provides a description of the local assessment area in relation to ELC categories.

EcoDistrict: According to the Nova Scotia's ELC (Neily et al. 2017), the local assessment area is located in the Northumberland Lowlands EcoDistrict, which is within the vast Northumberland/Bras d'Or Lowlands Ecoregion. The Northumberland Lowlands EcoDistrict is bounded to the south, east, and west by the uplands of the Cobequid Hills, Pictou Antigonish Highlands, and the Cumberland Hills, respectively. Elevations along this low coastal plain rarely exceed 50 m above mean sea level (amsl), with all but one watershed (the Nappan River) flowing north into the warm, salt waters of the Northumberland Strait. Surficial till deposits within the Northumberland Lowlands EcoDistrict are derived from Carboniferous sedimentary rocks, such as red sandstones, siltstones and shales. There are four dominant soil types within the EcoDistrict; these are: Queens series soils, Pugwash series soils, Debert series soils, and Hansford series soils. In general, these soils are shallow to bedrock or compacted till, which in combination with the shelter provided by higher terrain in the surrounding EcoDistricts often results in moisture deficits during the growing season (Neily et al. 2017).

The Northumberland Lowlands EcoDistrict is nearly 70% forested and its soils support predominantly softwood forests comprised mostly of red spruce (*Picea rubens*), hemlock (*Tsuga canadensis*), white pine (*Pinus strobus*), and black spruce (*Picea mariana*). In disturbed areas (either natural or anthropogenic), early successional species such as balsam fir, red maple, white and grey birch, and both trembling and large-toothed aspen dominate. Abandoned agricultural land is often re-forested by stands of white spruce after first being pioneered by speckled alder and willows. As soil drainage becomes increasingly poorer, black spruce, red maple and tamarack become increasingly dominant canopy species. Treed and shrub wetlands are scattered throughout the landscape, however, only 5.5% of the EcoDistrict is considered wetland (Neily et al. 2017). Karst terrain and associated deposits of gypsum and salt are not uncommon in the landscape, however, these features seem concentrated in the western end of the EcoDistrict, most notably around Oxford.

The Northumberland Lowlands EcoDistrict contains some of the largest dunes in the province and over 20% of all dunes in Nova Scotia (excluding Sable Island). Dune vegetation includes some provincially uncommon lichen communities and the dune communities between Pictou and Merigomish represent the only known occurrences of wooly hudsonia (*Hudsonia tomentosa*) (S1, may be at risk) in Nova Scotia. Lastly, the Northumberland shore is dissected by a number of rivers, many of them forming extensive estuaries with eel grass beds, saltmarshes and submerged estuarine mud flats. The area of estuarine flats is the second highest of any EcoDistrict in Nova Scotia.

EcoSections: According to the Provincial Landscape Viewer, the PFA has the potential to interact with different EcoSections within the Northumberland Lowlands EcoDistrict. EcoSections are intended to describe the enduring features of the physical landscape including soil drainage, soil texture and topography. The EcoSections with the potential to interact with the PFA are summarized in **Table 8.8-1.**

Table 8.8-1: EcoSections crossed by or adjacent to the project footprint area

EcoSection*	Soil Drainage	Soil Texture	Topography	Location
WCKK	Well drained	Coarse	Hilly terrain	South of the ETF footprint
IFHO	Imperfectly drained	Fine	Hummocky terrain	ETF footprint and pipeline prior to the causeway
IMHO	Imperfectly drained	Medium	Hummocky terrain	Majority of the pipeline route
WMHO	Well drained	Medium	Hummocky terrain	Pocket in the central portion of the pipeline route
WFHO	Well drained	Fine	Hummocky terrain	To the east of the Pictou roundabout portion of the pipeline route

- * EcoSection acronym is derived from first letters in each of the categories in next columns
- From: GNS 2018b

Similar EcoSections in adjacent EcoDistricts may have similar biological attributes, but EcoSections in different EcoRegions can be considered different due to major differences in climate and the biological process affecting ecosystem processes.

EcoElements and Forest Groups: As such, despite potentially interacting with four EcoSections, the local assessment area only has the potential to interact with three EcoElements within the Northumberland Lowlands EcoDistrict. EcoElements represent the existing habitat types occurring on the landscape. The Spruce Pine Hummocks EcoElement represents the vast majority of the PFA arising on the IMHO and WFHO EcoSections. The Red Spruce Hummocks and Tolerant Mixedwood Hills EcoElements, arising on the WCKK and WMHO EcoSections respectively, represent only a small portion of the PFA. To further scrutinize the forested habitats that exist within the PFA**,** a corresponding Forest Group that most closely resembled a given EcoElement was selected from the *Forest Ecosystem Classification for Nova Scotia* (Neily et al. 2013). **Table 8.8-2** illustrates the conversion from EcoSection to EcoElement to Forest Group.

Table 8.8-2: Eco-element and Forest Group Components of Ecosections Crossed by the Project Footprint Area

EcoSection	EcoElement	Forest Group
IMHO	Spruce Pine Hummocks	Spruce Pine Forest Group (SP)
WFHO	Spruce Pine Hummocks	Spruce Pine Forest Group (SP)
WCKK	Tolerant Mixedwood Hills	Mixedwood Forest Group (MW)
WMHO	Red Spruce Hummocks	Open Woodland Group (OW)

Each of the forest groups are described below (note scientific names for plant species are included in **Appendix P**):

- Spruce Pine Forest Group - Spruce Pine Forests are nutrient poor ecosystems that are often associated with fire disturbance. Crown closure can vary greatly within the Forest Group with black spruce and pines (white, red, and jack) dominating the over-story. The understory is typically dominated by ericaceous species tolerant of acidic, nutrient poor soils such as sheep laurel, huckleberry and blueberry along with regenerating spruce saplings. Herbaceous cover is dependent on crown closure limiting light to the understory; however, bracken fern and teaberry are nearly always present. Cover of lichens and bryophytes is expected to be moderate to extensive with common species including Shreber’s moss and broom moss. Reindeer lichens can be expected on drier sites. Forests in this group usually occur as small to large patches or matrix forests on sites that are nutrient poor and prone to seasonal drying. Productivity and species richness are generally low, but these forests do support several faunal and fungal species (Neily et al. 2013).
- Mixedwood Forest Group - Mixedwood Forests are typically closed canopy forests with a range of species depending on the history of disturbance. Early successional stages are often characterized by a dominance of red maple, white birch, balsam fir and aspens. Later successional stages typically contain increasingly higher cover of climax species such as yellow birch, sugar maple, red spruce and hemlock. The shrub layer of Mixedwood Forests is usually occupied by regenerating trees of the overstory, but fly-honeysuckle and striped maple are often present. The diversity of herbaceous vegetation and bryophytes is generally high and coverage can be extensive. Forests in this group usually occur as large patch to matrix forests (Neily et al. 2013).
- Open Woodland Group - Open Woodland forests are forests that typically have an overstory with less than 30% tree cover. These forests arise on sites where both tree growth and density are limited by low fertility, low moisture and thin soils such as bedrock outcroppings, shallow glacial tills and talus slopes. Pines, spruces, red maple and red oak are commonly associated with this group. Stunted trees and a well-developed shrub layer often consisting of huckleberry, sheep laurel, rhodora, blueberry and wild raisin are commonplace. The herbaceous diversity is often very low, however, a number of lichens occur including grey reindeer lichen, green reindeer lichen and star-tipped reindeer lichen. Forests in this group usually only occur as small patches as they are only found sharp ridges, cliffs, rocky outcrops and talus slopes (Neily et al. 2013).

Habitats and Land Use Along or Adjacent to the project footprint area

Additionally, there exist a number of other land uses and habitat types along the PFA such as agricultural land, wetlands, beaches, developed areas, and other land uses. **Figure 8.8-1,** illustrates landcover within the local assessment area. **Table 8.8-3,** summarizes the existing habitats and land uses along the PFA. **Plate 1** provides photos of typical habitats at the ETF footprint area. Most of the plant species identified during field surveys are listed as having secure populations within the province or are exotics (i.e., not native to the province). **Plate 2** provides typical habitat photos in the vicinity of the pipeline footprint area.

Table 8.8-3: Summary of Habitat Types Adjacent to the Project Footprint Area

Habitat Type	Description/Character	Linear Length (km)
Forested	Forested land adjacent the project footprint area is described in **Section 8.8.2** and generally falls into one of the three forest groups described above: • Spruce Pine Forest group; • Mixedwood Forest group; and • Open Woodland Forest group.	4.52
Developed	Developed land adjacent the project footprint area includes regularly mowed areas around the Pictou Roundabout, buildings, parking lots, developed land on the existing NPNS property and the Northumberland Ferries marine terminal.	3.32
Marine waters	Marine waters adjacent the project footprint area are restricted to the waters of the Pictou Harbour surrounding the Pictou Causeway and the coastal waters of the Northumberland Ferries marine terminal.	1.58
Wetlands	Wetlands adjacent the project footprint area are described in **Section 8.7**. Wetlands adjacent the project footprint area are generally associated with watercourses and are comprised of the following wetland types: • Shrub and treed swamps; • Bogs; • Marshes; and • Fens.	0.71
Agriculture	Agricultural land within the project footprint area represent a few small areas of cleared land for either haying or crop production.	0.48
Road Corridor	Land classified as other road corridor adjacent the project footprint area represent those roads, such as the Central Caribou and Three Brooks roads, that overpass or otherwise intersect with Highway 106 on route to the Northumberland Ferries marine terminal.	0.34
Old Field	Old field habitat is scarcely represented adjacent the project footprint area and represents agricultural lands left fallow and allowed to undergo natural succession. This is typically occupied first by willow and birches, and second stands of white spruce.	NA
Cutovers	Cutovers are also scarcely represented adjacent the project footprint area, however, some small areas exist. Cutovers represent the cleared land following tree harvesting and are occupied by early regenerating conifer species with an abundance of coarse woody debris covering the ground surface.	NA

Northern Pulp Nova Scotia Corporation

Replacement Effluent Treatment Facility
Environmental Assessment

Landcover and Significant Habitats
Figure 8.8-1

NORTHERN PULP
NOVA SCOTIA CORPORATION
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Approximate Project Footprint Area*
Approximate Outfall Location
Wooded
Cut Over (Varying Stages of Regeneration)
Old Field/Pasture
Agriculture
Wetland
Open Water
Beach
Developed
Brush/Scrub
Utility Corridor
Dunes/Cliffs

NSDNR Significant Wildlife Habitats
Species at Risk Habitat
Other Habitat
Species of Concern Habitat
Migratory Bird Habitat
Bird Colony (CWS)

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY Northern Pulp Nova Scotia, GeoNova, NSDNR, CWS

MAP CREATED BY: SCM
MAP CHECKED BY: SLD/AB
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 0.25 0.5 1
Kilometres

N
W E
S

*Precise Project Footprint to be determined following completion of detailed design

PROJECT: 17-6461

Date: 2019-01-30

Plate 8.8-1: Typical Habitat Photos (ETF Area)

Top Left - agricultural area and access road toward ETF footprint, Top Right - wetland (WL2) in proposed Spill Basin area

Bottom Left - typical forest in ETF footprint area, Bottom Right - standpipe area

Plate 8.8-2: Typical Habitat Photos (Pipeline Project Footprint Area)

Typical Highway 106 (Top), Pictou Roundabout (Bottom Left), Culvert (Bottom Right)

8.8.2.1.2 Potential Invasive Plant Species

Over 35% percent of the plant species observed in the local assessment area at the ETF are not native to the province of Nova Scotia. The majority of these species were associated with the industrial/ agricultural or roadside disturbed areas such as box elder, Norway maple, woolly burdock, common wormwood, Canada horseweed, wild carrot, common St. John's wort, birds-foot trefoil, coltsfoot and tufted vetch. The coastal habitats in the vicinity of the proposed ETF also were inhabited by a number of non-native species such as common wormwood, butter-and-eggs, old-man-in-the-spring, field sowthistle and brittle-stem hempnettle. Exotic species such as eastern helleborine and mouseear hawkweed occur within the forested areas on the site. Lastly, wild parsnip, marshpepper smartweed, alder-leaved buckthorn, rambler rose and curly dock occur within wetter, drainage areas. It is anticipated that the pipeline footprint area, proposed for the road shoulder, will have even greater percentage of exotic species.

Both alder-leaved buckthorn and rambler rose are considered potentially problematic invasive species (Hill and Blaney 2010) and have the ability to invade, outcompete and shade out native plants.

8.8.2.1.3 Significant Habitats

Significant habitats as identified by the province (GNS 2018b) are related to wildlife and birds and are discussed in respective sections (refer to **Sections 8.9 and 8.10**).

8.8.2.2 Priority Plants

The AC CDC provided a report of the potential historical occurrence of priority species (i.e., plants and animals) within a 5 km buffer zone (standard AC CDC procedure) focused using the centreline of the project footprint area (AC CDC 2018a).

The field investigation within the ETF footprint area was conducted in October 2017 and June 2018 and provided a reasonable level of confidence for the likelihood of priority flora habitat in the ETF footprint area. However, as botanical surveys were not possible within the pipeline footprint area by the time an alternative route had been identified in late fall 2018, a conservative assessment was made on the potential for priority flora species and their habitats as documented by available information from secondary sources including the AC CDC report. As such, in the absence of the confirmed presence or absence of priority plant species in the pipeline footprint, it is conservatively assumed that all priority flora species identified by the AC CDC as having been historically observed within the 5 km buffer zone of the PFA may be present where potential habitat exists within the PFA. A field reconnaissance survey to identify general terrestrial habitats in the approximate pipeline footprint area was conducted in December 2018. Targeted field surveys for priority flora species were not conducted as a part of this assessment, but are planned for the spring and summer 2019 as a follow-up measure (see **Section 8.8.5**).

Potential SAR Plants

Protected species were identified as potentially occurring in the PFA based on habitat characteristics and descriptions are noted below.

Black Ash **(*Fraxinus nigra*) -** The total number of black ash specimens in Nova Scotia is thought to be approximately 1,000 (NSDNR 2015). The black ash is listed as Threatened pursuant the NS ESA and as S1S2 by the AC CDC. Black ash trees are typically a smaller tree than white ash (*Fraxinus americana*) and can be distinguished from the latter by the number of leaflets present on its compound leaf; white ash typically have 5-9 leaflets, whereas black ash typically have 7-11 leaflets (Roland and Zinck 1998). The bark is often yellowish in colour with vertical, nearly parallel fissuring. Leaflets are usually lance-shaped to oblong with dense brown hairs found at the base of the midrib. Black ash trees flower in May through into June, are wind-pollinated and only produce seeds at 1 to 8 year intervals (NSDNR 2015). Black ash are typically slow-growing and have a longevity of approximately 130 to 150 years, but their age and size at maturity is still relatively unknown. Black ash is characteristic of poorly drained soils and are often found in lowlands, swamps, damp woods and riparian areas often associated with red maple, speckled alder and black spruce. This tree species is of significance to the Mi'kmaq for basket-making and other handcrafts (Munro et al. 2014). Transplanted seedlings are reported to grow well in open areas that are relatively dry and exposed to sunlight, such is the case in Mi'kmaw communities where the tree has been planted for cultural and research purposes (NSDNR 2015).

The Provincial (Nova Scotia) Status Report (Hurlburt 2013) include habitat loss and the alteration of wet habitats as key threats to the black ash in Nova Scotia. Other historic threats include plausible overharvest for cooperage, and the potential but escalating threat of the invasive beetle, Emerald Ash Borer (*Agrilus planipennis*).

A number of wetlands do exist along the proposed pipeline route and it is possible for black ash trees to be present along the fringes of those wetlands.

No black ash were observed at the ETF PFA.

Potential Non-vascular Priority Plants

The potential for non-vascular priority plant species (i.e. lichens and mosses) was also evaluated and focused on those species outlined in the Provincial Special Management Practices for At-Risk Lichens (NS DNR 2018). Most priority non-vascular plant species require very specific micro-habitats to survive and reproduce and nearly all priority lichen species in Nova Scotia are epiphytic, persisting on the bark surface of mature trees in contiguous forested habitats. Furthermore, these lichens often show an association with forests near the Atlantic Coast, as seen with Boreal Felt Lichen, and occur with decreasing frequency the greater the distance from that coast. Lastly, according to the AC CDC (2018) the nearest record for a priority non-vascular plant species is over 30 km from the PFA.

Additionally, during the field surveys and reconnaissance, habitat for epiphytic lichen species of interest (such as boreal felt lichen, blue felt lichen, ghost antler, blistered tarpaper lichen and for the aquatic eastern waterfan) was examined, and no species of interest were observed. As such, the PFA is not anticipated to harbour any priority non-vascular plant species and to have a low non-vascular plant diversity overall. This is largely because of the previously disturbed nature of both the ETF footprint area and pipeline footprint within existing highway road shoulders.

Protected priority species with potential for habitat to occur within the local assessment area are summarized in **Table 8.8-4** below.

Table 8.8-4: Summary of Potential SARA/NS ESA Listed Plant Species

Species	Status*	Habitat of Interest in Local Assessment Area	Potential
Black Ash (*Fraxinus nigra*)	**SARA:** Not listed **NS ESA:** Threatened **Prov. Rank:** S1S2/At Risk	Poorly drained soils and swampy woodlands. **Provincial Distribution**: Known from Digby to northern Cape Breton, scattered along the northern side, rare elsewhere.	May occur adjacent pipeline footprint area, but generally not anticipated within ETF footprint area.

*Status notes (as of December 2018) - S1: extremely rare in province; S2: rare in province; S3: uncommon in province; S4: widespread, common and apparently secure in province; S5: widespread, abundant and demonstrably secure in province, SU: unrankable (lack of info). The use of 'S#S#' is to denote a range in rank used to indicate any uncertainty about the status of the species or community. Qualifiers: B= Breeding (breeding population), N = Nonbreeding (nonbreeding population) ? = Inexact/Uncertain, H = Historic (possibly extirpated), M = Migrant and SNR = Not yet assessed in province. (ACCDC 2018a).

Potential for Other Species of Conservation Concern

No priority plants were observed in the ETF footprint area. Other species of conservation interest based on field work at the ETF footprint area and the AC CDC (2018) data for within 5 km of the PFA are summarized in **Table 8.8-5,** below.

Table 8.8-5: Summary of Priority Flora - SOCC Known to Have Been Historically Observed within 5 km of the Project Footprint Area

Common Name	Scientific Name	Background [2]	AC CDC Record Distance from PFA (km)
Jelly Lichen	*Collema tenax*	**AC CDC S-rank**: S3 **NS ESA**: Not listed. **Federal SARA**: Not listed. **Provincial distribution**: Not identified. **Habitat:** Eroding shores, soil surface, calcareous areas.	No AC CDC Record – observed during 2017/2018 work
Variable Forklet Moss	*Dicranella varia*	**AC CDC S-rank**: S3S4 **NS ESA**: Not listed. **Federal SARA**: Not listed. **Provincial distribution**: Not identified. **Habitat:** Eroding shores	No AC CDC Record – observed during 2017/2018 work
Hop Flatsedge	*Cyperus lupulinus ssp. macilentus*	**AC CDC S-rank**: S1 **NS ESA**: Not listed. **Federal SARA**: Not listed. **Provincial distribution**: Known only on the Northumberland shore from Antigonish County. **Habitat:** Sandy shorelines.	3.3 ± 0.0
Robinson's Hawthorn	*Crataegus robinsonii*	**AC CDC S-rank**: S1? **NS ESA**: Not listed. **Federal SARA**: Not listed. **Provincial distribution**: Only a few records known for NS including Loch Broom, Pictou County and around Truro. **Habitat:** Field edges, thickets, open brush.	7.7 ± 1.0
Red Pigweed	*Chenopodium rubrum*	**AC CDC S-rank**: S2 **NS ESA**: Not listed. **Federal SARA**: Not listed. **Provincial Distribution**: Common on Sable Island and collected from Northumberland region and Cape Breton. **Habitat**: Saltmarshes and coastal beaches (saline).	3.6 ± 0.0
Narrow-leaved Evening Primrose	*Oenothera fruticosa ssp. glauca*	**AC CDC S-rank**: S2 **NS ESA**: Not listed. **Federal SARA**: Not listed. **Provincial Distribution**: Scattered from Yarmouth to Northumberland Strait. **Habitat**: Old fields, roadsides, open soils.	3.6 ± 7.0
Bog Willow	*Salix pedicellaris*	**AC CDC S-rank**: S2 **NS ESA**: Not Listed **Federal SARA**: Not listed **Provincial Distribution**: Local, but may be common where found: Queens County, occasionally seen along Sharpe Brook in Kings County. **Habitat**: Acidic substrates in bogs and other peatlands.	3.6 ± 7.0

Common Name	Scientific Name	Background [2]	AC CDC Record Distance from PFA (km)
Canada Lily	*Lilium canadense*	**AC CDC S-rank**: S2 **NS ESA**: Not Listed. **Federal SARA**: Not listed. **Provincial Distribution**: Local; from Kings and Cumberland counties eastward to southern Cape Breton. **Habitat**: Wet meadows, floodplains and streamside.	6.7 ± 7.0
Richardson's Pondweed	*Potamogeton richardsonii*	**AC CDC S-rank**: S2 **NS ESA**: Not listed. **Federal SARA**: Not listed. **Provincial Distribution**: Scattered from Kings and Cumberland Counties to eastern Cape Breton. **Habitat**: Lakes and streams in brackish or alkaline waters.	6.8 ± 0.0
Buttonbush Dodder	*Cuscuta cephalanthi*	**AC CDC S-rank**: S2? **NS ESA**: Not listed **Federal SARA**: Not listed. **Provincial Distribution**: Locally abundant at Loch Broom, Pictou County. Known from Hubbards and Antigonish as well as Tusket River, Yarmouth County, Louis Head Beach, Shelburne County. **Habitat**: Low-lying coastal areas.	7.5 ± 1.0
Canada Germander	*Teucrium canadense*	**AC CDC S-rank**: S3 **NS ESA**: Not listed. **Federal SARA**: Not listed **Provincial Distribution**: Nova Scotia-wide. Nova Scotia to British Columbia, south to California and Florida. Absent only from Alberta. **Habitat**: Gravelly substrates behind coastal beaches, above the high-tide mark.	3.2 ± 5.0
Horned Sea-blite	*Suaeda calceoliformis*	**AC CDC S-rank**: S3S4 **NS ESA**: Not listed. **Federal SARA**: Not listed. **Provincial Distribution**: Near Pictou and along the Northumberland Strait where large colonies are found. Scattered elsewhere, but uncommon on the Fundy shores. **Habitat**: Sandy substrates along seashores and in saltmarshes.	3.4 ± 4.0
Sea-side Dock	*Rumex maritimus (R. persicarioides var. fueginus)*	**AC CDC S-rank**: S3S4 **NS ESA**: Not listed **Federal SARA**: Not listed Provincial Distribution: Infrequently found around the coast from Amherst and Advocate to Queens County. Abundant on Sable Island; scattered in western Cape Breton. **Habitat**: Open, organic coastal areas. Often in saltmarshes and barrachois.	4.7 ± 0.0

Note 1: Applicable Status Notes: Status as of December 2018.
Notes: *Status notes (as of December 2018) - S1: extremely rare in province; S2: rare in province; S3: uncommon in province; S4: widespread, common and apparently secure in province; S5: widespread, abundant and demonstrably secure in province, SU: unrankable (lack of info). The use of 'S#S#' is to denote a range in rank used to indicate any uncertainty about the status of the species or community. Qualifiers: B= Breeding (breeding population), N = Nonbreeding (nonbreeding population) ? = Inexact/Uncertain, H = Historic (possibly extirpated), M = Migrant and SNR = Not yet assessed in province. (ACCDC 2018a).
Note 2: Habitat and Distribution from both Munro et al. (2014) and Roland and Zinck (1998).

All priority flora species, both vascular and non-vascular, either identified within the 5 km buffer zone of the project footprint area or detected on the NPNS property, are discussed below with respect to their likelihood to occur within the project footprint area.

Jelly lichen (Collex tenax) – Jelly lichen is ranked S3 by the AC CDC. This lichen was observed in the fall of 2017 and June 2018 along eroding eastern shoreline on the NPNS property outside of the PFA. This lichen species has the potential to occur in similar habitat along Abercrombie Point. Commonly referred to as jelly lichen or black lichen, *Collema tenax* is a lichen of biotic soil crusts. Biotic soil crusts are communities composed of bacteria, cyanobacteria, algae, mosses, liverworts, fungi and lichen living on the soil surface. *Collema tenax* occurs in arctic and temperate regions and is thought to be circumboreal, making it the most widely distributed *Collema* species (Lange et al. 1998). This lichen is typically black or very dark green in colour with a thick, gelatinous thallus that is 1 to 3 cm wide. *Collema tenax* is a cyanobacterial lichen, meaning it contains a cyanobacterial symbiont, *Nostoc commune*. *Collema tenax* is an indicator of basic soils and can often be found in areas containing gypsum or other calcareous soils. The lichen species of interest are found on mineral soil in an unstable habitat (coastal bluff) that is subject to coastal erosion. They can be expected anywhere suitable habitat exists. *Collema tenax* and *Tortella tortuosa* (a S4? Moss species found) are typically calciphiles however salt from the ocean would increase the pH of coastal soils allowing them to thrive.

Variable forklet moss (Dicranella varia) – Variable forklet moss is ranked S3S4 by the AC CDC. This moss was observed in the fall of 2017 and June 2018 along eroding eastern shoreline on the NPNS property outside of the PFA. The moss species was found on the surface of mineral soil in an unstable habitat (coastal bluff) that is subject to ongoing coastal erosion. This species can be expected anywhere suitable habitat exists, such as the similarly eroding, unstable habitat along the north and east shorelines of Abercrombie Point.

***Hop Flat Sedge (Cyperus lupulinus ssp. macilentus)* -** The hop flat sedge is listed as S1 by the AC CDC and is a small annual species reaching up to 40 cm in height. This species differs in appearance from other *Cyperus* species by the globular outline of the heads of their spikelets. The sub-species of hop flat sedge that occurs in Nova Scotia is *Cyperus lupulinus* ssp. *macilentus* (Munro et al. 2014). This species fruits from August to October and prefers dry, sunny habitats with sandy soils such as dunes, sandy barrens and roadsides. The only known occurrences of hop flat sedge come from along the Northumberland Strait shore in neighbouring Antigonish County.

While some small areas of shoreline habitat exist within the PFA, these areas are within previously disturbed areas (i.e. Northumberland Ferries marine terminal and the Pictou Causeway) where it is unlikely hop flat sedge persists.

***Robinson's Hawthorn* (*Crataegus robinsonii*)** – Robinson's hawthorn in listed as S1? By the AC CDC, reflecting the uncertainty surrounding its distribution in the Province. There are only a few records of the species within the Province, most notably from Loch Broom, Pictou County. It has been suggested that these records of Robinson's hawthorn may represent a hybridization of *C. chrysocarpa* and *C. brainerdii* (Roland and Zinck 1998). Hawthorns tend to be found in brushy, open habitats, forest edges and thickets.

Given that some of the few known records of this plant occurred at nearby Loch Broom, it is possible that individual Robinson's Hawthorn plants may be persisting within this PFA.

Red Pigweed (Chenopodium rubrum) - Red pigweed is listed as S2 by the AC CDC and very closely resembles the more common lamb's quarters (*C. album*), but can be readily distinguished from the latter by its coastal saline habitat and the position of its seeds. Like lamb's quarters, red pigweed is freely branching and has strong angular stems. The leaves of red pigweed may vary greatly from ovate to hastate, and unlike *C. album*, are not pruinose beneath. This species flowers from August to November and can only be found in coastal habitats such as saltmarshes and beaches. It has been known to form extensive colonies on newly-reclaimed dyke-lands (Munro et al. 2014).

While some small areas of shoreline habitat do exist, there are no mapped saltmarshes within the PFA.

Narrow-leaved Evening Primrose (Oenothera fruticosa ssp. glauca) - Narrow-leaved evening primrose is listed as S2 by the AC CDC and very closely resembles the more common evening-primrose (*O. biennis*), but can be distinguished by the length of their flower petals; *O. biennis* has flower petals less than 1 cm long, whereas *O. fruticosa* has flower petals approaching 3 cm long. The sub-species of narrow-leaved evening primrose that occurs in Nova Scotia is *Oenothera fruticosa* ssp. *glauca* (Munro et al. 2014). This is a coarse, erect plant with a glabrous stem, but is not as robust as *O. biennis*. Narrow-leaved evening primrose flowers from June to August, with its inflorescent often comprising half its overall height. This species is affiliated with old field habitats, but can also be found at the edges of wetlands and roadsides. Roadside habitat is plentiful within the PFA as well there are a number of wetlands and old fields.

Bog Willow (*Salix pedicellaris*) - Bog willow is listed as S2 by the AC CDC. This typically small, slender shrub is usually less than 1 m in height. It has smooth, oval to lance-shaped leaves that are widest towards their apex, and have whiteish undersides with margins entire. The bud scales of these leaves are notable very small. The catkins of bog willow can range between 2 and 5 cm in length, flowering from May to July. It has been known to form colonies by layering. Flowers from this species prefer acidic substrates, such as those found in bogs and other peatlands, as well as nutrient-rich marshes and some sphagnous lacustrine habitats.

A number of peatlands do exist along the proposed pipeline route and so it is possible for bog willow to be present within those peatlands.

***Canada Lily* (*Lilium canadense*)** - The Canada lily is listed as S2 by the AC CDC. A tall, erect plant standing upwards of 60 cm, the Canada lily is able to reach heights well over 1 m. It has a stiff, unbranching stem that bears leaves in whorls of 4 to 10. Its flowers, which bloom in July, are rather large at 6 cm long and are a showy yellow-orange with red spots within. More than one flower per plant is common. The natural habitat of Canada lily are wet meadows, streambanks and riparian areas, but it has been known to occupy roadside ditches.

Very little natural habitat for Canada lily exists within the PFA, and so it is not anticipated to be found within the PFA.

Richardson's Pondweed (Potamogeton richardsonii) - Richardson's pondweed is listed as S2 by the AC CDC and is a distinctive species, having no floating leaves at all, only submersed ones. These submersed leaves occur strictly in two rows along a main stem and are 5 to 30 mm wide and up to 10 cm long. Each leaf has one main vein and is coarsely veined otherwise. This species flowers and fruits from July to September and prefers lakes and slow-moving streams, showing an affinity for brackish or alkaline water (Munro et al. 2014).

Very little habitat suitable for Richardson's Pondweed exists within the PFA and so it is not anticipated to be found within the PFA.

Buttonbush Dodder (Cuscuta cephalanthi)- Buttonbush dodder is listed as S2 (?) by the AC CDC. A twining parasitic species, the buttonbush dodder, unlike most plants, lacks chlorophyll and is therefore unable to photosynthesize its own energy. With no need, or ability, to collect its own energy, Buttonbush dodder also lacks leaves. It attaches to host plants by means of specialized rooting structures called 'haustoria', which allow it to draw energy and nutrients from its host. In August and September, buttonbush dodder blooms small, sessile flowers arranged in compact, round inflorescences. This plant is a coastal species preferring low-lying areas near the shore. Both Munro et al. (2014) and Roland and Zinck (1998) describe this species as often seen parasitizing New England aster (*Symphyotrichum novi-begii)*.

There are a few small areas of shoreline habitat and associated lowlands that exist within the PFA, most notably around the Northumberland Ferries marine terminal and the abutments of the Pictou Causeway. As these areas do represent potential habitat for buttonbush dodder, it is possible for buttonbush dodder to occur in within the PFA.

***Canada Germander* (*Teucrium canadense*)** - Canada germander is listed as S3 by the AC CDC and is a tall, upright plant reaching up to 1 m in height. It has a four-angled, square-ish stem that is pubescent and leafless along its lower portion. Its leaves, clustered along its upper stem, are coarsely serrated and borne on short petioles. This species flowers from July to September bearing a showy terminal spike of faintly purple to lavender coloured flowers each with a long subtending bract. Canada germander prefers gravelly substrates behind coastal beaches, but above the high-tide mark. It is often observed growing alongside marsh skullcap (*Scutellaria galericulata*) and can form dense colonies, rarely seen as individual plants.

While some small areas of shoreline habitat exist within the PFA, these areas are within previously disturbed areas (i.e., Northumberland Ferries marine terminal and the Pictou Causeway) where it is unlikely that Canada germander persists.

Horned Sea-blite* (*Suaeda calceoliformis) - Horned Sea-blite is listed as S3S4 by the AC CDC. This small, succulent halophyte is usually found sprawling prostrate along the soil surface. Mature plants may have reddish-purple, almost wine-like colour. It is freely branching and bears very simple, linear leaves. A late flowering species, from August to October, its flowers are arranged in clusters within the leaf axils. As this genus is very difficult to identify to species in the field, it is necessary to collect plants in fruit to identify to species. This species is most commonly found along seashores and saltmarshes in sandy substrates.

While some small areas of shoreline habitat exist within the PFA, these areas are within previously disturbed areas (i.e., Northumberland Ferries marine terminal and the Pictou Causeway) where it is unlikely that horned sea-blite persists. Furthermore, there are no mapped saltmarshes within the PFA**.**

Sea-side Dock (Rumex maritimus) - Sea-side dock is listed as S3S4 by the AC CDC, however, this species has been separated from the European *Rumex maritimus* and our Maritime populations are treated in Flora Nova Angliae (Haines 2011) as part of *Rumex persicariodes*. Two varieties are present in Eastern North America; the more common is *R. persicarioides* var. *fueginus* which is described by Munro et al. (2014) and here. Variety *persicarioides* is rarer and noted as less weedy in New England (Haines 2011). The status of *Rumex persicioides* var. *persicarioides* in Nova Scotia remains to be determined.

R. persicarioides var. *fueginus*, commonly referred to as sea-side dock or American golden dock, flowers from July to October. Its golden-tinged flowers are so densely clustered and tight to the stem, its narrow lance-shaped leaves can appear to emerge from a veil of golden flowers. Its achenes are nearly sessile, similarly tightly clustered along the stems. Once the achenes mature and open, their valves bear long bristles and tubercles are lanceolate. This species prefers sunny, organic coastal microsites, particularly of saltmarshes and barrachois.

While some small areas of shoreline habitat do exist, there are no mapped saltmarshes or barrachois within the PFA.

8.8.3 Impact Evaluation/Effects Assessment

The environmental effects assessment was conducted for priority floral species identified for the ETF footprint area based on field surveys conducted in 2017 and 2018, and for the pipeline footprint area primarily based on existing baseline data from secondary sources. The habitat requirements of priority floral species identified as potentially occurring within and/or near the PFA were compared to the range of environmental conditions within the local assessment area to determine if suitable habitat was present for these taxa. Knowledge of the habitats present within the PFA was determined through an interpretation of aerial photography, topographic and geological mapping, as well as information obtained through field reconnaissance efforts. In instances where appropriate habitat was present for a particular priority species, that taxon was considered to be potentially present in the PFA, mitigation identified, and potential impacts assessed. Potential accidental effects or malfunctions are considered in **Section 10**.

8.8.3.1 Potential Environmental Effects

A number of activities related to the project have the potential to interact with the plants and vegetation VEC.

The project construction may interact with priority flora in the following ways:

- Clearing and grubbing of the pipeline footprint area and the ETF footprint area during construction may result in sedimentation and degradation of adjacent priority plant habitat;
- Clearing and grubbing of temporary pipeline staging area on NPNS property will result in the disturbance of non-vascular SOCC habitat;
- Construction may cause direct loss or alteration of priority plant species composition within the pipeline footprint area; and
- Dust may affect habitats immediately adjacent to the PFA.

There are no known interactions between the project and the plants and vegetation VEC during the operation and maintenance phase. Maintenance activities related to road operation such as vegetation clearance and winter salting at the replacement ETF and along Highway 106 will not change from existing activities.

8.8.3.2 Mitigation

To minimize impacts on priority plant species, NPNS will implement the following mitigation measures:

- The pipeline will primarily be constructed primarily within the existing disturbed road shoulder. Watercourse and wetland crossings will be avoided (crossings will occur above or under the road culvert; unless additional assessment and approval process is followed);
- Prior to work in the road shoulder, a botanist will walk the pipeline footprint area to confirm that the priority flora species with potential road shoulder habitat and immediately adjacent are not present (see **Section 8.8.5**). If priority plants are identified within the pipeline footprint, an evaluation will be made to determine if the plants can be avoided. If avoidance is not possible, management measures will be implemented to minimize impact on the priority plant population in consultation with NSDLF within a context of contributing to the long-term survival of the species and maintenance of the viability of the population. Management will focus on designation, protection, and conservation of affected priority plant species outside the PFA. This may include additional land purchase and

protection; establishment of no-go buffer areas; control of off-road vehicle access to buffer areas; on-going monitoring of known populations on the property; management of runoff surface water quality to meet regulatory requirements; erosion control measures will be in place prior to construction to protect any identified downgradient priority plant habitat;

- The area cleared for the project will be limited to that required for the construction. No push offs or other disturbance would be permitted outside the clearing limits in the vicinity of the priority plants if identified during follow-up (**Section 8.8.5**);
- The ETF will be constructed on NPNS property in an area that has been historically disturbed and potential for priority plants was not identified within the ETF footprint area;
- The general mitigation measures outlined in **Section 5.7** (including Vegetation Clearing and Disposal) will be followed;
- Consideration of downgradient/adjacent priority plants in design, including non-vascular plants. Implementation of follow-up monitoring of priority species outside footprint if identified in follow-up (**Section 8.8.5**). Operational mitigation related to priority plant species if identified in habitats adjacent to the PFA, will include working with NSTIR to develop mitigative measures such as limiting application of salt or providing alternative drainage paths as long as hydrology is maintained and access is limited to areas with known priority plants. NPNS will work with Indigenous groups with respect to black ash if identified within the PFA;
- Mitigation as noted under the wetland VEC (**Section 8.7**) and surface water VEC (**Section 8.4**) is also applicable to downgradient flora habitat, including maintenance of surface water paths through culvert placement and appropriate structure sizing at the ETF site.
- Seeding of the disturbed areas of the project footprint as soon after final clean up as weather and soil conditions permit. The goal is to reclaim all disturbed lands within one growing season following construction;
- Restrict vehicle access over newly seeded areas;
- Follow-up vegetation monitoring (**Section 8.8.5**) will occur in the mid to late-summer when vegetation reaches it maximum size to allow for accurate identification and evaluation. Particular attention will be given to areas of terrain instability or soils that may be prone to erosion;
- Ensure all equipment (e.g., vehicles, materials, etc.) arrives on site in a clean condition to reduce the risk of weed introduction;
- Monitor topsoil windrows for weed growth during the course of construction during non-frozen soil conditions and direct the contractor to implement corrective measures (i.e., hand pulling, mowing, non-persistent herbicides);
- Use of an appropriate seed mix for non-native seed mixes and, where possible, obtaining seed from a local source; and
- Should monitoring indicate that further management measures are warranted to prevent the spread of invasive weed species further action to address the issues will be undertaken in a timely manner.

8.8.3.3 Characterization of Residual Environmental Effects

Construction Phase

Construction related activities with ground disturbance have potential to result in direct loss of vegetation and/or changes in the vegetation composition. Priority plant species are not present within the ETF footprint area. Potential habitat for priority plants was preliminarily identified within the road shoulder where the pipeline will be constructed; however, the likelihood for priority plants within the pipeline footprint area is generally very low. The likelihood of priority plants within adjacent habitat was identified as low to moderate. In order to confirm that impacts can be mitigated, additional plant surveys for the pipeline footprint area are proposed prior to construction (**Section 8.8.5**). If priority plants are identified within the pipeline footprint area or immediately adjacent to, the focus will be on avoidance unless a suitable mitigative alternative is developed in consultation with NSDLF.

Secondarily, indirect effects may result due to sediment generation, change in habitat due to hydrology impact or other water quality pathway to downgradient habitats or from microclimate changes in adjacent habitat related to vegetation clearance. Priority plants are not expected within the ETF footprint area. There was identified potential for priority plants in pipeline footprint area downgradient habitats such as wetlands along the route. Mitigation undertaken for water quality and dust as noted in **Sections 8.4** and **8.1**, will also provide mitigation for flora adjacent to the project.

Operation and Maintenance Phase

Operations of the project are not expected to interact with the plants and vegetation VEC beyond existing interactions related to Highway 106.

8.8.4 Summary

In summary, the environmental effects of the project on the plants and vegetation VEC are summarized in **Table 8.8-6,** below.

Table 8.8-6: Summary of Residual Effects Related to Plants and Vegetation VEC Components (Terrestrial)

Activities	Potential Effects	Mitigative Factors and Measures	Residual Effects	Significance of Residual Effects
Construction				
Priority Plants Clearing of the project footprint area and pipe preparation (no wetland or watercourse crossings)	Direct vegetation removal and loss of priority plants or alteration of vegetation composition; and, Indirect adjacent priority plant habitat changes due to microclimate changes.	Standard mitigation as outlined in **Section 5.7** (including Vegetation Clearing and Disposal). Loss of individual priority plants in project footprint area to be undertaken within the context of overall viability of the population. NPNS to work with NSDLF in development of management	Negligible with standard mitigation applied. Direct and Indirect, Irreversible Magnitude - negligible Duration – permanent Frequency - once Geographic extent - site-specific (project footprint area) Context – Low potential for	Not Significant -Adverse

Activities	Potential Effects	Mitigative Factors and Measures	Residual Effects	Significance of Residual Effects
		plan if required. Erosion and sedimentation control measures as identified for surface water VEC and wetland mitigation as noted for wetland VEC.	SARA, NS ESA or SOCC plant species in the project footprint area.	
Site drainage design	Disruption of wetland or upland habitat with priority plants adjacent to the project footprint area through altering hydrology.	Maintenance of surface water paths through culvert placement and appropriate structure sizing at the ETF site. Consideration of downgradient priority plants in design. Implementation of follow-up including monitoring of priority species outside footprint if identified. Implementation of mitigation measures identified for surface water VEC.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude - negligible Duration – long term (project duration) Frequency - once Geographic extent - site-specific (project footprint area) Context - Priority plants in and outside of project footprint area.	Not Significant -Adverse
Re-vegetation	Establishment of invasive species degrading habitat for adjacent priority plants.	Consideration of adjacent priority plants in design. Ensure all equipment (e.g. vehicles, materials, etc.) arrives on site in a clean condition to reduce the risk of weed introduction. Monitor topsoil windrows for weed growth during the course of construction during non-frozen soil conditions and direct the contractor to implement corrective measures (i.e. hand pulling, mowing, non-persistent herbicides). Use an appropriate seed mix for non-native seed mixes and, where possible, obtain seed from a local source. Should monitoring indicate that further management measures are warranted to prevent the spread of invasive weed species further action to address the issues will be taken in a timely manner.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude - negligible Duration – short to long term Frequency - once Geographic extent - site-specific (project footprint area) Context – Potential for priority plants outside of project footprint area.	Not Significant -Adverse

Based on available data and the above analysis, and in consideration of the nature of the project, the environmental setting, and proposed mitigation both standard and site-specific, the residual environmental effects of the project on the plants and vegetation VEC during all phases are rated not significant, with a moderate level of confidence. Carrying out a field investigation of the pipeline footprint area during spring and summer of 2019 to confirm these environmental effects predictions will improve the level of confidence (**Section 8.8.5**).

8.8.5 Follow-up and Monitoring

Follow-up will be conducted to verify the effects predictions or the effectiveness of mitigation, consisting of a field investigation of the pipeline footprint area during spring and summer of 2019 to confirm the information obtained from desktop sources.

In addition, monitoring will be conducted to confirm the regrowth of vegetation following construction activities and to assess the potential for invasive plant species to have been introduced. During the first year following the completion of construction, the pipeline footprint area will be inspected to identify areas where vegetation re-establishment has not been successful. The timing of vegetation monitoring will be in mid to late summer when the vegetation is mature enough for accurate identification and evaluation. Particular attention will be given to areas of terrain instability that may be prone to erosion. If warranted, detailed vegetation assessments will be completed at sites where reclamation problems are identified. If invasive plant species are identified, a control plan will be developed and implemented in consultation with NSDLF.

8.9 Terrestrial Wildlife/Priority Species

The potential environmental effects of the project on terrestrial wildlife /priority species and associated terrestrial habitat (hereinafter referred to as the wildlife VEC, for brevity) are assessed in this section.

8.9.1 Scope of VEC

The wildlife VEC focused on those species that rely on the project area to meet their habitat needs. Fauna types in this VEC include mammals, invertebrates, and herptiles (reptiles and amphibians) within terrestrial components of their lifecycle, as well as the habitats that support them. This VEC does not include birds which are addressed in **Section 8.10** and marine birds in **Section 8.13.** The wildlife VEC has connections to other VECs such as surface water, wetlands, and flora (refer to **Sections 8.4, 8.7** and **8.8**, respectively) as components of overall habitat.

Following the Nova Scotia *Guide to Addressing Wildlife Species and Habitat in an EA Registration Document* (NSE 2009), the focus for EA purposes is on priority species and habitats. Terrestrial wildlife/priority species is selected as a VEC as priority species are valued by the public and various interest groups, and may have formal regulatory protection (under provincial and/or federal legislation). Priority species are often susceptible to changes in the environment and may be indicators of ecosystem health and regional biodiversity. Potential for interactions was identified between wildlife, its habitat, and proposed project activities.

Based on the Nova Scotia EA guidance (NSE 2009), the wildlife VEC considered priority species and associated habitats that included the following:

- Species listed as Endangered, Threatened, or Special Concern (including Schedule 1) under the federal SARA, which are considered herein to be SAR;
- Species listed as Endangered, Threatened, or Vulnerable under the Nova Scotia ESA, which are also considered herein to be SAR; and
- COSEWIC species listed as Endangered, Threatened, or Special Concern and SOCC - At Risk or Sensitive under Nova Scotia's general status assessment process.

Additionally, the following were assessed:

- Species with ACCDC Provincial Species conservation status ranks (Sub-national/provincial "S Rank" of extremely rare (S1), rare (S2), or uncommon (S3)), which are considered herein to be SOCC; and
- Significant Species and Habitat as identified in the provincial database.

As noted in the Regulatory Environment Section of this document (**Section 3**), SARA and NS ESA provide regulatory protection to listed species. In addition, the Nova Scotia *Wildlife Act* prohibits disturbance of turtle nests.

8.9.1.1 Boundaries

Spatial boundaries for the assessment of environmental effects on the wildlife VEC include the following:

- The **project footprint area (PFA)** is defined as the maximum extent of the physical area of disturbance associated with the project. The PFA will include all temporary and permanent areas of ground and marine disturbance. The PFA is defined in **Section 5.1.1**. For the terrestrial wildlife VEC, two distinct footprint areas are assessed: the physical footprint of the replacement ETF (referred to as the ETF footprint area), an area comprising 20.8 ha of land within the NPNS property boundary; and the land-based portion of the effluent pipeline footprint (referred to as the pipeline footprint area) which is based on proposed disturbance during construction of Highway 106 road shoulder and associated areas required to be cleared ancillary to construction. The estimated total area of potential temporarily disturbed area during construction is 66.6 ha; and
- The **local assessment area** is the maximum area within which environmental effects from the project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence (i.e., the potential zone of influence of the project's indirect effects, such as noise on the wildlife VEC). As terrestrial wildlife may have species specific sensitivities to indirect effects, a conservative buffer of 5 km from the PFA is applied as the local assessment area. It is anticipated that beyond that distance, indirect pathways such as noise or dust arising from the project would not be distinguishable from existing levels (see **Sections 8.1 and 8.2**).

Temporal boundaries for the assessment of environmental effects on the environment include periods of construction, operation and maintenance, and decommissioning. Construction is estimated to be approximately 21 months, beginning second quarter of 2019, commencing as soon as the EA review has been completed and the applicable permits, approvals or other forms of authorization have been obtained. Operation and maintenance will commence immediately following the construction phase and will continue to operate efficiently and safely for several decades and likely much longer with a well-maintained system. For the purpose of this EA Registration, it has been assumed that the operation and maintenance phase will begin in the fourth quarter of 2020. Decommissioning of the project would occur at the end of mill life following the completion of operations. Once the ETF or pipeline is nearing the end of a useful service life, a decommissioning plan will be developed and will be submitted for a separate review requiring NSE approval.

8.9.1.2 Significance Criteria

A significant adverse residual environmental effect on the wildlife VEC is one where the population of a species is sufficiently affected to cause a decline in abundance and/or change in distribution beyond which natural recruitment (reproduction and immigration from unaffected areas) would not return the population to its former level within several generations. Additionally, a significant adverse residual environmental effect would include a contravention of the SARA, NS ESA, and/or the Nova Scotia *Wildlife Act* provisions.

8.9.2 Existing Environment

To provide information on the potential for occurrence of priority wildlife and associated habitats within the local assessment area, a review of the following existing data and information sources (as of fall 2018) was conducted:

- A site-specific AC CDC report (AC CDC 2018) including priority species and significant or managed areas;
- Available background information;
- Listed species by COSEWIC;
- Listed species under the federal SARA (and identified Critical habitat);
- Listed species under the NS ESA;
- Priority species as ranked species by the Nova Scotia General Status of Wild Species;
- Nova Scotia provincial Significant Habitat database; and
- Protected Areas (GNS 2018a)

The potential for priority wildlife species was based on species identified within 5 km of the PFA (or farther if potential wide ranging species) and comparison of the local assessment area habitats with potential habitat requirements for the identified species. **Appendix N** lists the potential at-risk species “short-listed” for the local assessment area, their likely habitat, preferred investigation period, and priority status. It is noted that fall 2017 to summer 2018 field investigations were undertaken at the replacement ETF site, but an alternate pipeline route was selected in the fall of 2018 (see **Section 5**) and due to the timing of route selection, only a preliminary reconnaissance visit was undertaken. Investigations included:

- Habitat evaluation at the ETF local assessment area – October 2017, June 2018;
- Additional investigation of potential priority herptile habitat at the ETF footprint area was conducted by J. Gilhen (herptile specialist) – June 7, 2018; and
- Reconnaissance of the pipeline footprint area – December 3, 2018.

The investigation within the ETF local assessment area provides a reasonable level of confidence of the likelihood of priority terrestrial wildlife habitat. However, as field verification was not possible at this time within the proposed pipeline route, a conservative assessment was made on the potential for priority terrestrial wildlife species habitat and it is assumed that such species may be present where potential habitat is present in the pipeline local assessment area.

8.9.2.1 Wildlife Habitat Overview

The regional setting is detailed in **Section 8.8**. The proposed project is located within the Nova Scotia Ecological Land Classification: Northumberland Lowlands Ecodistrict. The lowlands area which surrounds the local assessment area is influenced by the coastal climate associated with the Northumberland Strait. The climate and landscape characteristics of the Ecodistrict have led to the predominantly black and red spruce dominated coniferous forests (Neily et al. 2005). Balsam fir and early successional hardwoods have re-established in areas of disturbance due to natural or anthropogenic causes; and white spruce has dominated abandoned agricultural fields. Tolerant hardwood forests may be present on the rarer well drained slopes as well as tamarack and cedar in poorly drained areas (Neily et al. 2005). The PFA consists predominately of disturbed habitats. Various wetlands are also located within the local assessment area (refer to **Section 8.7**). For further description of existing vegetation within the PFA, refer to **Section 8.8**.

Terrestrial wildlife species focusing on priority species as well as their habitat requirements are discussed in the following sections along with potential occurrences within the local assessment area which are discussed in the **Sections 8.9.1.1 to 8.9.1.2**, below. Significant habitats are further discussed in **Section 8.9.1.3**, below.

Typical Wildlife Species

Based on the habitat characteristics of the local assessment area, typical wildlife species expected to occur within the Pictou Lowlands include common species characteristic of disturbed and agricultural habitats as well as a variety of forested and riparian habitats including small watercourses, wetlands and coastal areas. Common species (considered secure in the province) include white-tailed deer (*Odocoileus virginianus*), eastern coyote (*Canis latrans*), red fox (*Vulpes vulpes*), American red squirrel (*Tamiasciurus hudsonicus*), eastern chipmunk (*Tamias striatus*), snowshoe hare (*Lepus americanus*), North American porcupine (*Erethizon dorsatum*), northern raccoon (*Procyon lotor*), and several common rodents such as red-backed vole (*Myodes gapperi*). Muskrat (*Ondatra zibethicus*), mink (*Neovison vison*), short-tailed weasel (*Mustela erminea*), and American beaver (*Castor canadensis*) may also occur in suitable habitats. Although less common, river otter (*Lontra canadensis*) also are expected in the area. Bobcat (*Lynx rufus*) and American black bear (*Ursus americanus*) also may be expected to occur in the general area. During site visits to the ETF local assessment area, a high density of deer signs was observed, particularly in the treed area to the north and west of the existing NPNS facility.

NSDLF's General Status of Wild Species (GNS 2018c) reports 9 native reptiles (4 turtles and 5 snakes) and 13 amphibians known to occur in Nova Scotia. Species anticipated to occur within the general area include common frogs/toad (wood frog (*Lithobates sylvaticus*), northern spring peeper (*Pseudacris crucifer*), and American toad (*Anaxyrus americansu*)), salamanders (yellow spotted (*Ambystoma maculatum*) and blue spotted (*Ambystoma laterale*)) and snakes (common garter (*Thamnophis sirtalis*) and redbelly (*Storeria occipitomaculata*)). No federal or provincial threatened or endangered amphibian or reptile species are anticipated with the Northumberland Lowland landscapes; however, an uncommon form of blue spotted salamanders (polyploid) have been recorded in the Braeshore area (located approximately 4 km to the north and east of the project)(pers. comm. J. Gilhen, herptile specialist). The old field and edge habitat as well as isolated wetland/alder swale areas and second growth mixed forest areas at the NPNS property provide habitat for amphibians and snakes. During the June 2018 site visit to the EFT local assessment area, no amphibian larvae were noted in the shallow cattail ditches.

Butterfly and odonate (dragonfly and damselfly) species in Nova Scotia are summarized in the NSDLF General Status of Wild Species (GNS 2018c). The summary currently lists 71 butterfly and 116 odonate species are known to occur in the province. Priority invertebrates with potential to occur in the local assessment area are discussed further below (**Section 8.9.2.3**).

AC CDC Records or Observed Priority Wildlife

A review of the AC CDC site-specific summary report (AC CDC 2018) indicated that there are no historical records of federally or provincially protected terrestrial wildlife (note: birds are discussed in **Section 8.10**), and that no bat hibernacula have been reported to be present within 5 km of the PFA. Several non-SARA or NS ESA listed priority invertebrates were recorded by AC CDC with 5 km of the proposed project. The habitat characteristics surrounding the PFA are suitable for both protected SAR and other species of conservation concern known for the general area (AC CDC 2018), as described below.

8.9.2.2 Potential SAR Habitat

Protected species were identified as potentially occurring in the local assessment area based on habitat characteristics and descriptions are noted below.

Bats (Myotis lucifugus, Myotis septentrionalis, and Perimyotis subflavus) – There are three bats listed as Endangered under SARA and NS ESA, including: the little brown myotis (*Myotis lucifugus*), once the most common species of bat in Nova Scotia, the northern (long-eared) myotis (*Myotis septentrionalis*) also formerly very common within the province, and the tri-coloured bats (eastern pipistrelle) (*Perimyotis subflavus*), less common in the province (COSEWIC 2013). Little brown myotis and tri-colored bat forage over water as well as along waterways, and forest edges, while northern myotis may forage in similar areas but most often forages in gaps in the forest (COSEWIC 2013). All three species are listed as Endangered due to drastic population declines caused by a disease known as white-nose syndrome (a fungal infection). This disease severely affects all bat species that congregate in caves and abandoned mine shafts for winter hibernation and has recently devastated bat populations in eastern North America (COSEWIC 2013). Aside from white-nose syndrome, bats are considered sensitive within their hibernating areas to disturbance during the late fall to early spring congregation period. Population vulnerability is contributed by longevity and low fecundity. The recovery strategy (ECCC 2018c) provides a partial identification of critical habitat for hibernacula. Recent reports of bats within Nova Scotia indicate that bat species are still persisting in Nova Scotia, despite white-nose syndrome (Mersey Tobeatic 2018).

Sensitivity to disturbance is reduced when the bats leave wintering areas and become widely distributed throughout the province. Distribution tends to be patchy reflecting favourable habitat conditions (particularly available insect food sources). Summer roosting habitat includes tree cavities and more commonly in and around buildings. Maternal colonies may be established near a good food supply (typically near water or wetlands). Male roosting sites consist of any suitable hiding place such as under tree bark or nooks in buildings. Bats leave summer sites by fall and head to hibernation areas (COSEWIC 2013). Thus, they may be observed on-route in the fall and spring.

Bats were not identified within 5 km of the PFA within the ACC DC data report and the nearest records were over 20 km from the PFA for little brown myotis, over 30 km for northern myotis, and over 80 km for tri-colored bat (ACC DC 2018). Bat hibernacula were not identified for the local assessment area by ACC DC. The Nova Scotia bat sightings database (GNS 2018d) notes several bats recorded within 10 km of the NPNS property in 2018.

The nearest identified preliminary critical habitat (hibernaculum) identified in the recovery plan (ECCC 2015) are over 50 km from the proposed project site. With respect to potential for caves to occur in the general area, the local assessment area is primarily located within bedrock dominated by mudstones, siltstones, and sandstones (see **Section 8.3**), which are unlikely to support cave development. The portion of the proposed pipeline just north of the Town of Pictou (approximate chainage 4+500 to 6+000) is located within an area mapped as the Malagash Formation bedrock, which has a low potential for limestone beds and is unlikely to support cave development. A review of the abandoned mine opening database (GNS 2018e) identified the nearest abandoned mine shaft as over 5 km to the southeast (Trenton area) and southwest (Durham area). Those to the west of the proposed pipeline are over 7.5 km away, and the mine database indicates one of these has been plugged and not accessible.

Two sites with historic summer bat activity were identified over 10 km to the south of the proposed project; a limestone cave in the McLennan's Brook area and an old mine in the New Laing area (Moseley 2007). No underground observations of bats were made. Both sites were investigated in the fall of 2010 as a potential swarming site (Randall 2011) and were not confirmed as such.

The forested areas with wetlands/water features present within both the ETF and pipeline local assessment areas is expected to provide suitable summer roosting and foraging habitat for bats. Bats may forage widely wherever insect prey is abundant including the potential to incidentally occur within the PFA during the summer to fall period. The likelihood of maternity habitat within the PFA is low, based on the limited potential for larger/older trees.

Moose (Alces alces americanus; Mainland Population) - Moose within mainland Nova Scotia (i.e. mainland sub-species) are provincially listed as Endangered under NS ESA, but are not listed under SARA. A provincial recovery plan (NSDNR 2007, now known as Nova Scotia Lands and Forestry) and action plan (McNeil 2013) have been developed. Associations with deer (brainworm infection and other disease), interspecific competition, development/alteration of habitat, resource availability, hunting (including poaching), metals in browse or nutrient deficiency, and predation are thought to be possible causes for changes in population levels and distribution of mainland moose (Parker 2003; Pulsifer 1995). Small populations of mainland moose are known to currently persist in the Pictou-Antigonish Highlands (less than 100 individuals) and in the Cobequid Highlands (500-800 individuals) (Snaith and Beazley

2004). The core habitat moose areas are located over 50 km away from the proposed project area. However, moose may travel widely, particularly in the summer.

According to the Provincial Landscape Viewer (GNS 2018b), there are no identified mainland moose concentrations areas located within or adjacent to the PFA. The nearest identified concentration areas are a fringe area for the Cobequid population, located approximately 10 km to the west of the Pictou causeway in the Scotsburn to Salt Springs area, and a fringe area for the Pictou/Antigonish population located over 15 km to the southeast in the Thorburn area. The nearest ACCDC record to the PFA is over 25 km away (ACCDC 2018a).

Although most commonly associated with mixedwood forest areas, the mainland moose can be found in a wide range of habitats based on availability of browse (Parker 2003). Areas with early successional deciduous vegetation (which includes mature forest understory or open areas) are primary food sources (Snaith and Beazley 2004). Maples and birches are common forage, but balsam fir may also be an important component. Areas with dense cover such as mature conifer stands are important at times of thermal stress (both summer and winter), particularly if interspersed with small disturbed areas providing available forage. The preferred habitat for females and young often include wetlands or watercourses with access to submergent and emergent aquatic vegetation (Parker 2003).

<u>ETF local assessment area</u> – There is a very low likelihood of moose occurring within the ETF footprint area. The ETF footprint area is distant from areas of moose concentration. Although it is possible for individual moose to travel to the Abercrombie peninsula area, it is not expected to occur except on a very occasional basis. In addition, the peninsular location of the ETF footprint limits access from the north and the area is highly developed to the west and south with several large industrial facilities and roads. No evidence (tracks, browse, pellets) of moose were observed during 2017/2018 field investigations at the NPNS property.

<u>Pipeline local assessment area</u> – Although the pipeline footprint area is not part of identified moose habitat, there is potential for incidental occurrence of moose if individuals pass through the area on an occasional basis through the spring to fall period.

Snapping Turtle (Chelydra serpentine) – Snapping turtles are listed as Special Concern under COSEWIC/SARA and Vulnerable under NS ESA. These turtles typically occur near freshwater environments. Preferred habitat of the snapping turtle is characterized by slow-moving water with a soft mud bottom and dense aquatic vegetation (COSEWIC 2008). Areas near slow-moving rivers and streams, ponds, shallow bays, or areas of open water wetland/wetland complexes most often support established populations. Individual turtles are known to be found in developed areas; however, it is unlikely that significant populations persist in these areas (COSEWIC 2008). Snapping turtles may nest (late May and June) in a wide variety of habitats including lakeshores, roadsides, and residential lawn areas and driveways (COSEWIC 2008). Typically, populations require moderate to larger watersheds with both lakes and streams present.

A proposed Management Plan has been developed for snapping turtle in Canada (ECCC 2016a). Key threats to turtles identified by COSEWIC include conversion of aquatic and riparian to urban and agricultural developments, roads, nest predation, illegal harvesting, and fishing bycatch.

ETF local assessment area - The potential for habitat for snapping turtles within the NPNS property is limited. Snapping turtles are anticipated to occur in the freshwater portions of the Middle and West Rivers (main-stems), which are located over 2 km from the proposed ETF footprint area. There are snapping turtle ACCDC observation records approximately 17 km from the PFA associated with the Middle River. Occasionally, individuals get washed downstream and wander more widely within these watersheds which may include brackish and marine environments (pers. comm,. J. Gilhen). No turtles or evidence of turtle nesting was observed during the June 2018 herptile assessment within the ETF footprint area. It is unlikely that turtles use this area as habitat.

Pipeline local assessment area – The pipeline route travels through several small watersheds which include wetlands (see **Section 8.7**). Watercourses of a suitable size are not present, so there is low potential for snapping turtles in the area. It is noted that the existing Highway 106 road shoulder may have substrate suitable for nesting, particularly in the vicinity of wetlands with open water. However, the presence of the road is likely an existing threat to individuals (and young), if present.

Wood Turtle (Glyptemys insculpta) – Wood turtles are listed by SARA and NS ESA as Threatened. Wood turtles are semi-aquatic and are associated with riparian areas/rivers and streams with sand or gravel bottoms and typically clear meandering streams with moderate current (COSEWIC 2007). Nesting habitat is typically on sand or gravel sand beaches or stream banks, but nesting may also occur on anthropogenic sites such as gravelly areas associated with roads in late May to early July (COSEWIC 2007). Additionally, important habitat for this species includes over-wintering areas within typically within streams (but also potentially oxbows, marshes, and vernal pools) with deeper areas that do not freeze to the bottom (ECCC 2016b). Threats to wood turtles include vehicle mortalities (both to adult turtles and their nests), loss of riparian habitat, nesting habitat, winter habitat, poaching, and nest depredation.

A proposed recovery strategy for wood turtles in Canada has been developed by ECCC (ECCC 2016b). The strategy identifies activities of concern and partially identifies Critical habitat based on two criteria: habitat occupancy and habitat suitability. Wood turtles are not recorded in the ACCDC database as having been historically observed within 5 km of the proposed PFA and thus the habitat occupancy criteria for Critical habitat have not been confirmed. The nearest record is 13 km ± 5 km (recorded within 5 km grid) from the PFA. Review of NSDLF Significant Habitat mapping indicated species at risk within the freshwater portions of the Middle and East Rivers (located approximately 2 km and 5 km from the proposed project, respectively). NSDLF confirmed these polygons were identified for wood turtles and that wood turtle stream buffers have been applied to these areas (pers. comm. F. MacKinnon) which are outside of the project footprint. The province has developed a Stewardship Plan for wood turtles in Nova Scotia (MacGregor and Elderkin 2003), which identifies 1-2 turtles have been recorded for the Central Caribou area, indicating some potential for individuals to occur in the proposed pipeline local assessment area.

ETF local assessment area – Based on the June 2018 herptile habitat review, it was determined to be unlikely that wood turtles will use habitat present in the vicinity of the ETF footprint area (pers. comm. J. Gilhen). It is also noted that the adjacent Pictou Harbour estuary (at the mouth of the Middle and East Rivers) is not freshwater habitat and generally not expected to provide wood turtle habitat.

Pipeline local assessment area – As identified in the recovery strategy (ECCC 2016b), habitat suitability includes a mosaic of habitat attributes that contribute to habitat requirements for all life stages. Although occupancy is a key criteria in identifying Critical habitat and wood turtle records are not known for the pipeline assessment area, available habitat data were reviewed in terms of potential for wood turtle habitat along the pipeline route. With the exception of the Pictou Harbour estuaries, the small watersheds crossed by the proposed overland pipeline route have only small to intermittent watercourses (see **Section 8.4**), reducing habitat potential. Wetland areas have potential to meet some habitat requirements, potential natural nesting and overwintering areas are limited. The road shoulder of Highway 106 may have potential gravel habitats (suitability for nesting has not been identified) but road shoulders are identified in the recovery strategy as an ecological trap and as unsuitable habitat. It is considered unlikely that a wood turtle population is present in the pipeline local assessment area, however there is potential individuals may travel through the area.

Monarch (Danaus plexippus) - The monarch butterfly (NS ESA Endangered, SARA Special Concern) is expected to migrate through Nova Scotia on the way to breeding and/or wintering grounds. Breeding habitat requires milkweed plant species on which the larvae feed. Adults feed on a variety of flowering plants, most often goldenrod or aster species (Payzant 2012). The primary threat to monarch populations is impacts to overwintering habitat outside of Canada. A management plan has been developed for the monarch in Canada (ECCC 2016c).

The nearest AC CDC record for monarch was approximately 14 km from the PFA. Although the ETF local assessment area is not expected to provide extensive monarch habitat, a cultivated milkweed species was observed along the edges of hay fields in the PFA. As well, wildflowers occurring both along the ETF footprint area and along the roadside pipeline footprint area may be used for foraging by migratory monarchs in the summer to fall period.

Yellow-banded Bumblebee (Bombus terricola) – This bee (SARA Schedule 1 Special Concern, NS ESA Vulnerable) uses a diverse range of habitats including mixed woods and urban areas (COSEWIC 2015). It forages on flowers and nests underground in cavities such as abandoned rodent burrows or rotten logs (COSEWIC 2015).

The nearest ACCDC record was over 60 km from the PFA. The bee has been historically collected over most of Nova Scotia with the most recent in 2013; however, the population appears to have declined drastically in the last 10 years (COSEWIC 2015). Although unlikely in the PFA, potential habitat may be present in adjacent areas.

Summary

Protected priority species with potential for habitat to occur within the PFA and local assessment area are summarized in **Table 8.9-1**, below.

Table 8.9-1: Summary of Potential SARA/NS ESA listed Terrestrial Wildlife Species

Species	Status*	Habitat of Interest in Local Assessment Area	Potential Occurrence in Local Assessment and Project Footprint Area
Potential Mammals			
Little Brown Myotis (Myotis lucifugus)	SARA: Endangered Schedule 1 NS ESA: Endangered Prov. Rank: S1/At Risk	Waterways, wetlands and forest edges.	Foraging is expected within the project footprint during the summer. Migratory individuals may pass through the area on the way to/from hibernaculum in the spring and late summer/fall. Summer maternity habitat may be present in local assessment area.
Northern Myotis (Myotis septentrionalis)			
Tri-coloured Bat (*Perimyotis subflavus*)			
Moose (Alces alces americanus; Mainland Population)	NS ESA: Endangered Prov. Rank: S1/At Risk	Incidental throughout.	Although unlikely, due to known species distribution, individuals may incidentally occur.
Herptiles			
Snapping Turtle (*Chelydra serpentine*)	SARA: Special Concern Schedule 1 NS ESA: Vulnerable Prov. Rank: S3/Sensitive	Watercourses and wetlands, riparian gravel/sand areas.	Although unlikely, due to small size, Mill Brook and other unnamed tributaries that intersect with the pipeline footprint area may provide suitable foraging or nesting habitat. Hibernation habitat is considered limited.
Wood Turtle (*Glyptemys insculpta*)	SARA: Threatened Schedule 1 NS ESA: Threatened Prov. Rank: S2/Sensitive	Watercourses and wetlands, riparian gravel/sand areas.	Habitat not identified at ETF local assessment area and unlikely suitable along the watercourses that intersect with the pipeline footprint area.

Species	Status*	Habitat of Interest in Local Assessment Area	Potential Occurrence in Local Assessment and Project Footprint Area
Invertebrates			
Monarch (*Danaus plexippus*)	SARA: Special Concern Schedule 1 NS ESA: Endangered Prov. Rank: S2B/Sensitive	Butterfly of variety of habitat types – farm or urban fields, roadsides, open areas with abundant milkweed and wildflowers.	Occasional individuals may breed or forage in habitat throughout the project local assessment area during the summer to fall period.
Yellow-banded Bumblebee (*Bombus terricola*)	SARA Schedule 1 /COSEWIC Special Concern, NS ESA: Vulnerable Prov. Rank: S3/Sensitive	The bee species is a habitat generalist within open coniferous, deciduous and mixed hardwood forests, wet and dry meadows bordering riparian zones, and along roadsides, urban parks, gardens and agricultural areas.	Although habitat may be present adjacent to the project footprint area, the likelihood of the occurrence of the bee is reduced by low numbers currently in the province.

Notes: *Status notes (as of December 2018) - S1: extremely rare in province; S2: rare in province; S3: uncommon in province; S4: widespread, common and apparently secure in province; S5: widespread, abundant and demonstrably secure in province, SU: unrankable (lack of info). The use of 'S#S#' is to denote a range in rank used to indicate any uncertainty about the status of the species or community. Qualifiers: B= Breeding (breeding population), N = Nonbreeding (nonbreeding population) ? = Inexact/Uncertain, H = Historic (possibly extirpated), M = Migrant and SNR = Not yet assessed in province. (ACCDC 2018a).

8.9.2.3 Potential for Other Species of Conservation Concern

Other species of conservation interest and their potential to interact with the project are summarized in **Table 8.9-2**, below.

Table 8.9-2: Summary of Potential for Other Species of Conservation Concern

Species	Status*	Habitat Features	Potential Occurrence in Project Footprint Area
Herptiles			
Four-toed Salamander (Hemidactylium scutatum)	Prov. Rank: S3/Secure	Closely associated with sphagnum areas bordering streams and in sphagnum bogs during spring breeding season. During summer, adults have been found in woodland habitats (GNS 2018f).	Not anticipated within project footprint area but may occur in adjacent habitats if present.
Invertebrates			
Acadian Hairstreak (*Satyrium acadica*)	Prov. Rank: S1/Undetermined	Butterfly associated with willows (the host plant), wet meadows, fields, stream banks and is often found in roadside ditches (Layberry et al. 2002). The species flies from late June to mid-August and is most often observed in July (Layberry et al. 2002).	May incidentally occur within the project footprint area where wet areas or water features are present.

Species	Status*	Habitat Features	Potential Occurrence in Project Footprint Area
Baltimore Checkerspot (Euphydryas phaeton)	Prov. Rank: S2S3/Secure	Butterfly associated with fresh-water marshes, wet roadsides, meadows (Payzant 2012). Flight period is mid June to early August. Larval foods include turtlehead (ACCDC 2018b).	May incidentally occur within the project footprint area where habitat features are present.
Bronze Copper (Lycaena hyllus)	Prov. Rank: S2/Secure	Butterfly associated with open wet habitats usually marshes not overgrown with cattails including manmade ones. Host plants include docks and knotweeds; nectaring occurs on flowers. Flight periods early July to mid-September.	May incidentally occur within the project footprint area where habitat features are present. Recorded in Maritime Butterfly Atlas (AC CDC 2018b) in adjacent West River 10 km square.
Common Roadside Skipper (Amblyscirtes vialis)	Prov. Rank: S3S4/Secure	Butterfly species is almost always seen on the ground, on trails, gravelly or sandy roads, and road verges, usually in wooded areas. It is very rarely seen on flowers (Layberry et al. 2002). The species is observed from late May to mid-July (AC CDC 2018b).	May incidentally occur within the project footprint area where habitat features are present.
Eastern Pearlshell (Margaritifera margaritifera)	Prov. Rank: S2/Sensitive	A freshwater mussel associated with flowing water of rivers and streams (small to medium sized) with mud, sand, gravel or stoney bottom substrate (Davis 2007).	This species may incidentally occur within the project local assessment area where there are rivers and streams areas located adjacent to the project footprint area.
Ebony Boghaunter (*Williamsonia fletcheri*)	Prov. Rank: S2/May be at risk	Dragonfly specie is found in bog type from white cedar, black spruce, larch, to other forests with bogs/bog or fen pools (WOS 2018).	Not anticipated within the project footprint area but may occur in adjacent suitable bog habitat.
Forcipate Emerald (Somatochlora forcipata)	Prov. Rank: S2S3/May be at risk	Dragonfly species occurs at small spring-fed peatland streams, in or out of woodland. Larvae sprawl on bottom among detritus (IUCN 2018)	Not anticipated within the project footprint area but may occur in adjacent suitable peatland stream habitat.
Grey Comma (*Polygonia progne*)	Prov. Rank: S3S4/Secure	Butterfly associated with open forests, roadsides along forested areas (Payzant 2012). Overwinter as adult and flight periods April to mid-June and mid-July to early September. Host plant is currents (AC CDC 2018b).	May incidentally occur within the project footprint area where habitat features are present.
Jutta Arctic (*Oeneis jutta*)	Prov. Rank: S3/May be at risk	Butterfly species is found only in black spruce-tamarack bogs and it prefers the edges of treed areas. Flight period mid-May to early July. Host plants sedges (AC CDC 2018b).	Unlikely in the project footprint area but may incidentally occur within adjacent suitable habitats.
Kennedy's Emerald (*Somatochlora kennedyi*)	Prov. Rank: S1S2/May be at risk	Dragonfly associated with open fens, small ponds, shaded bog ponds, shallow bogs, and slow open streams in bogs or marshes (WOS 2018).	Unlikely in the project footprint area but may incidentally occur within adjacent swamps, shaded bogs or open streams.
Lance-Tipped Darner (*Aeshna constricta*)	Prov. Rank: S3/Secure	Dragonfly associated with lakes, ponds, marshes and slow streams and is observed in flight from early June to early October (Lung and Sommer 2001).	Unlikely in the project footprint area but may incidentally occur within adjacent ponds, marshes and slow streams.
Northern Cloudywing (*Thorybes pylades*)	Prov. Rank: S2S3/Sensitive	Butterfly found nectaring at flowers usually in partially wooded places and meadows, and may occur in built-up areas (Layberry et al. 2002). There is	May incidentally occur within the project footprint area where habitat features are present.

Species	Status*	Habitat Features	Potential Occurrence in Project Footprint Area
		only one generation from mid-May to early-July (Layberry et al. 2002). Host plants legumes, vetch and beach pea (AC CDC 2018b).	
Maine Snaketail (*Ophiogomphus mainensis*)	Prov. Rank: S2S3/May be at risk	Dragonfly species of small rapid rocky streams and rivers in forest. Larvae burrow in sandy substrates (IUCN 2018).	Unlikely in the project footprint area but may incidentally occur within adjacent rocky streams.
Question Mark (Polygonia interrogationis)	Prov. Rank: S3B/Secure	Butterfly, usually seen in or near woodlands, but in late summer in good migrant years it can be found in almost any habitat. (Layberry et al. 2002). Host plants include nettle, elm and hops (AC CDC 2018b). There are two generations per year, with the overwintering generation typically observed from late May to early July. The second generation is observed only in mid-September (Layberry et al. 2002).	May incidentally occur within the project footprint area where forested areas are located adjacent to the project footprint area. Recorded in Maritime Butterfly Atlas (AC CDC 2018b) in Caribou 10 km square.
Salt Marsh/Maritime Copper (Lycaena dospassosi)	Prov. Rank: S2/At Risk	Butterfly associated with salt marshes along the Northumberland Strait (Payzant 2012). Flight period mid -July to mid-August. Adults nectar on marsh and marsh edge flowering plants; and host plant is silverweed (AC CDC 2018b).	Although unlikely to occur within the project footprint area, this species may incidentally occur in adjacent habitat. Recorded in Maritime Butterfly Atlas (AC CDC 2018b) in adjacent 10 km square.
Striped Hairstreak (Satyrium liparops strigosum)	Prov. Rank: S2S3/Sensitive	Butterfly of forest openings and thickets as well as trails and gardens. Nectaring on flowers, especially milkweed. Flight period early July to late August. Host plant shrubs and trees in rose family (AC CDC 2018b).	May incidentally occur within the project footprint area where habitat features are present. Recorded in Maritime Butterfly Atlas (AC CDC 2018b) in adjacent West River 10 km square.
Taiga Bluet (*Coenagrion resolutum*)	Prov. Rank: S1S2/May be at risk	Damselfly, associated with a variety of non-moving waters including marshes, ponds, bogs, and sloughs (WOS 2018).	Not anticipated in project footprint area; may occur in adjacent swamps, shaded bogs or open streams.

Notes: *Status notes (as of December 2018) - S1: extremely rare in province; S2: rare in province; S3: uncommon in province; S4: widespread, common and apparently secure in province; S5: widespread, abundant and demonstrably secure in province, SU: unrankable (lack of info). The use of 'S#S#' is to denote a range in rank used to indicate any uncertainty about the status of the species or community. Qualifiers: B= Breeding (breeding population), N = Nonbreeding (nonbreeding population) ? = Inexact/Uncertain, H = Historic (possibly extirpated), M = Migrant and SNR = Not yet assessed in province. (ACCDC 2018a).

8.9.2.4 Significant Habitats

According to the NSDLF, significant habitats include:

- Sites where species at risk or other species of conservation concern can be found and/or;
- Sites where unusually large concentrations of wildlife occur, and/or;
- Habitats known to be rare in the province.

Significant habitats within 5 km as identified on the provincial dataset (GNS 2018b), and confirmed by NSDLF (pers. comm. F. MacKinnon) related to the wildlife VEC include:

- Species at risk habitat for wood turtles in the Middle and East Rivers south of the ETF footprint area (see **Section 8.9.2.2**).

The site-specific ACCDC report (AC CDC 2018a) obtained provided the locations of significant or managed areas within 5 km of the project footprint area. According to the AC CDC, 14 managed areas, and 2 significant areas are located within 5 km of the PFA. The managed areas and significant areas are summarized below in relation to the wildlife VEC.

- Sawmill Brook Nature Conservancy of Canada Preserve: Located over 2.5 km to the west of the proposed pipeline. The site consists of a sedge meadow and a mixed forest slope adjacent to an alluvial floodplain that provides a critical buffer for Sawmill Brook.
- Munroe's Island Nature Conservancy of Canada Preserve: Located over 400 m to the east and south of the Caribou Ferry channel (and proposed pipeline and outfall within the marine environment). The site includes sand dunes, sand spits, barrier islands and lagoons joined to Caribou Provincial Park (See **Section 8.15**).
- Abercrombie Wildlife Management Area (WMA): this area is regulated under the Abercrombie WMA Designation and Regulations and is located on privately owned land at Abercrombie Point. The key regulation is prohibition on hunting and trapping. It includes both developed and forested areas with some small areas of water and wetland. It was designated as a WMA following the establishment of a nature trail in the area in the 1970's. It also includes a 1.8 hectare area of Pictou Harbour east of the Pictou causeway where a double-crested cormorant colony has become established on some old pilings (see **Section 8.10**).

Figure 8.8-1 in Section 8.8 illustrated significant habitats adjacent to the PFA.

8.9.3 Impact Evaluation/Effects Assessment

The EA was conducted for priority wildlife species identified for the ETF local assessment area based on field surveys conducted in 2017 and 2018, and for the pipeline footprint area as well as the remainder of the local assessment area primarily based on existing baseline data, imagery interpretation, and a December 2018 reconnaissance survey. The habitat requirements of priority wildlife species identified as potentially occurring within and/or near the local assessment area were compared to the range of environmental conditions within the local assessment area to determine if suitable habitat was present for these species. Knowledge of the habitats present within the local assessment area was determined through an interpretation of imagery, topographic and geological mapping, as well as information obtained through field reconnaissance efforts. In instances where appropriate habitat was present for a particular priority species, that taxon was considered to be potentially present in the local assessment area, mitigation identified and potential impacts assessed. Potential accidental effects or malfunctions are considered in **Section 10**.

8.9.3.1 Potential Environmental Effects

A number of activities related to the project have the potential to interact with the wildlife VEC.

The project construction may interact with the wildlife VEC in the following ways:

- Clearing and grubbing of the pipeline route and the ETF footprint area during construction may result in direct loss of tree/forest and field or disturbed habitat, thereby reducing available wildlife habitat;
- Clearing and grubbing of the pipeline route and the ETF footprint area during construction may result in sedimentation and degradation of adjacent habitat;
- Clearing and grubbing of the pipeline route and the ETF footprint area during construction may result in changes to wildlife habitat and wildlife movement;
- Disturbance from construction equipment may cause wildlife avoidance or disruption of wildlife activity (such as breeding and/or feeding);
- Noise, dust, combustion fuel emissions, and vibration may cause a disturbance to wildlife activity and wildlife habitat;
- Construction equipment use may cause direct injury or death of wildlife, particularly to smaller or less mobile wildlife such as turtles, or destroy turtle nesting areas (assessed as an accident, malfunction or unplanned event in **Section 10**);
- Improper waste management control may attract wildlife species to PFA, increasing the potential for interactions; and
- Construction disturbance may cause avoidance of behaviour could result in changes to normal movements, migrations, and other life history processes.

Potential ETF operations that may interact with priority wildlife and associated habitat include:
- The spill basin may attract herptiles or feeding bats;
- Wildlife may enter open clarifiers; and
- Noise associated with the site may disturb wildlife.

Once in operation, anticipated interactions of priority terrestrial wildlife with the project pipeline would be limited, as the condition would reflect existing road operation and maintenance activities.

8.9.3.2 Mitigation

The following mitigation measures are planned to reduce environmental effects on the wildlife VEC.
- A Wildlife Management Plan will be developed if habitat is identified for the project. It will be prepared prior to commencement and will reflect a biologist assessment of potential for wildlife VEC prior to construction, as well as direction provided in recovery plans and provincially identified Best Management Practices such as for wood turtles (MacGregor and Elderkin 2003) and the NSLF Special Management Practices (2012);
- The footprint of the ETF portion of the project (i.e. the area of disturbance) will be reduced to the extent possible by clearing only what is necessary for construction of the project and using existing access where possible;
- The pipeline will primarily be constructed within existing disturbed road shoulder and watercourse and wetland crossings will not be conducted (crossings will occur above or under the road culvert when possible);
- Sediment and erosion control mitigation will be in-place prior to construction activities (see **Section 5** for additional details);

- Construction work within 30 m up gradient of wetlands and watercourses will be conducted during the low flow construction season (June 1 to September 30) when possible;
- Additional mitigation in relation to maintaining quality of adjacent watercourse or wetland dragonfly or turtle habitat is provided in **Sections 8.4 and 8.7**, respectively;
- Clearing and grubbing activities will take place outside of the nesting periods for turtles (avoiding the May – late July period), or if this is not possible, a trained biologist will conduct a pre-commencement turtle nesting survey to confirm no nest present in the PFA and/or develop mitigation in discussion with NSDLF;
- Suspend ROW preparation in the event that an active nest or amphibian or reptile habitat is discovered during ROW preparations. Sign, fence or flag off appropriate buffer area and contact the assigned project Environmental Inspector (or equivalent role);
- An EPP will be developed and implemented for the project, to which the contractor will adhere;
- The EPP will identify procedures to minimize potential for spills (see **Section 5.7**);
- The EPP shall outline proper waste management control methods to avoid unnecessary attraction of wildlife to the work area;
- Do not harass or feed wildlife. Harassment of wildlife is not permitted within NPNS property;
- Establish construction traffic speed limits and general public speed limits during construction to reduce the risk of collisions with wildlife;
- Nuisance or aggressive wildlife encountered will be reported to the local office of NSDLF, and if required a licensed wildlife nuisance contractor employed;
- See **Section 8.2** for mitigation measures to minimize noise disturbance;
- The project team and contractors will be educated to recognize potential priority species that may occur within the PFA with an emphasis on the Nova Scotia *Wildlife Act* prohibition on nest, egg or young destruction including turtle nests. In all cases, if nests are identified, work most stop to avoid nest destruction;
- Re-introduction of milkweed to areas adjacent to the existing ETF footprint area is proposed to mitigate loss of potential monarch habitat within the PFA;
- If a SAR is encountered, contact will be made to a SAR Biologist at NSDLF for an appropriate protocol; and
- Fencing, as necessary, to exclude wildlife is proposed at the spill basin. The majority of the ETF will be constructed (eg. wall heights) to minimize wildlife entry.

8.9.3.3 Characterization of Residual Environmental Effects

The following is a summary of residual environmental effects.

Construction Phase

Noise related to construction activities is expected to be within the current baseline condition and interaction with priority wildlife is not anticipated. Development of the project will result in minor vegetation clearing and the loss of some immature and mature forested and hayfield vegetation in the immediate ETF footprint area, but loss of vegetation and associated wildlife habitat will be consistent with existing road maintenance activities within the pipeline footprint area as the pipeline will primarily be constructed within the road shoulder.

Other than cultivated milkweed plants (monarch forage), the ETF footprint area was not identified as preferred habitat for priority species. Although it is not anticipated that the loss of milkweed is significant to monarch populations, it is proposed that the escapee cultivated milkweed be reintroduced outside the PFA.

For the pipeline portion of the project, potential habitat for priority terrestrial wildlife was identified for the general surrounding area. However, construction of the pipe primarily within an existing road shoulder is not anticipated to change the existing habitat for these species or result in increased habitat fragmentation. Potential for interaction with turtle nests is mitigated by clearing during the non-nesting season or development of alternate mitigation in consultation with NSDLF.

Operation and Maintenance Phase

Operations at the ETF and pipeline are not anticipated to result in substantive interactions between the project and the wildlife VEC.

8.9.4 Summary

In summary, the environmental effects of the project on the wildlife VEC are summarized in **Table 8.9-3,** below.

Table 8.9-3: Summary of Residual Environmental Effects Related to the Wildlife VEC (Terrestrial)

Activities	Potential Effects	Mitigative Factors and Measures	Residual Effects	Significance of Residual Effects
Construction				
Clearing (and grubbing) of the project footprint and pipe construction preparation and associated activities	Direct loss of non-mobile species or habitat within the footprint Wildlife mortality through traffic collisions	Follow general mitigation as noted in Section 5.7 including protection of adjacent watercourses and wetlands. Minimize project footprint area. Use existing access where possible for project access. Inclusion of wildlife fencing, as necessary, at the spill basin. NPNS wildlife policies, such as do not harass or feed wildlife.	Negligible with standard mitigation applied. Direct and Indirect, Irreversible Magnitude – negligible* Duration – permanent Frequency – construction period Geographic extent – small (limited to project footprint area) Context – limited potential for priority terrestrial wildlife species habitat present	Not Significant -Adverse

Activities	Potential Effects	Mitigative Factors and Measures	Residual Effects	Significance of Residual Effects
Clearing (and grubbing) of the project footprint and pipe construction preparation and associated activities	Noise disturbance during construction	Follow general mitigation as noted in Section 5.7. Follow the contractors' EPP and applicable guidelines and regulations including; • Minimizing the area of disturbance, • Meeting noise requirements identified in **Section 8.2**, • Project team and contractors will be educated on environmental awareness.	Negligible with standard mitigation applied. Indirect, Reversible Magnitude – negligible* Duration – temporary Frequency - construction period Geographic extent – small (limited to project footprint area) Context – limited potential for priority terrestrial wildlife species habitat present	Not Significant -Adverse
	Alteration of or disruption to turtle or bat nests and/or their habitat	See above. Follow the contractors' EPP and applicable guidelines and regulations including; • Clearing outside of the May to late July turtle nesting season or requirements as determined by ECCC, • Suspend activities in the event an active avian nest or amphibian or reptile habitat is discovered. • Project team and contractors will be educated on environmental awareness including direction that no one shall disturb, move or destroy SAR or herptile nests. If a nest or young are encountered, the contractor shall cease work in the immediate area of the nest and contact the project supervisor and NSDLF Wildlife Division.	Negligible with standard mitigation applied. Direct and Indirect, Irreversible and Reversible Magnitude - low Duration – short term (one season) Frequency - daily Geographic extent – project footprint area Context – limited potential for nest loss if clearing outside nesting season; bat nests not likely immediately adjacent the project footprint	Not Significant -Adverse

*Magnitude: Negligible - within normal variability of baseline conditions

The proposed mitigation is expected to result in residual effects on priority terrestrial wildlife and associated habitat that is not likely to be significant. Therefore, in consideration of the nature of the project, the environmental setting, and planned mitigation, the residual environmental effects of the project on the wildlife VEC (terrestrial wildlife/priority species) during all phases of the project are rated not significant, with a moderate level of confidence. Follow-up and monitoring, particularly conducting a field investigation in the pipeline footprint area to confirm the desktop information is expected to increase the level of confidence of this prediction.

8.9.5 Follow-up and Monitoring

Follow-up with respect to the wildlife VEC will include:

- Completion of field investigations in the pipeline footprint area to confirm the existing conditions information obtained from secondary (desktop) sources, specifically - follow-up turtle surveys to be conducted May to June prior to construction activity within the pipeline project footprint;
- Development of a Wildlife Management Plan, species at risk awareness, and EPP;
- Re-establishment and monitoring of monarch forage milkweed;
- Follow-up studies as required to verify the environmental effects predictions; and
- Compliance with federal and provincial approvals requirements.

8.10 Migratory Birds and Priority Bird Species/Habitat

The potential environmental effects of the project on migratory birds and priority bird species and their habitat (hereinafter referred to as the birds VEC, for brevity) are assessed in this section.

8.10.1 Scope of VEC

The birds VEC is focused on those species that rely on the project area to meet their habitat needs.

The birds VEC has connections to other VECs such as surface water, wetlands, and flora (refer to **Sections 8.4, 8.7** and **8.8**, respectively) as components of overall habitat. Migratory birds include those listed under the *Migratory Birds Convention Act* (MBCA), while priority birds are mostly species listed as protected pursuant to the Nova Scotia ESA or the Nova Scotia *Wildlife Act* (NSWA). However, the evaluation of priority species also considers the definitions provided in *Guide to Addressing Wildlife Species and Habitat in an EA Registration Document* (NSE 2009) as noted in **Section 8.8** previously.

This VEC is focused on birds, as well as the habitats that support them throughout their life history. Migratory and priority bird species and their habitat is selected as a VEC because of potential interactions between birds, their habitat, and proposed project activities. Potential interactions with the project are primarily anticipated to occur only during the construction phase, such as during vegetation clearing.

Species of conservation interest (i.e., SAR and SOCC, as identified by provincial and federal regulatory agencies) are of particular focus in this assessment because they are often at increased risk and more susceptible to changes in the environment. As such, they are useful indicators of ecosystem health and regional biodiversity.

Based on the Nova Scotia EA guidance (NSE 2009), the wildlife VEC considered priority species and associated habitats that included the following:

- Species listed as Endangered, Threatened, or Special Concern (including Schedule 1) under SARA, referred to as SAR;
- Species listed as Endangered, Threatened, or Vulnerable under Nova Scotia ESA, also referred to as SAR; and
- COSEWIC species listed as Endangered, Threatened, or Special Concern and SOCC - At Risk or Sensitive under Nova Scotia's general status assessment process.

Additionally the following were assessed:

- Species with AC CDC Provincial Species conservation status ranks (Sub-national/provincial "S-Rank" of extremely rare (S1), rare (S2), or uncommon (S3)), also referred to as SOCC; and
- Significant Species and Habitat as identified in the provincial database.

8.10.1.1 Boundaries

Spatial boundaries for the assessment of environmental effects on the birds VEC include the following:

- The **project footprint area (PFA)** is defined as the maximum extent of the physical area of disturbance associated with the project. The PFA will include all temporary and permanent areas of ground and marine disturbance. The PFA is defined in **Section 5.1.1**. For the birds VEC, two distinct footprint areas are assessed: the physical footprint of the replacement ETF, an area comprising20.8 ha of land within the NPNS property boundary; and the transmission pipeline footprint which is based on proposed disturbance during construction of Highway 106 road shoulder and associated areas required to be cleared ancillary to construction. The estimated total area of potential temporarily disturbed area during construction is 66.6 ha;
- The **local assessment area** is the maximum area within which environmental effects from the project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence (i.e., the potential zone of influence of the project's indirect effects, such as noise on the birds VEC). As birds may have species-specific sensitivities to indirect effects, a conservative buffer of 5 km from the PFA is applied as the local assessment area. It is anticipated that beyond that distance, indirect pathways such as noise or dust arising from the project would not be distinguishable from existing levels (see **Sections 8.1 and 8.2**); and
- The **regional assessment area** for birds includes the ecoregion encompassed by the project.

Temporal boundaries for the assessment of environmental effects on the environment include periods of construction, operation and maintenance, and decommissioning. Construction is estimated to be approximately 21 months, beginning second quarter of 2019, commencing as soon as the EA review has been completed and the applicable permits, approvals or other forms of authorization have been obtained. Operation and maintenance will commence immediately following the construction phase and will continue to operate efficiently and safely for several decades and likely much longer with a well-maintained system. For the purpose of this EA Registration, it has been assumed that the operation and maintenance phase will begin in the fourth quarter of 2020. Decommissioning of the project would occur at the end of mill life following the completion of operations. Once the ETF or pipeline is nearing the end of a useful service life, a decommissioning plan will be developed and will be submitted for a separate review requiring NSE approval.

8.10.1.2 Significance Criteria

A significant adverse residual environmental effect on migratory bird and priority bird species/habitat is one where the population of a species is sufficiently affected to cause a decline in abundance and/or change in distribution, beyond which natural recruitment (reproduction and immigration from unaffected areas) would not return the population to its former level within several generations. This includes effects identified in relation to a contravention of SARA (including impacts to identified critical habitat), NS ESA, MBCA or NS WA provisions, or in relation to population impacts to non-SARA or non-Nova Scotia ESA listed priority bird species.

8.10.2 Existing Environment

The vast majority of bird species found in Nova Scotia are migratory and are protected pursuant to the MCBA. The Act prohibits killing, injuring or harassing migratory birds, their nests, or their young. Furthermore, species listed pursuant to the federal SARA or the provincial NS ESA are protected from harm and the destruction of their nest, eggs or young is prohibited. Lastly, the NSWA protects all owl and raptor species and their nests.

The geographical setting of Nova Scotia, located halfway between the North Pole and the Equator, has a strong influence on the diversity of bird life. Due to this geography, there are many species of shorebird and sea duck that only visit Nova Scotia during their spring and fall migrations. Every spring, many of these species migrate from locations in Central and South America to breed in the Canadian Arctic, using locations in Nova Scotia to rest and feed in between. Similarly, there are many species of bird that also migrate from locations in the southern United States, Central and South America (and the Greater Antilles) every spring, but breed in Nova Scotia, before returning to their wintering grounds in the fall. Lastly, there are those species which are either non-migratory or such short-distance migrants that individuals of these species are present year-round within Nova Scotia.

Spring migration in northern Nova Scotia typically begins in March. As the snow melts and water bodies begin to thaw, the number of migrating water birds, hawks, and songbirds begin to arrive too. During April the pace of migration and the number of returning species increases and during the month of May reaches a peak, with a wide diversity of birds either passing through the area on their way to Arctic nesting grounds or arriving on their breeding territories in Nova Scotia. By early June, migration is nearly complete, but can continue through the first week or two for the latest arriving birds.

Nesting in in northern Nova Scotia can begin as early as mid-March, as with the barred owl (*Strix varia*), and continue into early-September, as with the American goldfinch (*Spinus tristis*) (See **Graph 8.10-1**, below) However, the vast majority of birds, as recognized by the Canadian Wildlife Service, are engaged in nesting activities from mid-April to late August (Nesting Zone C3).

The fall migration of birds in northern Nova Scotia can be first detected in early July with the flight of shorebirds on their journey from Arctic and boreal nesting grounds to the Gulf of Mexico, the Caribbean, and Central and South America. These migrating shorebirds occur primarily in coastal areas in Nova Scotia, where they stopover to rest and forage. Many other species, including local nesting birds, begin their southward migration in August, with the peak fall migration often occurring in late August and lasting into early October. By mid-October and early November, many of the birds remaining in the area are likely birds that have arrived from more northerly climes and will overwinter within the area.

Nesting Calendar for Breeding Birds within the Northumberland Lowlands Ecodistrict

8.10.2.1 Regional Setting

As noted previously, the PFA and local assessment area are located in what is known as the Northumberland/Bras d'Or Lowlands EcoRegion, more specifically, within the Northumberland Lowlands EcoDistrict (Neilly et al. 2017). This EcoDistrict is comprised of undulating plains of ridges and valleys containing a few lakes and streams on the lowlands that branch irregularly as they flow northward from their source in the Cobequid Highlands. Peatlands are common in areas of low relief and salt marshes line some of the shallower harbours and inlets along the coast (Webb and Marshall 1999).

Mixedwood forests are common within the ecoregion and are composed mainly of red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), red maple (*Acer rubrum*), and hemlock (*Tsuga canadensis*). However, tolerant hardwood stands comprised of species such as American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), and yellow birch (*Betula alleghaniensis*) dominate the fertile soils along the ridge tops. Less fertile ridges are occupied by American beech (*Fagus grandifolia*), red maple, and trembling aspen (*Populus tremuloides*) (Zelazny 2007). Conifer species within the ecoregion are typically associated with shallower soils in the lowlands and along lower slopes where they can form near pure softwood stands. These softwood stands are often dominated by red spruce, balsam fir, and white spruce (*Picea glauca*). Eastern hemlock (*Tsuga canadensis*) and white pine (*Pinus strobus*) are also present, but very rarely dominant. Peatlands too are often ringed with a perimeter of softwood trees, typically stunted black spruce and eastern larch. Lastly, this ecoregion has a history of forest fires due to the warm, dry summers and is corroborated by the abundance of fire-adapted species, particularly jack pine (*Pinus banksiana*) and black spruce (*Picea mariana*) (Webb and Marshall 1999).

For more detailed information on habitats located within and adjacent the PFA, see **Section 8.8** (Flora)

8.10.2.2 Desktop Analysis

Dillon reviewed readily available information from a number of credible sources. As noted in **Section 5**, the proposed location of the pipeline changed following the completion of the avian program. As such, a significant portion of the PFA (in the pipeline corridor) has not been surveyed for avian SOCC and/or SAR. The information regarding the presence and characterization of potential avian SOCC and/or SAR habitat within the PFA and local assessment area was therefore derived from several sources including existing databases and secondary information sources (i.e., desktop analysis) as well as limited field surveys. Confirmatory field surveys will be conducted in spring and summer 2019 to confirm the desktop information.

To provide information on potential occurrences of priority birds, and unique or sensitive bird habitats potentially existing within the PFA, a review of the following existing data and information sources was conducted:

- Nova Scotia provincial Significant Habitat database;
- Protected Areas (GNS 2018b);
- Ecological Reserves in the Maritimes;

- Environmentally Sensitive Areas database;
- Atlas of Breeding Birds of the Maritime Provinces;
- Important Bird Areas of Canada;
- Federally designated Migratory Bird Sanctuaries;
- Identified Protected Natural Areas, and Wildlife Management Zones.
- Publicly-available GIS map layers and databases; and
- NSDLF Provincial Landscape Viewer Wet Area Mapping and Predictive Flow Models.

The potential for priority bird species was informed by species identified by the AC CDC as having been historically recorded within 5 km of the project footprint (or farther if potential wide-ranging species) and comparison of the local assessment area habitats with potential habitat requirements for the identified species.

Field investigations within the PFA included:

- Habitat evaluation at the ETF footprint area and Pictou Harbour – October 2017, June 2018; and
- Reconnaissance of the proposed pipeline footprint – December 3, 2018.

A custom AC CDC report was obtained for a 5 km radius around the PFA. The report lists historical observations of species of flora and fauna, including rare species, SOCC (S1 and S2) and SAR within a 5 km radius from the PFA (refer to **Appendix N**). On review of the SARA/COSEWIC species listed as Endangered, Threatened, or Special Concern, 22 species are identified as having potential to occur within the local assessment area and are listed in **Table 8.10-1** below. It is noted that scientific names for the birds are included in the tables and are not provided in the text unless not occurring in the tables.

Table 8.10-1: Bird Species Potentially Occuring in the Local Assessment Area

Common Name	Scientific Name	Status[1]	Breeding or Migratory Habitat (whichever is most applicable)	Detected or Observed during Field Work?	Possible Habitat Type in the Local Assessment Area
American Bittern	*Botaurus lentiginosus*	Provincial S3S4B - Sensitive	Breeding - Nests in freshwater wetlands and occasionally in salt marshes.	No	Open wetlands.
American Coot	*Fulica americana*	Provincial S1B - Undetermined	Breeding - found in aquatic habitats year around and during migration.	No	Open wetlands.
American Golden-Plover	*Pluvialis dominica*	Provincial S1S2M - Sensitive	Migratory - during fall migration prefers open grass areas, less often on mudflats and beaches.	No	Agricultural lands, fields and shorelines.
American Kestrel	*Falco sparverius*	Provincial S3B - Secure	Breeding – cavity-nester in trees or structures. Prefer open areas, such as agriculture and open woodland.	No	Agricultural lands, fields and open wetlands.
American Three-toed Woodpecker	*Picoides dorsalis*	Provincial S1? - Undetermined	Breeding - nest in conifer forests and montane regions, often black spruce near bogs.	No	Wetlands, especially peatlands.
Arctic Tern	*Sterna paradisaea*	Provincial S3B - May Be At Risk	Breeding - Nest on coastal islands or gravel beaches with little to no vegetation. Migratory - May occur in coastal areas during spring/fall migration.	No	Pictou and Caribou Harbours, but no known nearby breeding colony exists.
Baltimore Oriole	*Icterus galbula*	Provincial S2S3B - May be at risk	Breeding – Nests in open, deciduous forest often along watercourse, but will also nests in urban areas.	No	Developed or cleared areas.
Bank Swallow	*Riparia riparia*	COSEWIC/SARA Threatened Sched. 1; NS ESA Endangered Provincial S2S3B May Be At Risk	Breeding – Nests in sandy banks and cliffs around coastlines and watercourse. Will also use human-made habitats such as gravels pits and road cuts.	No	Steep shorelines, such as Abercrombie point.
Barn Swallow	*Hirundo rustica*	COSEWIC/SARA Threatened Sched. 1	Breeding – shows a tendency to construct its nest on human-made structures such as	Yes, ETF Site facing	NPNS facility, the Pictou Causeway and other built

Common Name	Scientific Name	Status[1]	Breeding or Migratory Habitat (whichever is most applicable)	Detected or Observed during Field Work?	Possible Habitat Type in the Local Assessment Area
		NS ESA Endangered Provincial S2S3B/At risk	barns, bridges, cottages or any structure with a shelf, vertical surface or overhang.	northeast (May 2018).	structures.
Barrow's Goldeneye – Eastern pop.	*Bucephala islandica*	COSEWIC/SARA Special Concern Sched. 1 Provincial S1N/At Risk	Migratory - Winters in coastal waters and rivers during winter months.	Yes, west of Site along Highway 106 (Jan. 2018).	Pictou and Caribou Harbours. [2]No Critical habitat identified within the PFA.
Bay-breasted Warbler	*Dendroica castanea*	Provincial S3S4B/Sensitive	Breeding - Nests in mid-aged to mature conifer forests, including managed stands, preferring spruce, fir or hemlock.	No	Conifer-dominated forest adjacent Highway 106.
Bicknell's Thrush	*Catharus bicknelli*	COSEWIC Threatened, SARA Special Concern Sched. 1, NS ESA Endangered, Provincial S1S2B - At Risk	Breeding - Nests in early successional fir and spruce at high elevations.	No	None – no high elevation forest. [3]No Critical habitat identified within the PFA.
Black-backed Woodpecker	*Picoides arcticus*	Provincial S3S4 - Sensitive	Breeding - Nests in mature softwood stands and burnt areas with dead, standing trees. Occasionally in peatlands.	No	Wetlands, especially peatlands.
Black-bellied Plover	*Pluvialis squatarola*	Provincial S3M - Secure	Migratory - Winters on coastal beaches and estuaries.	No	Shorelines within the Pictou and Caribou Harbours.
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Provincial S3B - May be at Risk	Breeding - Nests in forest edges and tall shrub thickets, showing an association for young deciduous trees, often near water.	No	Developed or cleared areas, riparian corridors and wetlands.
Black-crowned Night-heron	*Nycticorax nycticorax*	Provincial S1B - May Be At Risk	Breeding – Colony nester in trees, often near the coast or on coastal islands. Rare ground nester.	No	Shorelines within the Pictou and Caribou Harbours, but no known nearby colony exists.

Common Name	Scientific Name	Status[1]	Breeding or Migratory Habitat (whichever is most applicable)	Detected or Observed during Field Work?	Possible Habitat Type in the Local Assessment Area
Black-headed Gull	*Chroicocephalus ridibundus*	Provincial S3N - Secure	Migratory/Vagrant – Some individuals winter along the Atlantic Coastline in estuaries and sheltered bays.	No	Pictou and Caribou Harbours
Black-legged Kittiwake	*Rissa tridactyla*	Provincial S3B,S5N - Sensitive	Breeding - Colony cliff nester of steep, offshore islands and coastal cliffs.	No	None – no known nearby colony.
Blackpoll Warbler	*Dendroica striata*	Provincial S3S4B - Sensitive	Breeding - Nests in young fir or spruce, often in high elevation or coastal areas.	No	Peatlands
Blue-winged Teal	*Anas discors*	Provincial S3S4B - May be at Risk	Breeding - Nests in cattail marshes and other open water wetlands.	No	Open wetlands.
Bobolink	*Dolichonyx oryzivorus*	COSEWIC/SARA Threatened Sched. 1 NS ESA Vulnerable Provincial S3S4B - Sensitive	Breeding – Shows a strong affinity for cultivated grasslands, but also nests in fens, and other graminoid dominated environments.	No	Agricultural lands and unmanaged grasslands
Boreal Chickadee	*Poecile hudsonica*	Provincial S3 - Sensitive	Breeding - Nest in mature coniferous forests, typically at higher elevations.	No	Conifer-dominated forest adjacent Highway 106.
Boreal Owl	*Aegolius funereus*	Provincial S2?B - Undetermined	Breeding – Often will nest in old woodpecker holes and other tree cavities in mature coniferous forest.	No	Conifer-dominated forest adjacent Highway 106.
Brown Thrasher	*Toxostoma rufum*	Provincial S1B - Undetermined	Breeding - Nest in shrubby environments, such as thickets, swales and edge habitats.	No	Wetlands.
Brown-headed Cowbird	*Molothrus ater*	Provincial S2B - Secure	Breeding - Parasitic nester, closely associated with agricultural grassland and livestock farming.	No	Agricultural lands, developed areas and other cleared land.
Bufflehead	*Bucephala albeola*	Provincial S3S4N - Secure	Migratory - Winters along the coast, using sheltered coves, harbours, and estuaries.	Yes, ETF Site facing northeast Dec. 2017,	Pictou and Caribou Harbours.

Common Name	Scientific Name	Status[1]	Breeding or Migratory Habitat (whichever is most applicable)	Detected or Observed during Field Work?	Possible Habitat Type in the Local Assessment Area
				Jan. and March 2018).	
Canada Warbler	*Wilsonia Canadensis*	COSEWIC/SARA Threatened Sched. 1 NS ESA Endangered Provincial S3B - At risk	Breeding – Nests in forested wetlands with dense understories.	No	Wetlands. [4]No Critical habitat identified within the PFA.
Cape May Warbler	*Dendroica tigrina*	Provincial S2B - Sensitive	Nests in mature coniferous forests, typically black spruce.	No	Conifer-dominated forest adjacent Highway 106.
Chimney Swift	*Chaetura pelagica*	COSEWIC/SARA Threatened Sched. 1 NS ESA Endangered Provincial S2B,S1M - At Risk	Breeding – Typically forms nesting colonies in vertical, and often, human-made chimneys. Will also nest in large, standing dead trees that have hollowed out.	No	Possible in wetlands. No known nearby chimney roosting site exists.
Cliff Swallow	*Petrochelidon pyrrhonota*	Provincial S2S3B - May be at Risk	Breeding – Colonial nester, creates nests on buildings and other human-made structures suing available mud and their saliva.	Yes, west of Site along Hwy 106 C and D (June 2018).	NPNS facility, the Pictou Causeway and other built structures.
Common Eider	*Somateria mollissima*	Provincial S3S4 - Secure	Breeding – Colony nester of offshore islands. Migratory – Winters along rocky coastlines	No	Pictou and Caribou Harbours.
Common Goldeneye	*Bucephala clangula*	Provincial S2B, S5N - Secure	Breeding - Nests in large trees with cavities near freshwater wetlands, ponds, lakes and rivers. Migratory – Winters in shallow coastal bays, harbours and estuaries.	Yes, ETF Site facing northeast (Dec 2017, Jan. and March 2018). Yes, observed from	Breeding: Open wetlands. Migratory: Pictou and Caribou Harbours.

Common Name	Scientific Name	Status[1]	Breeding or Migratory Habitat (whichever is most applicable)	Detected or Observed during Field Work?	Possible Habitat Type in the Local Assessment Area
				shoreline site, 350 m northeast from Hwy 106 causeway facing south and east (Jan. and March 2018).	
Common Moorhen	*Gallinula chloropus (Gallinula galeata)**	Provincial S1B - Undetermined	Breeding - Nest in cattail marshes, and other waterbodies with dense emergent vegetation.	No	Open wetlands.
Common Nighthawk	*Chordeiles minor*	COSEWIC/SARA Threatened Sched. 1 NS ESA Threatened Provincial S2B - At risk	Breeding - Nests on the ground in open to semi-open habitats such as scrub barrens, headlands, rocky outcroppings, clear cut areas, burns and even gravelled rooftops and parking lots.	No	Open wetlands, disturbed areas and other cleared land. [5]No Critical habitat identified within the PFA.
Common Tern	*Sterna hirundo*	COSEWIC Not at risk Provincial S3B - Sensitive	Breeding - Nests on coastal islands, sand spits and barrier beaches, occasionally will use derelict piers or even dredge spoils.	Yes ETF Site facing northeast and west of Site along Hwy 106 in May 2018. Yes, observed from shoreline site, 350 m	Pictou Bar and Ballast Island; Pictou and Caribou Harbours.

Common Name	Scientific Name	Status[1]	Breeding or Migratory Habitat (whichever is most applicable)	Detected or Observed during Field Work?	Possible Habitat Type in the Local Assessment Area
				northeast from Hwy 106 causeway facing S and E (May 2018).	
Cooper's Hawk	*Accipiter cooperii*	Provincial S1?B - Undetermined	Breeding – Nests in a wide variety forest types, buts shows an association with mature hardwood forests or mature Mixedwood forests.	No	Forested areas adjacent Highway 106.
Eastern Bluebird	*Sialia sialis*	COSEWIC Not at risk Provincial S3B - Sensitive	Breeding – Cavity nester preferring open habitats, such as bogs or fens, but often associated with agricultural lands.	No	Open wetlands and agricultural areas.
Eastern Kingbird	*Tyrannus tyrannus*	Provincial S3B - Sensitive	Breeding - Nests in open, scrubby habitats along woodland edges, wetlands and watercourses.	No	Wetlands.
Eastern Whip-Poor-Will	*Caprimulgus vociferus*	COSEWIC/SARA Threatened Sched. 1 NS ESA Threatened Provincial S1?B - At Risk	Breeding – Nests on the ground in deciduous and Mixedwood forests with little to no understory.	No	Forested areas adjacent Highway 106.
Eastern Wood-Pewee	*Contopus virens*	COSEWIC/SARA Special Concern Sched. 1 NS ESA Vulnerable Provincial S3BS4B – Sensitive	Breeding – Nests in mature deciduous or mixed wood forest, often in forest clearings and in edge habitat.	No	Forested areas adjacent Highway 106.
Evening Grosbeak	*Coccothraustes vespertinus*	COSEWIC Special Concern	Breeding – Nests in mature coniferous to mixedwood forests, but can tolerate a wide	No	Forested areas adjacent Highway 106.

Common Name	Scientific Name	Status[1]	Breeding or Migratory Habitat (whichever is most applicable)	Detected or Observed during Field Work?	Possible Habitat Type in the Local Assessment Area
		Provincial S3S4B, S3N - Secure	variety of forested habitats		
Fox Sparrow	*Passerella iliaca*	Provincial S3S4B - Secure	Breeding - Nests in higher elevation coniferous forest, often stunted spruce or fir. Will also use regenerating forests after cutting and conifer plantations.	No	Forested areas adjacent Highway 106.
Gadwall	*Anas strepera*	Provincial S2B - May Be At Risk	Breeding - Nest in cattail marshes, and other waterbodies with dense emergent vegetation.	No	Open wetlands.
Gray Catbird	*Dumetella carolinensis*	Provincial S3B - May be at risk	Breeding – Nests in shrubby thickets, early successional and edge habitats.	Yes, observed from shoreline site, 350 m northeast from Hwy 106 causeway facing S and E (June 2018).	Wetlands.
Gray Jay	*Perisoreus canadensis*	Provincial S3 - Sensitive	Breeding – Nests in old-growth coniferous forest, often comprised of spruce and fir.	No	Conifer-dominated forest adjacent Highway 106.
Great Cormorant	*Phalacrocorax carbo*	Provincial S2S3 - Sensitive	Breeding – Nests in colonies on steep coastal cliffs and offshore islands. Migratory – Winters in coastal areas in bays, harbours and coves.	Yes, overwintering survey (December 2017)	Breeding: May nest amongst double-crested colony on Pictou Causeway. Migratory: Pictou and Caribou Harbours.
Great Crested Flycatcher	*Myiarchus crinitus*	Provincial S1B/May be at risk	Breeding - Nest in holes/cavities in deciduous forests, particularly along lakes, watercourse and wetlands.	No	Open wetlands.

Common Name	Scientific Name	Status[1]	Breeding or Migratory Habitat (whichever is most applicable)	Detected or Observed during Field Work?	Possible Habitat Type in the Local Assessment Area
Greater Yellowlegs	*Tringa melanoleuca*	Provincial S3B,S3S4M - Sensitive	Breeding – Nests in bogs, fens and other sparsely wooded wetlands. Migratory – Winters along shorelines, saltmarshes, mudflats and other ice-free waterbodies.	No	Breeding: Peatlands. Migratory: Pictou and Caribou Harbours
Harlequin Duck - Eastern pop.	*Histrionicus histrionicus pop. 1*	COSEWIC/SARA Special Concern Sched. 1 NS ESA Endangered Provincial S2N - At Risk	Migratory – Winters along coasts, mostly inn turbulent waters near submerged reefs.	No	None. [6]No Critical habitat identified within the PFA.
Hudsonian Godwit	*Limosa haemastica*	Provincial S1S2M - Sensitive	Migratory - Migrants use marshes, beaches, flooded fields and mudflats.	No	Open wetlands and the Pictou and Caribou Harbours.
Hudsonian Whimbrel	*Numenius phaeopus hudsonicus*	Provincial S2S3M - Sensitive	Migratory – Migrants use marshes, beaches, flooded fields, mudflats and saltmarshes.	No	Open wetlands and the Pictou and Caribou Harbours.
Indigo Bunting	*Passerina cyanea*	Provincial S1?B - Undetermined	Breeding – Nests in shrubby areas, typically early successional or edge habitats.	No	Agricultural lands, developed areas and other cleared land.
Killdeer	*Charadrius vociferus*	Provincial S3B - Sensitive	Breeding – Nest on open ground in disturbed areas such as borrow pits, agricultural land and gravelled areas.	Yes, observed from shoreline site, 350 m northeast from Hwy 106 causeway facing south and east (May 2018).	Agricultural lands, developed areas and other cleared land.

Common Name	Scientific Name	Status[1]	Breeding or Migratory Habitat (whichever is most applicable)	Detected or Observed during Field Work?	Possible Habitat Type in the Local Assessment Area
Lapland Longspur	*Calcarius lapponicus*	Provincial S3?N - Secure	Migratory - During spring and fall migration, found on plowed fields, grassland, and other open, graminoid dominated environments	No	Agricultural lands, developed areas and other cleared land.
Least Sandpiper	*Calidris minutilla*	Provincial S1B, S3M - Secure	Breeding – Nests in coastal heathlands and sand dunes. Migratory – Winters on coastal mudflats, wet meadows and the mucky edges of waterbodies.	No	Breeding: None. Migratory: Pictou and Caribou Harbours
Lesser Yellowlegs	*Tringa flavipes*	Provincial S3M - Secure	Migratory - Winter in coastal estuaries, marshes, edges of lakes and ponds.	No	Open wetlands and the Pictou and Caribou Harbours.
Long-eared Owl	*Asio otus*	Provincial S2S3 - May Be At Risk	Breeding – Typically selects an abandoned hawk or corvid stick nest in a wide variety of forest types, but often near wetlands such as fens, bogs or beaver ponds.	No	Wetlands.
Marsh Wren	*Cistothorus palustris*	Provincial S1B - Undetermined	Breeding – Nests in either fresh or saltwater marshes with abundant emergent vegetation.	No	Open wetlands.
Nelson's Sparrow	*Ammodramus nelsoni*	Provincial S3S4B - Secure	Breeding - Nests in saltmarshes and along tidal sections of large rivers.	No	Pictou and Caribou Harbours.
Northern Goshawk	*Accipiter gentilis*	COSEWIC Not at risk Provincial S3S4 - Secure	Breeding – Nests in mature forests with low density understory and a high percentage of canopy closure.	No	Forested areas adjacent Highway 106
Northern Harrier	*Circus cyaneus*	COSEWIC Not at risk Provincial S3S4B - Secure	Breeding – Nests on the ground in cultivated grassland, scrubland, bogs, and in open habitats around the coast.	No	Open wetlands and agricultural lands.
Northern Mockingbird	*Mimus polygolottos*	Provincial S1B - Secure	Breeding – Nests in open, shrubby habitats, often near human developed and landscaping.	No	Agricultural lands, developed areas and other cleared land.

Common Name	Scientific Name	Status[1]	Breeding or Migratory Habitat (whichever is most applicable)	Detected or Observed during Field Work?	Possible Habitat Type in the Local Assessment Area
Northern Shoveler	*Anas clypeata*	Provincial S2B - May Be At Risk	Breeding – Nests in fresh or brackish marshes.	No	Open wetlands.
Olive-sided Flycatcher	*Contopus cooperi*	SARA Threatened Sched. 1 NS ESA Threatened Provincial S2B - At risk	Breeding – Typically nests in coniferous forest or treed wetlands, often near water.	No	Wetlands. [7]No Critical habitat identified within the PFA.
Pectoral Sandpiper	*Calidris melanotos*	Provincial S2S3M - Secure	Migratory – During migration uses open wetlands, mudflats and the shorelines.	No	Wetlands and the Pictou and Caribou Harbours.
Peregrine Falcon - anatum/tundrius	*Falco peregrinus pop. 1*	SARA Special Concern Sched. 1 NS ESA Vulnerable Provincial S1B SNAM - Sensitive	Breeding - Nests on shoreline cliffs, mostly around the Bay of Fundy.	No	None.
Pine Grosbeak	*Pinicola enucleator*	Provincial S2S3B,S5N - May Be At Risk	Breeding - Nests in open coniferous forest.	No	Conifer-dominated forest adjacent Highway 106.
Pine Siskin	*Carduelis pinus*	Provincial S2S3 - Sensitive	Breeding - Nests in conifer-dominated forests.	No	Conifer-dominated forest adjacent Highway 106.
Pine Warbler	*Dendroica pinus*	Provincial S1B - Undetermined	Breeding – Nests in mature red or white pines.	No	Abercrombie Point and forested areas adjacent Highway 106.
Piping Plover melodus ssp.	*Charadrius melodus melodus*	SARA Endangered Sched. 1 NS ESA Endangered Provincial S1B - At Risk	Breeding – Nests on shallow sloping, sparsely vegetated sandy beaches.	No	Pictou Bar and other sandy beaches within the Pictou and Caribou Harbours. [8]No Critical habitat identified within the PFA. However, number of nearby beaches within the

Common Name	Scientific Name	Status[1]	Breeding or Migratory Habitat (whichever is most applicable)	Detected or Observed during Field Work?	Possible Habitat Type in the Local Assessment Area
					LAA are considered Critical habitat.
Purple Martin	*Progne subis*	Provincial SHB/May Be At Risk	Breeding - Nest in open areas in cavities (natural and human-made) always near water.	No	Agricultural lands and open wetlands.
Purple Sandpiper	*Calidris maritima*	Provincial S3?N - Sensitive	Migratory - Winters along turbulent, rocky coastlines and sometimes human-made jetties.	No	Pictou and Caribou Harbours.
Red-breasted Merganser	*Mergus serrator*	Provincial S3S4B,S5N - Secure	Breeding – Often nests in association with gull or terns colonies, using dunes, barrier beaches and offshore islands. Will also nest inland around lakes and rivers. Migratory - Winters on coastal waters in May-August	Yes ETF Site facing northeast in Dec. 2017, Jan., March and May 2018; west of Site along Hwy 106 (March and May 2018). Yes, observed from shoreline site, 350 m northeast from Hwy 106 causeway facing south and east (March 2018).	Breeding: Pictou Bar; other locations within Pictou and Caribou Harbours Migratory: Pictou and Caribou Harbours.

Common Name	Scientific Name	Status[1]	Breeding or Migratory Habitat (whichever is most applicable)	Detected or Observed during Field Work?	Possible Habitat Type in the Local Assessment Area
Red-breasted Nuthatch	*Sitta canadensis*	Provincial S3 - Secure	Breeding - Nests in cavities in dead trees, often in conifer-dominated forests.	No	Wetlands and conifer-dominated forest adjacent Highway 106.
Red Crossbill	*Loxia curvirostra*	Provincial S3S4 - Secure	Breeding - Nests in conifer-dominated forests, especially those with older spruce, balsam fir and pine.	No	Conifer-dominated forest adjacent Highway 106. [9]No Critical habitat identified within the PFA.
Red Knot rufa ssp	*Calidris canutus rufa*	SARA Endangered Sched. 1, NS ESA Endangered Provincial S2M - At risk	Migratory - During migration may be found on coastal mudflats and tidal zones, sometimes on open sandy beaches.	No	Pictou and Caribou Harbours. [10]No Critical habitat identified within the PFA.
Red-necked Phalarope	*Phalaropus lobatus*	COSEWIC Special Concern Provincial S2S3M - Sensitive	Migratory – typically overwinter offshore and in coastal areas, in migration can found along the coast.	No	Pictou and Caribou Harbours.
Roseate Tern	*Sterna dougallii*	COSEWIC /SARA Endangered Sched. 1 NS ESA Endangered Provincial S1B - At Risk	Breeding – Nests on rocky, offshore islands linked to stable colonies of arctic and common terns. Migratory – Winters offshore and along coasts.	No	None - There is no known record of a Roseate Tern colony along the Northumberland Strait. [11]No Critical habitat identified within the PFA.
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Provincial S2S3B - Sensitive	Breeding - Nests in open deciduous forest with a well-developed shrub understory, often near waterbodies or wetlands.	No	Forested areas adjacent Highway 106.
Rough-legged Hawk	*Buteo lagopus*	Provincial S3N - Secure	Migratory - Overwinters in open habitats such as grasslands, open wetlands and other clearings	No	Open wetlands and agricultural lands.

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Ruby-crowned Kinglet	*Regulus calendula*	Provincial S3S4B - Sensitive	Breeding - Nest in a variety of forest types both young and old.	No	Forested areas adjacent Highway 106.
Ruddy Duck	*Oxyura jamaicensis*	Provincial S1B - Secure	Breeding – Nesting habitats not well-understood in the Maritimes, but is associated with lagoons, impounded wetlands and bogs.	No	Open wetlands.
Ruddy Turnstone	*Arenaria interpres*	Provincial S3M - Secure	Migratory – In migration and winter can be found near rocky shorelines and beaches with ample sea wrack.	No	Pictou and Caribou Harbours.
Rusty Blackbird	*Euphagus carolinus*	COESWIC/SARA Special Concern Sched. 1 NS ESA Endangered Provincial S2S3B - May be at risk	Breeding - Nests around treed wetlands and beaver ponds.	No	Wetlands.
Sanderling	*Calidris alba*	Provincial S3M,S2N - Secure	Migratory – During migration will use hard-packed sand beaches, tidal mudflats, rocky coastlines, and inland bodies of water, including ponds, streams, and wetlands, near coastal beaches.	No	Pictou and Caribou Harbours.
Savannah Sparrow princeps ssp	*Passerculus sandwichensis princeps*	COESWIC/SARA Special Concern Sched. 1 NS ESA Endangered Provincial S1B - Sensitive	Migratory – This subspecies nests exclusively on Sable Island. Some birds may winter on beaches on mainland NS on dunes and coastal grassland.	No	Pictou Bar
Scarlet Tanager	*Piranga olivacea*	Provincial S2B - Undetermined	Breeding - Nests in mature, shade-tolerant hardwood forests.	No	Forested areas adjacent Highway 106.

Common Name	Scientific Name	Status[1]	Breeding or Migratory Habitat (whichever is most applicable)	Detected or Observed during Field Work?	Possible Habitat Type in the Local Assessment Area
Semipalmated Plover	*Charadrius semipalmatus*	Provincial S1B,S3S4M - Secure	Breeding - Nests on gravel beaches Migratory – beaches and coastlines	No	Breeding: Gravel beaches with Pictou and Caribou Harbours. Migratory: Pictou and Caribou Harbours.
Semi-palmated Sandpiper	*Calidris pusilla*	Provincial S3M - Sensitive	Migratory – In migration is found on mudflats, open wetlands, shallow estuaries and sandy beaches.	No	Open wetlands and the Pictou and Caribou Harbours.
Short-billed Dowitcher	*Limnodromus griseus*	Provincial S3M - Secure	Migratory - In migration is found in coastal areas such as tidal flats, estuaries and bays, marshes, sandy beaches.	No	Pictou and Caribou Harbours.
Short-eared Owl	*Asio flammeus*	COSEWIC/SARA Special Concern Sched. 1 Provincial S1S2B - May Be At Risk	Breeding - Nest on dry ground, often on raised hummocks in grasslands, barren headlands and uncultivated grasslands, often near the coast.	No	Wetlands. [12]No Critical habitat identified within the PFA.
Spotted Sandpiper	*Actitis macularius*	Provincial S3S4B - Sensitive	Breeding – Typically nests along the shoreline of major rivers, but are associated with almost any type of aquatic habitat.	No	Wetlands, riparian corridors and shorelines with the Pictou and Caribou Harbours
Swainson's Thrush	*Catharus ustulatus*	Provincial S3S4B - Secure	Breeding – Nests in a wide variety of forested habitats, but shows a preference for mature, closed canopy forests away from human habitation.	No	Forested areas adjacent Highway 106.
Tennessee Warbler	*Vermivora peregrina*	Provincial S3S4B - Sensitive	Breeding – Typically nests in thickets of deciduous shrubs within conifer-dominated forest.	No	Forested areas adjacent Highway 106.

Common Name	Scientific Name	Status[1]	Breeding or Migratory Habitat (whichever is most applicable)	Detected or Observed during Field Work?	Possible Habitat Type in the Local Assessment Area
Tree Swallow	*Tachycineta bicolor*	Provincial S4B - Sensitive	Breeding - Nests in cavities, either natural of human-made, near lakes and other waterbodies.	Yes, site ETF Site facing northeast in May 2018. Yes, observed from shoreline site, 350 m northeast from Hwy 106 causeway facing south and east (May 2018).	Open wetlands.
Turkey Vulture	*Cathartes aura*	Provincial S2S3B - Sensitive	Breeding – Nests on steep, rocky cliffs where they use sheltered crevices/caves, occasionally will nest inside hollow trees, logs or man-made structures.	No	Wetlands.
Veery	*Catharus fuscescens*	Provincial S3S4B - Secure	Breeding - Nests in wet areas with dense shrub cover, such as shrub or treed swamps.	No	Wetlands.
Vesper Sparrow	*Pooecetes gramineus*	Provincial S2B - May be at risk	Breeding – Nests in a variety of grassland-type habitats such as barren headlands and cultivated blueberry fields.	No	Wetlands and agricultural lands.
Virginia Rail	*Rallus limicola*	Provincial S2S3B - Undetermined	Breeding - Nests in marshes or lakeshores with abundant emergent vegetation.	No	Open wetlands.
Warbling Vireo	*Vireo gilvus*	Provincial S1B – Undetermined	Breeding - Breeds mature riparian forests	No	Wetlands and riparian corridors.

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White-rumped Sandpiper	*Calidris fuscicollis*	Provincial S3M - Secure	Migratory - During migration is found in freshwater marshes, tidal flats, beaches and shorelines.	No	Open wetlands and the Pictou and Caribou Harbours.
Willet	*Tringa semipalmata*	Provincial S2S3B - May be at risk	Breeding – Nests in coastal marshes, barrier islands and beaches, and occasionally in upland wet meadows.	No	Open wetlands; Pictou Bar.
Willow Flycatcher	*Empidonax traillii*	Provincial S2B - Sensitive	Breeding - Nests in thickets of deciduous trees and shrubs, willows when available, often along streams or near wetlands.	No	Wetlands and riparian corridors.
Wilson's Snipe	*Gallinago delicata*	Provincial S3B - Sensitive	Breeding - Nests in freshwater wetlands.	No	Wetlands.
Wilson's Warbler	*Wilsonia pusilla*	Provincial S3B - Sensitive	Breeding – Nests in shrubby habitats, such as shrub swamps and regenerating clear-cut areas.	No	Wetlands.
Wood Thrush	*Hylocichla mustelina*	COSEWIC/SARA Threatened Sched. 1 Provincial SUB - Undetermined	Breeding - Nests in the shrubby understory of a variety of forest types, but shows a preference for mature hardwood forests.	No	Forested areas adjacent Highway 106.
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Provincial S3S4B - Sensitive	Breeding - Nests on ground in mosses, often in younger coniferous forests near wetlands.	No	Wetlands.

[1] Status notes (as of December 2018) - S1: extremely rare in province; S2: rare in province; S3: uncommon in province; S4: widespread, common and apparently secure in province; S5: widespread, abundant and demonstrably secure in province, SU: unrankable (lack of info). The use of 'S#S#' is to denote a range in rank used to indicate any uncertainty about the status of the species or community. Qualifiers: B= Breeding (breeding population), N = Nonbreeding (nonbreeding population) ? = Inexact/Uncertain, H = Historic (possibly extirpated), M = Migrant and SNR = Not yet assessed in province. (ACCDC 2018a).

[2] ECCC. 2013b. Management Plan for the Barrow's Goldeneye.

[3] ECCC. 2016e. Recovery Strategy for the Bicknell's Thrush.

[4] ECCC. 2016f. Recovery Strategy for the Canada Warbler.

[5] ECCC. 2016g. Recovery Strategy for the Common Nighthawk.

[6] ECCC. 2007. Management Plan for the Harlequin Duck.

[7] ECCC. 2016h. Recovery Strategy for the Olive-sided Flycatcher.
[8] ECCC. 2012a. Recovery Strategy for the Piping Plover.
[9] ECCC. 2012b. Action Plan for the Red Crossbill, percna subspecies.
[10] ECCC. 2016i. Recovery Strategy and Management Plan for the Red Knot.
[11] ECCC. 2010. Amended Recovery Strategy for the Roseate Tern.
[12] ECCC. 2018d. Management Plan for the Short-eared Owl.

Maritime Breeding Bird Atlas

The Second Atlas of Breeding Birds of the Maritime Provinces (MBBA) represents a scientifically-designed five-year field project to assess the status, distribution and abundance of bird species that breed within the three Maritime Provinces. Data collection for the MBBA began 2006 and ended in 2010 (Stewart et al. 2015).

To this day, the second MBBA remains one of the largest wildlife monitoring projects ever undertaken in the region and involved Bird Studies Canada, Environment and Climate Change Canada's Canadian Wildlife Service, New Brunswick Department of Natural Resources, Nova Scotia Lands and Forestry, and Prince Edward Island Department of Agriculture and Forestry.

The MBBA ranks the probability of breeding birds as "Possible" (birds were observed singing in suitable breeding habitat), "Probable" (mated pair of birds, agitated or displaying birds were observed), and "Confirmed" (nests, distraction displays or fledged young were observed) based on observer records. For ease of analysis, the Maritime Provinces were divided into 1,770 10 km by 10 km (100 km^2) squares based from the UTM (NAD83) grid. Avian data are summarized for each 10 km x 10 km square. The entire local assessment area is located within MBBA squares '20NR25' and '20NR26'.

A combined 166 bird species were detected within MBBA squares '20NR25' and 20NR26' during the second MBBA. Of these, the breeding status was considered "Confirmed' for 61 species, "Probable" for another 32 species, and "Possible" for 28 species. The breeding status of the remaining 42 species was left undetermined as no breeding evidence was recorded.

Significant Habitats for Birds

According to the NSDLF, significant habitats include:

- Sites where SAR or other SOCC can be found and/or;
- Sites where unusually large concentrations of wildlife occur and/or; and
- Habitats known to be rare in the province.

Significant habitats within 5 km as identified on the provincial dataset (GNS 2018b), and confirmed by NSDLF (pers. comm. F. MacKinnon) related to the bird VEC are discussed by species below. See **Section 8.8, Figure 8.8-1.**

Bald Eagle - There are five polygons within the vicinity of the PFA listed as 'Other Habitat' and identified as bald eagle nesting records. These locations are illustrated on **Section 8.8, Figure 8.8-1**. The bald eagle was an uncommon bird in the Maritimes during the 1960s, presumably a result of widespread pesticide usage, which wreaked havoc on fledgling success rates of many raptor species. However, in the 1970s and 1980s, NSDNR led a number of projects to restore their population. In 1975, it was estimated that there were a minimum of 65 breeding pairs of bald eagle in Nova Scotia, by 1995 it was estimated that number had grown to over 200. Today, bald eagles are a common sight across much of Nova Scotia, but they remain protected from persecution and hunting by Section 50 of the NSWA.

Double-crested Cormorant - For many decades there has been a double-crested cormorant colony located adjacent the Pictou Causeway (Tufts 1986). These birds typically arrive in late May and nest on the abandoned pilings of an old causeway structure as well as on the rip-rap scour protection alongside the causeway itself. The colony has been estimated to be around 1,000 birds. This colony is regulated under the Abercrombie Wildlife Management Area Designation and Regulations and represents a 1.8 ha adjunct area within the Pictou Harbour from the 138 ha area located mostly on privately owned land on Abercrombie Point. The primary regulation is prohibition on hunting and trapping. Like the bald eagle, the future of double-crested cormorants seemed in doubt during the 1970s, due to both widespread pesticide use and water pollution, however, with the banning of dichlorodiphenyltrichloroethane (DDT) and other environmental protections their numbers have rebounded and they no longer are considered at risk.

Greater Scaup- There is a large polygon that is identified as migratory bird habitat for the greater scaup within the East River estuary adjacent to the ETF footprint area. There is also a smaller polygon located immediately east of Abercrombie Point. The greater scaup are protected by federal Migratory Bird Regulations (MBR) pursuant to the MBCA.

Piping Plover - There are many beaches in the area identified as piping plover habitat (**Section 8.8, Figure 8.8-1**). The piping plover is listed as Endangered – Schedule 1 pursuant to the federal SARA and COSEWIC, as Endangered pursuant to the NS ESA and as S1B by AC CDC.

SAR habitat for piping plovers along the Caribou Island coast over 500 m west of the marine portion of the pipeline.

- SAR habitat for piping plovers along the Bellows Island coast approximately 5 km west of the marine portion of the pipeline;
- SAR habitat for piping plovers along the Lighthouse Beach coast approximately 4.5 km southeast of the pipeline; and
- Pictou Bar Site of Ecological Significance (SES).

Tern spp. - There are two areas identified as significant habitat for tern SAR in the vicinity of the PFA. The first is within the East River estuary on Ballast Island, just over 2 km southeast from the ETF footprint area. The second location is the Pictou Bar, located at the mouth of Pictou Harbour and over 4 km to the east of the PFA. Both Ballast Island and the Pictou Bar are identified as Significant/Sensitive Ecological Sites, and are under consideration for Nature Reserve status.

8.10.2.3 Field Surveys

Avian field surveys were conducted during the winter of 2017/18 and into the summer of 2018 for both the ETF footprint area and the former alignment of the pipeline. Due to changes in design and location of the proposed pipeline, many of the locations that were surveyed for birds during this time are no longer within the immediate vicinity of anticipated project footprint for the pipeline. As such, only those data collected at avian survey locations surrounding the existing PFA are discussed below. For a complete set of the avian data collected see **Appendix Q.** A brief field reconnaissance of the new pipeline corridor was conducted in December 2018 but detailed avian surveys were not conducted; follow-up avian surveys in the new pipeline corridor are planned for spring and summer 2019.

Description of Bird Survey Methodology

Three types of bird surveys were conducted by Dillon biologists, focusing on the local assessment area; i) overwintering bird survey; ii) breeding bird survey; and iii) migratory stop-over survey. The overwintering and migratory stop-over surveys were conducted from five locations surrounding the Pictou Causeway. Two additional locations on the NPNS property were added during the breeding bird survey to better assess terrestrial species within the PFA. Survey locations were selected to incorporate the variety of forested and non-forested habitats present within the local assessment area as well as locations that also provided a good vantage of Pictou Harbour. **Figure Q-1 in Appendix Q** illustrates the reference locations of the avian survey locations. All of the surveys were based on a 10-minute point count methodology whereby the observer recorded all birds heard or seen within a 10-minute period from a stationary location. However, during this time, the observer would also scan any available open water for water birds using binoculars. When necessary, additional time would be taken at a given location in order to record all birds present.

Field studies focused on the ETF local assessment area and only indirectly addressed the pipeline to Caribou Harbour, focusing on the Pictou Harbour portion of the local assessment area. The overwintering bird survey was designed to detect and record those species which use the subset of local assessment area to survive over the winter months (i.e., November to March); however, the survey did not directly address the project as redesigned to include the pipeline to Caribou Harbour. The breeding bird survey was designed to detect and record those species which use the subset of the local assessment area to breed and raise their young. The migratory stop-over survey was designed to detect and record those species present within the subset of the local assessment area during migratory periods and which may use the area as a stop-over location. The overwinter bird survey consisted of three survey events, the first of which was conducted on December 7, 2017. The remaining two survey events occurred on January 26 and March 20, 2018. The breeding bird survey took place on June 16, 2018, and the migratory bird survey occurred on May 14, 2018.

Weather conditions - Certain weather conditions can pose problems for obtaining valid point count data as wind makes it difficult to hear birds. This problem is compounded in a forested area due to the rustling of leaves. Fog also makes it difficult to see birds and depresses overall bird activity. Birds also become inactive during periods of heavy rain. The NPNS site, due to its coastal location on the Northumberland Strait, can experience wind and frequent fog that requires some flexibility in choosing acceptable conditions for conducting point counts. Point counts were not made when wind conditions exceeded 29 km/hour, when visibility was less than 100 m, or when precipitation was greater than a light rain. Weather observations were recorded at the beginning of each transect, at each point count and at the beginning of each 40-minute block in the diurnal passage counts. These observations included temperature, sky cover, precipitation, wind direction and speed, and visibility.

Results of the Overwintering Bird Survey

In total, only 25 species were detected during the overwintering bird surveys; however, three of which are considered SOCC: the Barrow's goldeneye, bufflehead, and great cormorant.

By far, the most common species detected were water birds and waterfowl using the Pictou Harbour area. Greater scaup, which were seen in flocks of approximately 500 on two different occasions, were by far the most abundantly detected species during the overwintering survey. **Table 8.10-2** summarizes the results of the overwintering bird survey.

Table 8.10-2: Overwintering Bird Survey Summary - December 7, 2017, January 26, 2018, and March 20, 2018

Common Name	Scientific Name	S-ranking*	Provincial NS ESA	Federal SARA	Total number detected
Greater Scaup	*Aythya marila*	S4N	-	-	1,427
Canada Goose	*Branta canadensis*	SNAB, S4N	-	-	762
Red-breasted Merganser	*Mergus serrator*	S3S4B, S5N	-	-	533
Herring Gull	*Larus argentatus*	S5	-	-	397
Common Goldeneye	*Bucephala clangula*	S2B, S5N	-	-	314
Bonaparte's Gull	*Chroicocephalus philadelphia*	S5M	-	-	213
Common Merganser	*Mergus merganser*	S5	-	-	187
Long-tailed Duck	*Clangula hyemalis*	S5N	-	-	75
Iceland Gull	*Larus glaucoides*	S4N	-	-	65
Rock Pigeon	*Columba livia*	SNA	-	-	58
Great Black-backed Gull	*Larus marinus*	S4S5	-	-	50
Ring-billed Gull	*Larus delawarensis*	SUB, S5N	-	-	39
American Black Duck	*Anas rubripes*	S5	-	-	21
Bufflehead	*Bucephala albeola*	S3S4N	-	-	17
Bald Eagle	*Haliaeetus leucocephalus*	S5	-	-	13
Barrow's Goldeneye	*Bucephala islandica*	S1N	-	Special Concern	6
Double-crested Cormorant	*Phalacrocorax auritus*	S4B	-	-	6

Common Name	Scientific Name	S-ranking*	Provincial NS ESA	Federal SARA	Total number detected
Lesser Scaup	*Aythya affinis*	SNA	-	-	6
Hooded Merganser	*Lophodytes cucullatus*	S5B	-	-	4
Osprey	*Pandion haliaetus*	S4B	-	-	2
European Common Gull	*Larus canus*	SNA	-	-	1
Great Cormorant	*Phalacrocorax carbo*	S2S3	-	-	1
Red-throated Loon	*Gavia stellata*	S4N	-	-	1
Red-winged Blackbird	*Agelaius phoeniceus*	S4B	-	-	1
Tufted Duck	*Aythya fuligula*	SNA	-	-	1

*S-rank - Status notes (as of December 2018) - S1: extremely rare in province; S2: rare in province; S3: uncommon in province; S4: widespread, common and apparently secure in province; S5: widespread, abundant and demonstrably secure in province, SU: unrankable (lack of info). The use of 'S#S#' is to denote a range in rank used to indicate any uncertainty about the status of the species or community. Qualifiers: B= Breeding (breeding population), N = Nonbreeding (nonbreeding population) ? = Inexact/Uncertain, H = Historic (possibly extirpated), M = Migrant and SNR = Not yet assessed in province. (ACCDC 2018a). **Bold** indicates a species of conservation concern.

Results of the Migratory Stop-over Survey

In total, only 25 species were detected during the migratory stop-over surveys; however, four are considered SOCC: the common tern, red-breasted merganser, barn swallow, and killdeer.

The most common species detected during the migratory stop-over survey were again water birds and waterfowl using the Pictou Harbour area. Namely the top three species detected were common tern, double-crested cormorants, and Bonaparte's gull. **Table 8.10-3** summarizes the results of the migratory stop-over survey.

Table 8.10-3 Migratory Stop-over Summary – May 14, 2018

Common Name	Scientific Name	S-ranking*	Provincial NS ESA	Federal SARA	Total number detected
Common Tern	*Sterna hirundo*	S3B	-	-	161
Double-crested Cormorant	*Phalacrocorax auritus*	S4B	-	-	132
Bonaparte's Gull	*Chroicocephalus philadelphia*	S5M	-	-	100
European Starling	*Sturnus vulgaris*	SNA	-	-	48
Tree Swallow	*Tachycineta bicolor*	S4B	-	-	31
Song Sparrow	*Melospiza melodia*	S5B	-	-	17
American Crow	*Corvus brachyrhynchos*	S5	-	-	16
Canada Goose	*Branta canadensis*	SNAB, S4N	-	-	16
Rock Pigeon	*Columba livia*	SNA	-	-	15
Red-breasted Merganser	*Mergus serrator*	S3S4B, S5N	-	-	12
American Goldfinch	*Spinus tristis*	S5	-	-	11
American Robin	*Turdus migratorius*	S5B, S3N	-	-	8
Bald Eagle	*Haliaeetus leucocephalus*	S5	-	-	7
Barn Swallow	*Hirundo rustica*	S2S3B	Endangered	Threatened	4
Osprey	*Pandion haliaetus*	S4B	-	-	4
Black-capped Chickadee	*Poecile atricapillus*	S5	-	-	3
Ring-billed Gull	*Larus delawarensis*	SUB, S5N	-	-	3
Killdeer	*Charadrius vociferus*	S3B	-	-	2
Savannah Sparrow	*Passerculus sandwichensis*	S4S5B	-	-	2
Belted Kingfisher	*Megaceryle alcyon*	S5B	-	-	1
Common Grackle	*Quiscalus quiscula*	S5B	-	-	1
Common Raven	*Corvus corax*	S5	-	-	1
Hairy Woodpecker	*Picoides villosus*	S5	-	-	1
Mourning Dove	*Zenaida macroura*	S5	-	-	1
White-throated Sparrow	*Zonotrichia albicollis*	S5B	-	-	1

*S-rank - Status notes (as of December 2018) - S1: extremely rare in province; S2: rare in province; S3: uncommon in province; S4: widespread, common and apparently secure in province; S5: widespread, abundant and demonstrably secure in province, SU: unrankable (lack of info). The use of 'S#S#' is to denote a range in rank used to indicate any uncertainty about the status of the species or community. Qualifiers: B= Breeding (breeding population), N = Nonbreeding (nonbreeding population) ? = Inexact/Uncertain, H = Historic (possibly extirpated), M = Migrant and SNR = Not yet assessed in province. (ACCDC 2018a). **Bold** indicates a species of conservation concern.

Results of the Breeding Bird Survey

In total, only 37 species were detected during the breeding bird survey; however, three are considered SOCC: the cliff swallow, gray catbird, and barn swallow. **Table 8.10-4** summarizes the results of the breeding bird survey.

Table 8.10-4: Breeding Bird Survey Summary – June 16, 2018

Common Name	Scientific Name	S-ranking*	Provincial NS ESA	Federal SARA	Total number detected
Double-crested Cormorant	*Phalacrocorax auritus*	S4B	-	-	204
European Starling	*Sturnus vulgaris*	SNA	-	-	137
Yellow Warbler	*Dendroica petechia*	S5B	-	-	49
Rock Pigeon	*Columba livia*	SNA	-	-	44
American Goldfinch	*Spinus tristis*	S5	-	-	39
Song Sparrow	*Melospiza melodia*	S5B	-	-	35
Cedar Waxwing	*Bombycilla cedrorum*	S5B	-	-	34
Red-eyed Vireo	*Vireo olivaceus*	S5B	-	-	33
Alder Flycatcher	*Empidonax alnorum*	S5B	-	-	28
Cliff Swallow	*Petrochelidon pyrrhonota*	S2S3B	-	-	26
Scoter spp.	*Melanitta spp.*	S4N (all scoters have same S-rank)	-	-	25
American Redstart	*Setophaga ruticilla*	S4S5B	-	-	24
American Crow	*Corvus brachyrhynchos*	S5	-	-	20
American Robin	*Turdus migratorius*	S5B, S3N	-	-	19
Savannah Sparrow	*Passerculus sandwichensis*	S4S5B	-	-	15
Black-capped Chickadee	*Poecile atricapillus*	S5	-	-	12
Common Grackle	*Quiscalus quiscula*	S5B	-	-	11
Great Blue Heron	*Ardea herodias*	S4B	-	-	6
Common Raven	*Corvus corax*	S5	-	-	5
Purple Finch	*Haemorhous purpureus*	S4S5B, S3S4N	-	-	5
Red-winged Blackbird	*Agelaius phoeniceus*	S4B	-	-	5
Blue Jay	*Cyanocitta cristata*	S5	-	-	4
Chestnut-sided Warbler	*Dendroica pensylvanica*	S5B	-	-	4

Common Name	Scientific Name	S-ranking*	Provincial NS ESA	Federal SARA	Total number detected
Mourning Dove	*Zenaida macroura*	S5	-	-	4
Chipping Sparrow	*Spizella passerine*	S4B	-	-	3
Common Yellowthroat	*Geothlypis trichas*	S5B	-	-	3
Canada Goose	*Branta Canadensis*	SNAB, S4N	-	-	2
Gray Catbird	***Dumatella carolinensis***	**S3B**	-	-	**2**
Mallard	*Anas platyrhynchos*	S5	-	-	2
Northern Parula	*Setophaga americana*	S5B	-	-	2
Barn Swallow	***Hirundo rustica***	**S2S3B**	**Endangered**	**Threatened**	**1**
Belted Kingfisher	*Megaceryle alcyon*	S5B	-	-	1
Black-and-white Warbler	*Mniotilta varia*	S5B	-	-	1
Black-throated Green Warbler	*Dendroica virens*	S5B	-	-	1
Osprey	*Pandion haliaetus*	S4B	-	-	1
Ovenbird	*Seiurus aurocapilla*	S5B	-	-	1
Ruby-throated Hummingbird	*Phalacrocorax auritus*	S5B	-	-	1

*S-rank - Status notes (as of December 2018) - S1: extremely rare in province; S2: rare in province; S3: uncommon in province; S4: widespread, common and apparently secure in province; S5: widespread, abundant and demonstrably secure in province, SU: unrankable (lack of info). The use of 'S#S#' is to denote a range in rank used to indicate any uncertainty about the status of the species or community. Qualifiers: B= Breeding (breeding population), N = Nonbreeding (nonbreeding population) ? = Inexact/Uncertain, H = Historic (possibly extirpated), M = Migrant and SNR = Not yet assessed in province. (ACCDC 2018a).
Bold indicates a species of conservation concern

Summary of Nesting Birds - Based on the results of the desktop analysis and field surveys, it is clear that a wide variety of breeding, wintering, and migratory habitat exists for many bird species within the local assessment area. While many of these species are not considered SAR or SOCC, most are protected pursuant to the MBR pursuant to the MBCA. However, there are those that are considered SAR or SOCC and are discussed further below.

8.10.2.4 Priority Bird Species

The following provides a description of potential priority bird species that may interact with the project.

Priority Birds Observed within the Local Assessment Area

As noted in **Tables 8-10-1** to **8-10-4** above, the following nine COSEWIC/SARA/NS ESA and S3 or lower listed birds were observed within the local assessment area:

1) **Barn Swallow** - The barn swallow is an SAR that is listed as Threatened federally under SARA and COSEWIC, Endangered by the NS ESA, and as S2S3B by the AC CDC. This species typically inhabits open areas near human settlements and land uses including parks, ball fields, golf courses and

agricultural fields where they forage for flying insects (Cornell 2008). Barn swallows will typically construct their nests on human-made structures, rarely selecting to nest in natural locations such as cliffs or caves (Cornell 2008; Erskine 1992). This species is migratory and spends its winters in Central and South America. Several barn swallows were observed during the May 2018 surveys on the ETF site and additional potential habitat within the project footprint includes NPNS facility, Pictou Causeway and a number of overpasses along Highway 106.

2) **Barrow's Goldeneye** - The Barrow's goldeneye is comprised of two distinct breeding populations; one population that breeds in northern Québec and Labrador, the other along the west coast of Canada and into Alaska. The eastern population (i.e., those that breed in Québec and Labrador), is an SAR that is listed as Special Concern federally under SARA and COSEWIC, and as S1N by the AC CDC. The eastern population spend their winters in the coastal waters of the Atlantic Provinces and the New England states. These medium-sized, diving ducks feed primarily on aquatic and benthic invertebrates, but will also feed of small fish, fish eggs and aquatic vegetation. They are often observed in sheltered coves and bays in mixed flocks of both Barrow's goldeneye and the more numerous common goldeneye (*Bucephala clangula*). Several Barrow's goldeneye were observed during the January 2018 surveys west of the ETF site and along the shores of Pictou Harbour from Highway 106.

3) **Bufflehead** - Bufflehead is an SOCC that is listed as S3S4N by the AC CDC. This species of small-diving duck does not breed in Nova Scotia, but rather around ponds and lakes within the boreal forest in Central and Western Canada. However, bufflehead do overwinter in Nova Scotia using sheltered coves, harbours and estuaries, but generally avoiding open coastlines. Inland, they will use ponds, lakes, impoundments, or bays along slow-moving rivers (Cornell 2018). Small numbers of bufflehead were observed during the overwintering bird survey within the Pictou Harbour and around the Pictou Causeway.

4) **Cliff Swallow** - The cliff swallow is an SOCC that is listed as S2S3B by the AC CDC. They are colonial nesters, once restricted to natural cliff faces and overhangs, where, using available mud, vegetation and their specialized saliva build hollow, gourd-like nest structures. However, they now often nest on buildings and other human-made structures. Cliff swallows feed on the wing for flying insects above open habitats such as grasslands, riparian areas, open wetlands and disturbed areas. A number of cliff swallows were observed during the breeding bird survey on and around the NPNS property gathering nesting materials and one such bird was observed returning to a nest structure attached to the existing NPNS plant building. Based on the colonial nature of this species and the above observations, it is likely that cliff swallows are using the existing NPNS building as a colony site. Additional potential habitat for the cliff swallow within the local assessment area and possibly the project footprint exist and include the Pictou Causeway, overpasses/bridges along Highway 106 and the Northumberland Ferries Terminal building.

5) **Common Tern** - The common tern is an SOCC that is listed as S3B by the AC CDC. This species of seabird breeds across Nova Scotia during the summer and winters along the western, northern and eastern coasts of South America. These birds nest on offshore islands, and occasionally on barrier

beaches, sand-spits and dunes. The nest is rarely more than a depression in the ground, sometimes lined with dead vegetation. Common terns prey on small fish by diving head first into the water. There are two areas identified as significant habitat for tern species-at-risk in the local assessment area. These are the Pictou Bar and Ballast Island, located roughly 5 km to the east and over 2 km to the southeast of the PFA, respectively. Over 160 common terns were detected during the migratory bird survey on May 18, 2018 in the vicinity of the Pictou Harbour. Curiously, no common terns were detected during the breeding bird survey on June 16, 2018. Although, this may simply be that by mid-June common terns are engaged in nesting activities and are less apparent further from their breeding colonies.

6) **Gray Catbird** - The gray catbird is an SOCC that is listed as S3B by the AC CDC. The species breeds across Nova Scotia in habitats with dense shrubs and thickets. Due to this, these birds commonly occur around human development such as suburban areas with hedgerows, parks, abandoned farmland or golf courses. Catbirds are primarily an insectivorous bird feeding on ants, beetles, grasshoppers and other invertebrates, but they will eat fruits and berries when they are readily available. Although some catbirds along the eastern United States are resident birds, those in Nova Scotia migrate and winter in the southern United States, Central America and the Greater Antilles. Two gray catbirds were detected during the breeding bird survey on June 16, 2018. Both were detected in shrub-dominated habitats on the north-side of the Pictou Causeway, one of which was detected in Wetland WL-4 (see **Section 8.7**). Additional potential breeding habitat for this species includes shrubby, disturbed areas and wetlands.

7) **Great Cormorant -** The great cormorant is an SOCC that is listed as S2S3B by the AC CDC. This species breeds in colonies, like its close relative the double-crested cormorant, but tends to nest away from human activity and is largely restricted to rocky offshore islands and steep, coastal cliffs. The species feeds exclusively on fish and captures its prey through an underwater dive and chase. In winter they tend not to migrate much, but rather stick around in nearby coastal waters. There are no known great cormorant colonies on the Northumberland Shore of Nova Scotia and the nearest breeding record comes from across the Northumberland Strait near the Woods Island Ferry Terminal, PEI (Stewart et al. 2015). That said, one great cormorant was detected during the overwintering bird survey in December 2017 in the Pictou Harbour. Both the Pictou and the Caribou Harbours represent potential overwintering habitat for the great cormorant. Furthermore, while there are no known great cormorant colonies nearby, they have been known to nest amongst double-crested cormorants. Therefore, the possibility exists that there are great cormorants breeding amongst the double-crested cormorant colony known to exist within the Abercrombie WMA located adjacent the Pictou Causeway.

8) **Killdeer -** The killdeer is an SOCC that is listed as S3B by the AC CDC. This species of shorebird is somewhat peculiar in that it inhabits primarily dry habitats. Killdeer breed across Nova Scotia showing a preference for dry, barren type habitats such as sandbars, mudflats, grazed fields, athletic fields, graveled areas, parking lots and golf courses. They are opportunistic foragers known feed primarily on insects, worms and beetles, but occasionally will prey on frogs and minnows. In many

parts of their range, the killdeer is a resident species remaining in one geographic area year round, but those that breed in Nova Scotia likely migrate to the southern United States during the winter. Two killdeer were observed during the migratory stop-over survey on May 14, 2018. Both were detected from the same location near the Maritime Oddfellows Home. Potential breeding habitat for killdeer within the PFA includes disturbed areas, agricultural lands and any graveled area, including road shoulders.

9) **Red-breasted Merganser** - The red-breasted merganser is an SOCC that is listed as S3S4B/S5N by the AC CDC. This species breeds across Nova Scotia and is found primarily along beaches and coastal wetlands, where they frequently breed in association with tern or gull colonies (Stewart et al. 2015). More than the closely related common merganser (*Mergus merganser*), the red-breasted merganser prefers saline environments over freshwater. These birds feed primarily on fish and crustaceans they catch during acrobatic underwater dives. Red-breasted mergansers tend to winter in protected bays around rocky coastlines all across Nova Scotia and are considered a resident species in the Province. Hundreds of red-breasted merganser were observed during the overwintering bird survey, primarily during the December 2017 and March 2018 visit. Furthermore, twelve more birds were detected during the migratory bird survey on May 14, 2018. No red-breasted merganser were detected during the breeding bird survey. It is clear that the Pictou and Caribou Harbours represent overwintering and migratory habitat for red-breasted merganser. Possible breeding habitat for the red-breasted merganser exists on the Pictou Bar and within the Caribou Harbour Estuary.

Additional Priority Bird Species with Potential Habitat in the Local Assessment Area

Potential priority bird species identified in the short-list (**Appendix Q**) are based on a review of AC CDC and MBBA records. These birds represent additional priority species that were not detected during field surveys, but have the potential to be observed in the area based on available habitat.

As noted in **Table 8.10-1** above, the following COSEWIC/SARA/NS ESA or S2 or lower listed birds identified by the AC CDC that may have suitable habitat within or in the immediate vicinity of the PFA.

1) **American Coot** - The American coot is an SOCC that is listed as S1B by the AC CDC. This bird inhabits a wide variety of freshwater wetlands and breed near heavy stands of emergent aquatic vegetation along the shoreline. They feed mainly on aquatic plants and occasionally on insect or small aquatic vertebrate prey. They are widespread across North America with the exception of the artic, and northern populations migrate to southern United States or Central America. Open wetlands along Highway 106 may provide potential breeding habit in for this species adjacent to the PFA.

2) **American Golden-plover (migratory)** - The American golden-plover is an SOCC that is listed as S1S2M by the AC CDC. This bird is an arctic breeder but may be present during migration or found during the winter in cultivated grasslands or agricultural fields. They feed on invertebrates, berries,

leaves and seeds. During their fall migration this species may occur on agricultural lands, fields and shorelines adjacent to the PFA

3) **Baltimore Oriole** - The Baltimore oriole is an SOCC that is listed as S2S3B by the AC CDC. The nest high in leafy deciduous trees and prefer open woodland habitats such as forest edge, river banks, and small groves of trees. These birds feed on insects, fruit and nectar. Developed areas and cleared lands adjacent to the PFA may provide potential breeding habitat in for this species.

4) **Bank Swallow** - The bank swallow is an SAR that is listed as Threatened by COSEWIC and SARA, Endangered by the NS ESA, and as S2S3B by the AC CDC. This species is a colonial breeder and is found across New Brunswick in lowlands along rivers, streams and ocean coasts. Colonies can range from 10 to 2,000 nesting pairs and are always found around vertical, or near vertical cliffs or banks. Historically, bank swallows were most commonly found around natural bluffs or eroding streamside banks, however, they now are more commonly associated with sand and gravel quarries. These birds are aerial insectivores catching nearly all their prey on the wing. Common prey items include bees, wasps, ants, butterflies and moths. Bank swallows winter in Central and South America. The steep shoreline of Abercrombie Point may provide breeding habitat for this species within or adjacent to the PFA.

5) **Barn Swallow** - See above Section, bullet #1

6) **Barrow's Goldeneye (migratory)** - See above Section, bullet #2

7) **Bicknell's Thrush** - Bicknell's thrush is an SAR that is listed as Special Concern federally under SARA and as Threatened under COSEWIC, as Endangered by the NS ESA, and as S1S2B by the AC CDC. They breed and overwinter in high elevation and mountain forests while feeding on insects, spiders and fruit (Cornell 2008). Although they share a range encompassing the project footprint, no potential habitat, such as high elevation forests, are present in the footprint and so the Bicknell's thrush is not anticipated to occur within the PFA.

8) **Black-crowned Night-heron** - The black-crowned night-heron is an SOCC that is listed as S1B by the AC CDC. This stocky heron species is the most widespread heron in the world in terms of geographic range breeding across North America and wintering in South America. They will use nearly any shallow water habitat, be it freshwater, brackish or marine for foraging and prefer some emergent and terrestrial vegetation for cover. Black-crowned night-herons are secretive and opportunistic foragers, typically avoiding other herons, whose diet includes prey items such as leeches, earthworms, insects, small fish, amphibians, small birds, and occasionally eggs. Very little suitable breeding habitat exists in the footprint of the project and no nearby colonies are known to exist, as such the black-crowned night-heron is not anticipated to occur within the PFA.

9) **Bobolink** - The bobolink is an SAR that is listed as Threatened by COSEWIC and SARA, Vulnerable by Nova Scotia ESA and as S3S4B by the AC CDC. The bobolink is a ground-nesting species that inhabits hayfields, moist meadows and other areas that are dominated by a mixture of tall grasses both during the breeding season and throughout migration (Cornel 2008). This species feeds primarily on seeds, grains, insects and spiders. Population numbers of the bobolink have sharply declined both in

Nova Scotia and throughout its eastern range in recent decades. This decline is thought to be in part because of more intensive agricultural haying practices, which can destroy active nests. Agricultural lands and open wetlands along Highway 106 may provide suitable breeding habitat for this species adjacent to the PFA.

10) **Boreal Owl** - The boreal owl is an SOCC that is listed as S2?B by the AC CDC. Breeding owls will often nest in old woodpecker holes and other tree cavities in mature mixed and coniferous forest. They forage for small mammals, birds and insects in spruce-fir forests in the winter and in clear-cuts and agricultural fields in spring. Conifer-dominated forest adjacent Highway 106 may provide potential breeding habitat for this species adjacent to the PFA.

11) **Brown Thrasher** - The brown thrasher is an SOCC that is listed as S1B by the AC CDC. This reclusive species is typically found along dense forest edges, in thickets or swales and in overgrown clearings. It is omnivorous ground-feeding bird preying mostly on insects, but supplementing their diet with fruits, seeds and nuts. Common insect prey items for the brown thrasher include many kinds of beetles, along with grubs, wire-worms, army worms, cutworms, tent caterpillars, gypsy-moth caterpillars, leafhoppers, treehoppers, cicadas and grasshoppers. Brown thrashers usually nest low in a thorny shrub, but will sometimes nest directly on the ground. Shrub swamps and other wetlands along roadways and Highway 106 may provide potential breeding habitat for this species adjacent to the PFA.

12) **Brown-headed cowbird** - The brown-headed cowbird is an SOCC that is listed as S2B by the AC CDC. This species is associated with grazing livestock and can often be seen around residential areas and agricultural field and pastures. They generally avoid forested habitats and prefer open areas like grass lands, woodland edges, thickets and fields. The brown-headed cowbird is a parasitic nester and can utilize a variety of nest types. Agricultural lands, developed areas and other cleared land within the ETF footprint area or adjacent to Highway 106 may provide potential breeding habitat for this species.

13) **Canada Warbler** - The Canada warbler is an SAR that is listed as Threatened pursuant to the federal SARA/COSEWIC, as Endangered pursuant to the Nova Scotia ESA, and as S3B by the AC CDC. These birds arrive in Nova Scotia in the spring and are fairly common throughout the summer. Canada warblers will inhabit a variety of forest habitats, but prefer mature to mid-aged mixed forests where they build their nests on or near the ground in wet, swampy places in woods of mixed growth. They prefer areas with dense understory, particularly areas where large trees have long since been uprooted and tangled debris remains. They are also found in riparian areas, shrub forests on slopes, in ravines and in old-growth forests with canopy openings, as well as regenerating stands. Shrub swamps and other wetlands along roadways and Highway 106 may provide potential breeding habitat for this species adjacent to the PFA.

14) **Cape May Warbler** - The Cape May warbler is an SOCC that is listed as S2B by the AC CDC. This species nests in mature coniferous forests, usually black spruce, and feed on primarily on insects. Cape May warblers are spruce budworm specialists and their populations wax and wane with

outbreaks of the insect. Ongoing outbreak suppression, coupled with increasing timber harvesting are though to contributing factors to their overall population decline (Stewart et al. 2015). Conifer-dominated forest adjacent Highway 106 may provide potential breeding habitat for this species adjacent to the PFA.

15) **Chimney Swift** - The chimney swift is an SAR that is federally listed as Threatened, Schedule 1 (SARA 2011) by SARA and COESWIC, Endangered by Nova Scotia ESA and as S2B, S1M by the AC CDC. Chimney swifts prefer to roost and nest in chimneys, old cabins or in hollow trees and may be found in both urban and rural areas. They typically forage in areas with abundant insects, usually over wetlands or large water bodies. It is hypothesised that the recent decline in numbers is due in part to the loss of cavity trees (through harvesting) and the changes to chimney designs or availability in rural and urban areas. These birds are migratory and winter in primarily on the northern and western coasts of South America. Standing, hollowed tree stumps in wetlands along Highway 106 may provide suitable breeding habitat for this species adjacent to the PFA; however, there are no reported chimney roosting sites within the local assessment area.

16) **Cliff Swallow** - See above Section, bullet #4.

17) **Common Goldeneye** - The common goldeneye is an SOCC that is listed as S2B, S5N by the AC CDC. These birds nest in large trees with cavities near freshwater wetlands, ponds, lakes and rivers. During winter migration, they are seen in shallow coastal bays, harbours and estuaries. Birds were observed during the December 2017, and January and March 2018 surveys on the ETF property and close to the pipeline route. Open wetlands along Highway 106 may provide suitable breeding habitat for this species adjacent to the PFA. The ice-free waters of both the Pictou and Caribou harbours may provide habitat adjacent to the PFA for this species during migratory periods.

18) **Common Gallinule (*Gallinula galeata*)** – The common gallinule is listed as S1B and is thought to be a relatively recent arrival to the Maritimes (Stewart et al. 2015). It was once recorded as the common moorhen (*G. chloropus*), before a recent taxonomic split from an Old World species. These birds favour open wetlands with robust emergent vegetation, usually cattails a bulrushes, however they will use impounded and managed wetlands as well. Open wetlands along Highway 106 may provide potential breeding habit in for this species adjacent to the PFA.

19) **Common Nighthawk** - The common nighthawk is an SAR that is listed as Threatened– Schedule 1 pursuant to the federal SARA and COSEWIC, as Threatened pursuant to the Nova Scotia ESA, and as S2B by the AC CDC. The common nighthawk is a ground-nesting species that uses a wide variety of habitats including dunes, beaches, logged forests, bogs, marshes, open woodlands, grasslands, rock outcroppings, barren ground and even gravel rooftops. This species is an aerial insectivore preying on insects on the wing, usually at dusk or dawn, in open areas usually near a waterbody. From late August to early October, migrating flocks of nighthawks can number in the hundreds en route to wintering grounds in South America. Open wetlands, agricultural land and other cleared or developed areas may provide suitable breeding habitat for this species within the ETF PFA or adjacent to Highway 106.

20) **Common Tern** - See above Section, bullet #5.

21) **Cooper's Hawk** - The Cooper's hawk is an SOCC that is listed as S1?B by the AC CDC. This small accipiter is a woodland hawk found most often in open woodland where it preys on a variety of birds and mammals. With an average weight of only approximately 400 grams, the Cooper's hawk is extremely aggressive for its size. Common prey items for this species include European starlings, mourning doves, American robins, blue jays, ring-necked pheasant, mice, squirrels and even bats occasionally. The Cooper's hawk is a migratory bird and spends its winters in the southern United States. Forested areas adjacent Highway 106 may provide potential breeding habitat for the Cooper's hawk adjacent to the PFA.

22) **Eastern Whip-poor-will** - The eastern whip-poor-will is an SAR that is listed as Threatened pursuant to the federal SARA and COSEWIC, Threatened by Nova Scotia ESA and ranked as S1?B by the AC CDC. These nocturnal, ground-nesters build virtually no nest at all; instead they simply lay their eggs in a slight depression and rely on their cryptic plumage patterns keep them hidden from potential predators. Interestingly, the eastern whip-poor-will breeds in phase with specific lunar patterns, typically timing its young to hatch days before the full moon in June. This breeding strategy ensures brighter, fuller moons at night so that the parents may forage for flying insects longer and can be more successful so that they may provide for their newly hatched young. The eastern whip-poor-will's preferred breeding habitat is mature deciduous or mixed-wood forest with little to no understory. Forested areas adjacent Highway 106 may provide potential breeding habitat for this species adjacent to the PFA.

23) **Eastern Wood-pewee** - The eastern wood-pewee (*Contopus virens*) is an SAR that is listed as Special Concern pursuant to the federal SARA and COSEWIC, as Vulnerable pursuant to the Nova Scotia ESA and ranked as S3BS4B by the AC CDC. These birds breed throughout Nova Scotia during the summer months before migrating to northern South America and wintering in countries such as Ecuador, Colombia, Venezuela, Guyana, Peru and Brazil. This species breeds in open woodland of all types in Nova Scotia, but shows a preference for forests with a dominance of deciduous trees. The Eastern wood-pewee forages on flying insects in the middle canopy and will often return to the same perch after capturing an insect. Forested areas along Highway 106 may provide suitable breeding habitat for the eastern wood-pewee within the PFA.

24) **Evening Grosbeak** - The evening grosbeak is an SAR that is federally listed as Special Concern Schedule 1 under SARA, provincially listed as Vulnerable under the (Nova Scotia ESA) and as S3S4B/S3N by the AC CDC. Evening grosbeaks tend to breed in older growth and second-growth conifer-dominated forests. During the winter months, this species occupy a wide variety of forested landscapes and can be common in urban and suburban areas around feeders. Evening Grosbeaks primarily prey on insects and their larvae, such as spruce budworm larvae, caterpillars, and aphids. In winter, they feed on a wide variety of seeds the leaf buds of many deciduous species. Forested areas adjacent Highway 106 may provide potential breeding habitat for this species adjacent to the PFA.

25) **Gadwall -** The gadwall is an SOCC that is listed as S2B by the AC CDC. This medium-sized dabbling duck breeds across Canada and its preferred breeding habitat include freshwater marshes with abundant emergent vegetation and boreal wetlands. Gadwalls forage primarily on aquatic vegetation and invertebrates, increasing their consumption of invertebrates during the breeding season. Open wetlands along Highway 106 may provide suitable breeding habitat for this species adjacent to the PFA.

26) **Great Cormorant -** See above Section, bullet #7.

27) **Great Crested Flycatcher -** The great crested flycatcher is an SOCC that is listed as S1B by the AC CDC. Great crested flycatchers tend to select breeding territories in open deciduous forests or at forest edges rather than in densely, undergrown habitats. This species shows an association with dead snags and dying trees as they often provide cavities they need for nesting (Cornell 2018). However, they will make use of cavities in unconventional locales such as ornamental trees in woody urban areas like parks, cemeteries, and golf courses. Great crested flycatchers, as their name suggests, prey mainly on insects, but other invertebrates and small berries also make it into their diet. Open wetlands along Highway 106 may provide suitable breeding habitat for this species adjacent to the PFA.

28) **Harlequin Duck (migratory) -** The harlequin duck is an SAR that is federally listed as Special Concern Schedule 1 under SARA and COSEWIC, provincially listed as Endangered (Nova Scotia ESA) and as S2N by the AC CDC. This is a migratory bird that winters along the eastern coast of North America, including Nova Scotia. These birds are typically seen between November and April along rocky coastlines in southeastern Nova Scotia. They are often associated with the turbulent waters close to shore where the surf breaks along rocky headlands, subtidal ledges or reefs, and ice buildup in minimal (Environment Canada 2007). Harlequin ducks are also often found on or near offshore islands. Winter locations are largely determined by prey availability; these ducks feed on small shellfish and shrimp-like animals often associated with turbulent coastal areas. Wintering populations of harlequin ducks are threatened by fishing nets, aquaculture development, boating, and oil/bilge contamination. During the spring and summer, this species is found in freshwater environments such as fast flowing rivers. The ice-free waters of both the Pictou and Caribou Harbours may provide habitat within the PFA for this species during migratory periods.

29) **Hudsonian Godwit (migratory) -** The Hudsonian godwit is an SOCC that is listed as S1S2M by the AC CDC. These are large shorebirds with a long, upturned bill. Hudsonian godwits breeds in the Arctic on vegetated tundra and winters in southern South America. Following breeding, the Hudsonian godwit undertakes a migration from the subarctic to South America, making non-stop flights of several thousands of kilometres at a time, occasionally stopping at beaches, flooded agricultural lands, tidal flats and wetlands to rest. Open wetlands, agricultural fields and shorelines within both the Pictou and Caribou Harbours may provide migratory habitat for this species within the PFA.

30) **Hudsonian Whimbrel (migratory)** - The Hudsonian whimbrel is an SOCC that is listed as S2S3M by the AC CDC. The Hudsonian whimbrel breeds in a variety of tundra-like habitat in and around the Hudson's Bay area and winters in South America. It has a long, downward curved bill which it uses to probe the sand of beaches for invertebrates. In migration, this species frequents various coastal and inland habitats, including agricultural and sports fields, beaches and coastlines. Open wetlands, agricultural fields and shorelines within both the Pictou and Caribou Harbours may provide migratory habitat for this species within the PFA.

31) **Indigo Bunting** - The indigo bunting is an SOCC that is listed as S1?B by the AC CDC. These small, brilliantly blue birds breed in brushy and weedy habitats, which are often associated with early successional forest and forest edges. They typically will nest within 1 m of the ground in dense thickets and shrubs, but occasionally in herbaceous vegetation. While migrating and in winter, Indigo Buntings forage in fields, grasslands, suburban lawns and ornamental landscaping. During the winter, indigo buntings forage on the seeds of many weedy species such as thistles, dandelions and goldenrods, supplementing this diet with berries and insect prey during the summer months. Agricultural lands, developed areas and wetlands along roadways and Highway 106 may provide suitable breeding habitat for this species adjacent to the PFA.

32) **Least Sandpiper** - The least sandpiper is an SOCC that is listed as S1B/S3M by the AC CDC. This diminutive shorebird primarily breeds well north of Nova Scotia in the tundra and stunted boreal forests across the extreme northern regions of North America. While least sandpipers breeding in the north prefer wet meadows and subarctic tundra, those nesting in the Maritimes seem to prefer wet, coastal heathlands (Stewart et al. 2015). Least sandpipers construct their nest within tufts of short marsh grass on damp ground. In migration, they will use coastal mudflats, shorelines, and inland habitats including wet meadows, flooded fields, and muddy edges of lakes, ponds, and ditches (Cornell 2018). No suitable breeding habitat for this species exists within the PFA, however, shorelines within both the Pictou and Caribou Harbours may provide migratory habitat within the PFA for this species.

33) **Long-eared Owl** - The long-eared owl is an SOCC that is listed as S2S3 by the AC CDC. This large owl species is completely nocturnal and roosts is dense woodland, often near open areas or forest edges. Long-eared owls prey primarily on small mammals, but will occasionally prey on songbirds. They breed between April and July and usually make use of the abandoned stick nests of crows or hawks. Forested areas adjacent Highway 106 may provide suitable breeding habitat for this species adjacent to the PFA.

34) **Marsh Wren** - The marsh wren is an SOCC that is listed as S1B by the AC CDC. This small songbird species, as its names suggests, prefers marshes both freshwater and brackish with dense, emergent vegetation. Marsh wrens build domed, enclosed nests built from intertwined grasses and sedges attached to vegetation over water. They primarily feed at the water level gleaning insects and spiders from vegetation and below the water's surface. Open wetlands along Highway 106 may provide suitable breeding habitat for this species adjacent to the PFA.

35) **Northern Mockingbird** - The northern mockingbird is an SOCC that is listed as S1B by the AC CDC. The northern mockingbird is found in areas with open ground and with shrubby vegetation, as well as, suburban areas. They breed in open, shrubby habitats and often near human development and landscaping. Agricultural lands, developed areas and other cleared land around the Town of Pictou and along Highway 106 may provide suitable breeding habitat for this species within the PFA, and agricultural fields near the pipeline could serve as suitable habitat for the northern mocking bird.

36) **Northern Shoveler** - The northern shoveler is an SOCC that is listed as S2B by the AC CDC. The northern shoveler is a distinctive, dabbling duck in that its bill is spatulate, meaning it is flattened and widened toward the tip. Unlike most dabbling ducks which invert themselves to feed on aquatic vegetation, the northern shoveler instead uses its unique bill shape to strain aquatic insects from the water. They nest on the ground, often concealing their nest location in dense grasses near an open water wetland. Open wetlands along Highway 106 may provide suitable breeding habitat for the northern shoveler adjacent to the PFA.

37) **Olive-sided Flycatcher** - The olive-sided flycatcher is an SAR that is listed as Special Concern under COSEWIC and as Threatened pursuant to the federal SARA, as Threatened pursuant to the Nova Scotia ESA and as S2B by the AC CDC. These birds breed throughout Nova Scotia during the summer months and winter in Central and South America. Their preferred habitat includes coniferous forest edges, early post-fire landscapes, and openings such as meadows, rivers, bogs, swamps and ponds. Nests are typically built on horizontal branches 2-15 m off the ground and are most commonly located in spruce trees. Olive-sided flycatchers feed on flying insects, especially bees, and are often see perched on the tops of tall trees or snags in open woodland habitat. Dead, standing trees in wetlands along Highway 106 may provide suitable breeding habitat for this species adjacent to the PFA.

38) **Pectoral Sandpiper** - The pectoral sandpiper is an SOCC that is listed as S2S3M by the AC CDC. They breed in wet coastal tundra (Cornell 2008) and during migration, use open wetlands, mudflats and the shorelines. Their diet is not well known but they appear to mostly eat insects and other invertebrates (Kaufman 1996). Wetlands and shorelines within both the Pictou and Caribou Harbours may provide habitat within the PFA for the pectoral sandpiper during migratory periods.

39) **Peregrine Falcon** - Peregrine falcons are an SAR that are federally listed as Special Concern under SARA and COSEWIC, provincially listed as Vulnerable under the Nova Scotia ESA and as S1B SNAM (Not Applicable Migrant) by the AC CDC. These crow-sized birds of prey feed primarily on other birds and small mammals. They nest on cliff ledges along coasts, and major rivers and are known to reuse nests. Their populations were in peril with the prevalence of DDT use, but since the ban, their numbers have improved. There are is no suitable breeding habitat for the peregrine falcon with the PFA.

40) **Pine Grosbeak** - Pine grosbeak is an SOCC that is listed as S2S3B, S5N by the AC CDC. They nest in open coniferous forests and feed on buds, seeds, and fruits from trees. They winter in similar

habitat at lower altitudes and/or further south from their breeding ranges. The forested areas adjacent Highway 106 may provide suitable breeding habitat for this species adjacent to the PFA.

41) **Pine Siskin** - Pine siskin is an SOCC that is listed as S2S3 by the AC CDC. These birds nest in open coniferous or mixed forests, as well as suburban areas such as woodlands, cemeteries and parks. Pine siskins prefer to feed on conifer seeds and will occasionally feed on deciduous seeds, arthropods, and from backyard feeders. Conifer-dominated forest adjacent Highway 106 may provide suitable breeding habitat for this species adjacent to the PFA.

42) **Pine Warbler** - Pine warbler is an SOCC that is listed as S1B by the AC CDC. These birds nest in mature red or white pines or mixed-pine forests. Nests are placed high in pine trees and are concealed by needles and cones (Cornell 2008). They forage mainly on caterpillars and will eat other arthropods and occasionally fruits and seeds. Birds that breed in the northern part of their range (northern United States and Canada) migrate to wintering grounds in the southeastern United States. The pine-dominated stand on Abercrombie Point and forested areas adjacent Highway 106 may provide suitable breeding habitat for the pine warbler within or adjacent to the PFA.

43) **Piping Plover** - The piping plover is an SAR that is listed as Endangered – Schedule 1 pursuant to the federal SARA and COSEWIC, as Endangered pursuant to the Nova Scotia ESA and as S1B by AC CDC. Nova Scotia's sandy beaches represent part of the summer breeding range of this species, although their occurrence is fairly rare. This small shorebird nests and rears their young on open sandy beaches, alkali flats and sand flats, laying their eggs in depressions in the sand above the highest tide line. Historically and presently, human uses of beach habitat have had a large negative influence on breeding piping plovers in the province. Pictou Bar Spit is identified as critical habitat for the piping plover (*melodus* subspecies) (Environment Canada 2012) and is located 5.5 km from the PFA. Additionally, any sandy beaches and shorelines within and around both the Pictou and Caribou Harbours may provide suitable breeding habitat for the piping plover within the local assessment area.

44) **Purple Martin** - The purple martin is an SOCC that is listed as SHB (Historical, possibly extirpated) by the AC CDC. Purple martins are aerial insectivores, meaning the prey on insects while flying in the air. Historically, in eastern North America purple martins used to breed along forest edges and rivers, however, since humans began supplying nest boxes for these birds, eastern martins have become more urban, living almost exclusively near cities and towns. The purple martin feeds exclusively on a wide variety of insects which include beetles, flies, dragonflies, damselflies, leafhoppers, grasshoppers, crickets, butterflies, moths, wasps, bees, caddisflies, spiders, cicadas, termites, and mayflies. These birds are migratory and spend their winters in South America. Agricultural lands and wetlands along Highway 106 may provide suitable breeding habitat for this species adjacent to the PFA, but as this species has possibly been extirpated from our region this is considered very unlikely.

45) **Red Knot rufa spp. (migratory)** - The red knot rufa subspecies is an SAR that is listed as Endangered pursuant to COSEWIC, as Endangered pursuant to the Nova Scotia ESA and as S2M by the AC CDC.

The red knot breeds in the high arctic, above the Arctic Circle, during the summer months before embarking on an approximately 15,000 km migration to the coasts of South America. Red knots that are observed in the Atlantic Provinces during the fall are individuals in mid-migration who will seek out intertidal, marine habitats such as coastal inlets and estuaries in order to forage and retain energy for its continued migratory journey. The red knot's preferred prey items during migration include aquatic invertebrates, particularly bivalves, small snails, and crustaceans. Shorelines within both the Pictou and Caribou Harbours may provide migratory habitat for this species.

46) **Red-necked Phalarope (migratory)** - The red-necked phalarope is an SOCC that is listed as Special Concern pursuant to COSEWIC, and as S2S3M by the AC CDC. These birds are Arctic tundra breeders around lakes, bogs, and marshes and typically overwinter offshore and in coastal areas; however, during migration, they can found along the coast. Red-necked phalaropes feed mainly on aquatic invertebrates and flying insects. Both the Pictou and Caribou Harbours may provide migratory habitat for this species within the PFA.

47) **Roseate Tern** - The roseate tern is an SAR that is listed as Endangered – Schedule 1 pursuant to the federal SARA and COSEWIC, as Endangered pursuant to the Nova Scotia ESA, and as S1B by the AC CDC. These birds nest on rocky, offshore islands linked to stable colonies of arctic and common terns; however, there is no known record of a roseate tern colony along the Northumberland Strait. There is no known roseate tern breeding colony along the Northumberland Strait; therefore, this species is not anticipated to occur within the PFA. Furthermore, migratory and wintering birds are typically found further offshore and not within bays and harbours.

48) **Rose-breasted Grosbeak** - The rose-breasted grosbeak is an SOCC that is listed as S2S3B by the AC CDC. These birds nest in open deciduous forests with a well-developed shrub understory and often near waterbodies or wetlands. During the breeding season, rose-breasted grosbeaks eat a lot of insects, as well as wild fruit and seeds. They mostly feed on berries during fall migration, and on their wintering grounds they have a varied diet of invertebrates and plant material (Cornell 2008). Forested areas along Highway 106 may provide suitable breeding habitat for the rose-breasted grosbeak, adjacent to the PFA.

49) **Ruddy Duck** - The ruddy duck is an SOCC that is listed as S1B by the AC CDC. Their nesting habitats in the Maritimes, is associated with forested wetlands and beaver ponds that are surrounded by regenerating coniferous and mixed forest, as well as regenerating clear-cuts and plantations (Bird Studies Canada 2013). They forage mostly by diving to the bottom of shallow ponds to feed on aquatic insects, crustaceans, zooplankton, and other invertebrates, along with small amounts of aquatic plants and seeds (Cornell 2008). Open wetlands along Highway 106 may provide suitable breeding habitat for the ruddy duck adjacent to the PFA.

50) **Rusty Blackbird** - The rusty blackbird is an SAR that is federally listed as Special Concern under SARA, Schedule 1, as Endangered under the Nova Scotia ESA and as S2S3B by the AC CDC. Their breeding habitat primarily consists of riparian zones, swamps, beaver ponds, marshes, peat bogs, pasture edges and sedge meadows. They are known to feed extensively on aquatic invertebrates within the

riparian zones of shallow, slow moving rivers and streams. This species is normally located close to wetlands in forests dominated by conifers. Wetlands along Highway 106 and other roadways may provide suitable breeding habitat for this species adjacent to the PFA.

51) **Sanderling (migratory)** - Sanderlings are an SOCC that are listed as S3M/S2N by the AC CDC. Sanderlings breed in the tundra of High Arctic Canadian islands and peninsulas (Cornell 2018). During their migration along the North American coast, sanderlings make use of a variety of habitats including sandy beaches, tidal mudflats, and rocky coastlines. They will also use inland bodies of water such ponds, streams, shallow lakes and reservoirs. They typically winter on sandy beaches along the south-eastern United States, Central America and northern South America. Less commonly, they can be observed wintering along Nova Scotian shorelines. The Pictou and Caribou Harbours may provide suitable migratory and overwintering habitat for sanderlings within the PFA.

52) **Scarlet Tanager** - The scarlet tanager is an SOCC that is listed as S2B by the AC CDC. Scarlet tanagers breed in mature deciduous forests and mixed deciduous-coniferous forests often selecting a nest site high in the canopy of mature deciduous trees such as maple, beech, or oak (Cornell 2018). During their spring and fall migration they use similar forest habitats, as well as more open habitats, such as suburban parks and golf courses. Scarlet tanagers winter in mature forests and forest edges in northern and western South America. Forested areas along Highway 106 may provide suitable breeding habitat for this species adjacent to the PFA.

53) **Semipalmated Plover** - The semipalmated plover is an SOCC that is listed as S1B/S3S4M by the AC CDC. This small shorebird species, bearing a single dark neck band, can be confused for the similar looking, but much rarer, piping plover. Although the vast majority of semipalmated plovers breed in Canada's low arctic and subarctic tundra, there exists a small population that breeds in the Maritimes (Stewart et al. 2015). In the Maritimes, this species prefers rocky beaches, often with a saltmarsh or brackish pond nearby, where they nest directly onto the beach surface. Gravel and cobble beaches within the Pictou and Caribou Harbours may provide suitable breeding habitat for this species within the PFA (the shoreline is classified as mixed sediment). Suitable migratory habitat for this species may also be provided by the Pictou and Caribou Harbours.

54) **Short-eared owl** - The short-eared owl is an SAR that is federally listed as Special Concern under SARA and ranked by the AC CDC as S1S2B. Short-eared owls live in large, open areas with low vegetation. Their wintering habitat tends to be more open, but similar to their breeding habitat and winter areas often become breeding areas when food is plentiful (Cornell 2008).These owls nest on dry ground, often on raised hummocks in grasslands, barren headlands and uncultivated grasslands, often near the coast. Open wetlands along Highway 106 may provide suitable breeding habitat for this species adjacent to the PFA.

55) **Turkey Vulture** - Turkey vultures are an SOCC that are listed as S2S3B by the AC CDC. These large, carrion-eating birds are most often seen when soaring over open habitats such as agricultural lands, open forests and uncultivated grasslands. They are particularly noticeable around roadways where they will often search for fresh roadkill, as they prefer freshly dead animals. Turkey vultures almost

never attack living prey (Cornell 2018). These birds nest in rock crevices and ledges on steep cliff faces, but will also use mammal burrows, fallen trees and even abandoned hawk or heron nests if available. Turkey vultures prefer to nest far away from civilization and often return to the same site for years in a row. Dead, hollowed tree stumps in wetlands along Highway 106 may provide suitable breeding habitat for this species adjacent to the PFA.

56) **Vesper Sparrow** - The vesper sparrow is an SOCC that is listed as S2B by the AC CDC. This small sparrow species inhabits grasslands and fields across its range, but in the Maritimes is strongly associated with open bare ground and scrubland, which is often commercial blueberry fields (Stewart et al. 2015). Vesper Sparrows primarily forage on seeds and grains, but also will glean insects and spiders from low plants during the breeding season. Their nests are nothing more than a shallow depression, typically well concealed under clumps of vegetation and other woody debris. Agricultural lands, cleared areas and open wetlands may represent suitable breeding habitat for this species within or adjacent to the PFA.

57) **Virginia Rail** - The Virginia rail is an SOCC that is listed as S2S3B by the AC CDC. Virginia rails breed in shallow freshwater wetlands with extensive stands of emergent vegetation, such as cattails, reeds and bulrushes. Using available materials, they loosely weave a 'basket'-shaped nest onto floating mats of vegetation at or just above the water's surface, often weaving a 'canopy' over the nest as well (Cornell 2018). Open wetlands along Highway 106 may provide suitable breeding habitat for this species adjacent to the PFA.

58) **Warbling Vireo** - The warbling vireo is an SOCC that is listed as S1B by the AC CDC. This species prefers mature deciduous forests, especially near wetlands and waterbodies, but they will also nest in young deciduous stands should more preferred habitat not be available. They usually place their nest in the outer portions of a large deciduous tree, often quite high off the ground. Warbling vireos preys primarily on caterpillars, pupae, and adult moths and butterflies, but also eat a variety of other terrestrial invertebrates. In fall they migrate south, wintering in Mexico and Central America. Wetlands and riparian areas along Highway 106 and other roadways may provide suitable breeding habitat for this species adjacent to the PFA.

59) **Willet** - The willet is an SOCC that is listed as S2S3B by the AC CDC. This large species of shorebird breeds across Nova Scotia during the summer and winters along rocky coastlines from Maine to Brazil. During the summer months, willets breed in saltmarshes, on barrier islands, and barrier beaches nesting on the ground within cord grass, salt grass, or beach grasses. Willets forage mainly by probing the ground for worms, snails, insects and aquatic larvae, but they will take fiddler and mole crabs as well as some small fish. Open wetlands along Highway 106 may provide suitable breeding habitat for the willet adjacent to the PFA.

60) **Willow Flycatche**r - The willow flycatcher is an SOCC that is listed as S2B by the AC CDC. This species of aerial insectivore is often difficult to distinguish visually from other closely related flycatchers and often must be identified by its song. They breed across Canada and prefer shrubby wetlands, swamps, thickets and alder swales. Willow flycatchers build their nests small trees or bushes often

very near a wetland, open water or both. They prey on a variety of flying insects including dragonflies, moths, mosquitoes, beetles and damselflies. Wetlands and riparian areas along Highway 106 and other roadways may provide suitable breeding habitat for this species adjacent to the PFA.

61) **Wood thrush** - The wood thrush is an SAR that is listed as Threatened by COSEWIC and SARA, and as SUB by the AC CDC. The wood thrush primarily breeds in mature deciduous or mixed wood forests where it feeds on leaf-litter invertebrates and shrub fruits. They will typically construct their nest low in a shrub or sapling where a fork provides good support and the surrounding foliage conceals and shades the nest. Wood thrush are a migratory species and winter in the southern United States, the Greater Antilles and Central America. Forested areas adjacent Highway 106 may provide suitable breeding habitat for this species within and adjacent to the PFA.

8.10.3 Impact Evaluation/Effects Assessment

The environmental effects assessment was conducted for priority avian species identified for the ETF footprint area based on field surveys conducted in 2017 and 2018, and for the pipeline footprint area as well as the remainder of the local assessment area primarily based on existing baseline data, imagery interpretation, and a December 2018 reconnaissance survey. The habitat requirements of priority wildlife species identified as potentially occurring within and/or near the local assessment area were compared to the range of environmental conditions within the local assessment area to determine if suitable habitat was present for these species. Knowledge of the habitats present within the local assessment area was determined through an interpretation of imagery, topographic and geological mapping, as well as information obtained through field reconnaissance efforts. In instances where appropriate habitat was present for a particular priority species, that taxon was considered to be potentially present in the local assessment area, mitigation identified and potential impacts assessed. Potential accidental effects or malfunctions are considered in **Section 10**.

8.10.3.1 Potential Environmental Effects

A number of activities related to the project have the potential to interact with the birds VEC.

The project construction may interact with the birds VEC in the following ways:

- Clearing and grubbing of the pipeline route and the ETF footprint area during construction will result in the direct loss of some trees/shrubs, as well as the loss of managed grassland (lawn) habitat and some shoreline area, thereby reducing the available bird habitat in the area;
- Clearing and grubbing of the pipeline route and the ETF footprint area during construction may cause sedimentation and thereby alter and/or degrade adjacent bird habitat;
- Clearing and grubbing of the pipeline route and the ETF footprint area during construction may result in changes to bird habitat and bird movement;
- Disturbance from construction equipment including noise, dust, emissions and vibration may cause birds to avoid the area temporarily, disrupting their natural activity (such as breeding, foraging, or migrating);

- Disturbance related to pipeline staging within the marine environment adjacent the NPNS property may cause birds to avoid the area temporarily, disrupting their natural activity (such as breeding, foraging, or migrating);
- Dust and combustion fuel emissions caused by machinery during construction may alter and/or degrade adjacent bird habitats;
- Heavy machinery and other mobile equipment may cause direct injury or death to birds as a result of accidental collision;
- Improper waste management may result in the alteration and/or degradation of adjacent bird habitats; and
- Improper waste management may also attract some bird species to PFA, increasing the potential for unintended, negative interactions.

Potential ETF operations during the operation and maintenance phase that may interact with priority birds and associated habitat include:

- The spill basin may attract birds, especially waterbirds and waterfowl;
- Waterfowl may use open clarifiers as foraging or migratory habitat; and
- Additional noise associated with the site may result in a greater disturbance to both breeding and migratory birds.

Once in operation, anticipated interactions of priority birds with the pipeline would be limited, as the condition would reflect existing road operation and maintenance activities.

8.10.3.2 Mitigation

The following mitigation measures are planned to reduce environmental effects to the birds VEC:

- The footprint of the ETF portion of the project (i.e. the area of disturbance) will be minimized to the extent possible by clearing only what is necessary for the successful completion of the project and will make use existing access points where possible;
- The pipeline will be constructed primarily within the existing disturbed road shoulder and watercourse and wetland crossings will not be conducted (crossings will occur either above or under any existing road culverts), and no additional clearing and/or widening of the existing cleared area is likely to occur, thereby limiting the loss or alteration of bird habitat;
- Any clearing of existing vegetation within the footprint of the ETF or the road shoulder will occur outside of the breeding season for birds, or have appropriate mitigation developed in consultation with Environment Canada and the Canadian Wildlife Service;
- Sediment and erosion control mitigation will be in-place prior to construction activities (see **Section 5** for additional details);
- Clearing/grubbing or earth moving activities will be scheduled to avoid periods of heavy precipitation and high winds;
- Additional mitigation in relation to maintaining quality of adjacent watercourse and wetland bird habitat is provided in **Sections 8.4 and 8.7**, respectively;

- Suspend ROW preparation in the event that an active nest or amphibian or reptile habitat is discovered during ROW preparations. Sign, fence or flag off appropriate buffer area and contact the project Environmental Inspector (or equivalent role);
- An EPP will be developed and implemented for the duration of the project including, but not limited to procedures to minimize the potential for accidental spills (see **Sections 5 and 10)** and outline proper waste management control methods;
- Establish construction traffic speed limits and general public speed limits during construction to reduce the risk of collisions with birds (Site roads currently specify a speed limit of 30 km/hr);
- See **Section 8.2** for mitigation measures to minimize noise disturbance;
- Project team and contractors will be educated to recognize potential priority species that may occur within the PFA with an emphasis on the MBR of the MBCA prohibition on the destruction of the nest, eggs or young of migratory birds. In all cases, if nests are identified, work must stop and not continue until an appropriate buffer, developed in consultation with the Canadian Wildlife Service, be installed and enforced; and
- Should a SAR be encountered during construction, contact will be made to a SAR Biologist at NSDLF to discuss and develop an appropriate protocol.

8.10.3.3 Characterization of Residual Environmental Effects

Construction Phase

Noise related to construction activities is expected to be largely within the current baseline condition and substantive interaction with priority birds is not anticipated.

Development of the project will result in some minimal vegetation clearing and the permanent loss of some forested and managed grassland (lawn) habitat in the immediate ETF footprint area. The loss of vegetation and associated bird habitat within the pipeline footprint along the road shoulder will be consistent with existing road maintenance activities and thus, will not result in any additional loss of bird habitat.

Other than the observed cliff swallows collecting nesting materials, the ETF footprint area was not identified as preferred or critical habitat for any other priority species. It is not anticipated that the loss of the lawn habitat will negatively impact the nesting cliff swallows as there are many other, managed and un-managed, grassland habitats nearby from which they can gather nesting materials.

For the pipeline portion of the project, potential habitat for priority birds was identified for the general surrounding area. However, construction and installation of a buried pipeline primarily within an existing road shoulder is not anticipated to permanently alter the existing conditions or habitat for these species or result in any increased habitat fragmentation. Potential for interaction with nesting birds is mitigated by conducting clearing operations outside of the breeding season for birds unless an alternative appropriate mitigation has been agreed with ECCC.

Operation and Maintenance Phase

Additional noise at the NPNS facility as a result of the operation of the proposed ETF is expected to be largely within the current baseline condition and a substantive negative interaction with the birds VEC is not anticipated.

Operation and maintenance of the pipeline are not anticipated to result in substantive interactions with the birds VEC.

8.10.4 Significance Summary

In summary, the environmental effects of the project on the wildlife VEC are summarized in **Table 8.10-5** below

Table 8.10-5: Summary of Residual Environmental Effects Related to the Birds VEC

Activities	Potential Effects	Mitigative Factors and Measures	Residual Effects	Significance of Residual Effects
Construction				
Clearing (and grubbing) of the project footprint and pipeline construction preparation and associated activities	Permanent loss of some trees/shrubs, managed grassland and shoreline habitat.	Follow standard mitigation as outlined in **Section 5.7**. Minimize project footprint area. Using existing access where possible for project access. Following the contractors' EPP and applicable guidelines and regulations including; Minimizing the area of disturbance; Conduct clearing outside of the breeding season unless appropriate mitigation developed in consultation with ECCC; Project team and contractors will be educated on environmental awareness; and Suspend activities in the event an active bird nest detected.	Negligible with standard mitigation applied. Direct and Indirect, Irreversible Magnitude – negligible* Duration – permanent Frequency - once Geographic extent – small (limited to project footprint area) Context – limited potential for priority bird species habitat present	Not Significant -Adverse
Clearing of the project footprint and pipeline construction preparation and associated activities (CONTINUED)	Temporary noise disturbance. Sedimentation/degradation of adjacent habitats.	See above. Following the contractors' EPP and applicable guidelines and regulations including; Meeting noise requirements; and Proper installation of sediment and erosion control measures. Maintain tight construction spread (i.e. interval between front-end activities such as brushing and grading, and back-end activities such as clean-up) to reduce the duration of activities and effects of the project on adjacent habitats and birds.	Negligible with standard mitigation applied. Direct, Reversible Magnitude - low Duration – short term (one season) Frequency - daily Geographic extent – project footprint area Context – limited potential for nest loss if clearing outside nesting season; bat nests not likely	Not Significant -Adverse

Activities	Potential Effects	Mitigative Factors and Measures	Residual Effects	Significance of Residual Effects
			immediately adjacent the project footprint	
Operation and Maintenance				
Presence and operation/maintenance of the ETF	Noise disturbance.	Most birds habituate to routine traffic and industrial noise. Enforce existing NPNS wildlife policies, including do not harass birds or wildlife on NPNS property.	Negligible with standard mitigation applied. Direct, Reversible Magnitude - low Duration – long term (project duration) Frequency - daily Geographic extent – ETF footprint area Context – existing disturbance	Not Significant -Adverse
Presence and operation/maintenance of the ETF (CONTINUED)	Spill basin and clarifiers may attract waterfowl and other waterbirds.	Enforce existing NPNS wildlife policies, including do not feed birds or wildlife on NPNS property.	Negligible with standard mitigation applied. Direct, Reversible Magnitude - low Duration – long term (project duration) Frequency - daily Geographic extent – ETF footprint area Context – existing disturbance	Not Significant -Adverse

*Magnitude: Negligible - within normal variability of baseline conditions

The proposed mitigation is expected to result in some residual effects on priority birds and associated habitat, but it is not likely to be significant. Therefore, in consideration of the nature of the project, the environmental setting, and planned mitigation, the residual environmental effects of the project on the Migratory Birds and Priority Bird Species/Habitat VEC during all phases of the project are rated as not significant, with a moderate level of confidence. Follow-up, such as a comprehensive field survey of the pipeline footprint is expected to increase the level of confidence of this prediction.

8.10.5 Follow-up and Monitoring (Bird Habitat and Priority Species)

A comprehensive field migratory survey and breeding bird survey of the pipeline footprint area will be conducted in spring/summer 2019 as a follow-up measure to confirm the desktop information provided herein, as a follow-up measure to confirm the resulting effects prediction.

Construction in the vicinity of environmentally significant/sensitive areas will be monitored to ensure the spatial magnitude of the physical disturbance is limited to the extent possible. Further follow-up and monitoring will include, but not limited to:

- NPNS will review the SAR list during construction and modify monitoring accordingly.

8.11 Harbour Physical Environment, Water Quality, and Sediment Quality

The potential effects of the project on harbour physical environment, water quality, and sediment quality are assessed in this section.

8.11.1 Scope of VEC

Harbour physical environment, water quality, and sediment quality was selected as a VEC in consideration of federal and provincial regulatory requirements such as the Pulp and Paper Effluent Regulations (PPER) under the *Fisheries Act*, the Disposal at Sea Regulations under the *Canadian Environmental Protection Act, 1999* (CEPA), DFO's *Measures to Avoid Causing Harm to Fish and Fish Habitat* (DFO 2014), and the Canadian Council of Ministers of the Environment's (CCME) Canadian Environmental Quality Guidelines.

Various aspects of the physical environment (e.g., bathymetry, tides, currents, wind and wave patterns, sea surface temperature, ice formation, water quality, and sediment quality) are described in **Section 8.11.2** to provide an overview of existing environmental conditions in the Northumberland Strait and Caribou Harbour (i.e., the physical environments in which project activities will occur) as well as Pictou Harbour (i.e., as a proxy for Caribou Harbour with respect to water quality, in the absence of available water quality data for Caribou Harbour). The environmental effects assessment for this VEC focuses on changes in water quality and sediment quality since these are the primary environmental effects of concern associated with this VEC.

8.11.1.1 Boundaries

The spatial boundaries for the assessment of the environmental effects of the project on the harbour physical environment, water quality, and sediment quality include the following:

- **Marine project footprint area (PFA):** The PFA is the area of anticipated physical disturbance associated with the project. The marine PFA (i.e., generally the PFA for the marine portion of the pipeline) consists of a corridor approximately 15 m wide and 4.1 km long that begins at the ordinary high-water mark and extends seaward into the Northumberland Strait until the pipeline terminates at the effluent outfall diffuser. This 15 m wide corridor contains the proposed 3 m wide excavated trench within which the pipe will be installed and also accounts for the temporary placement of excavated marine sediments. The estimated total area of the marine PFA in the Northumberland Strait is approximately 6 ha.
- **Marine local assessment area (LAA):** The LAA the maximum area within which environmental effects from project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence (i.e., the potential zone of influence of project-related environmental effects). The marine LAA (i.e., generally the LAA for the marine portion of the pipeline) consists of a corridor approximately 300 m wide and 4.1 km long that begins at the ordinary high-water mark and extends seaward into the Northumberland Strait until the pipeline terminates at the effluent outfall diffuser including an area 300 m encircling the outfall. This 300 m wide corridor contains the marine PFA and also accounts for the most acute potential effects of sediment resuspension and underwater

sound/vibration from physical activities in the marine PFA as well as the most acute potential effects of the effluent plume from the diffuser. The estimated total area of the marine LAA in the Northumberland Strait is approximately 126 ha.

Temporal boundaries for the assessment of environmental effects on the environment include periods of construction, operation and maintenance, and decommissioning. Construction is estimated to be approximately 21 months, beginning second quarter of 2019, commencing as soon as the EA review has been completed and the applicable permits, approvals or other forms of authorization have been obtained. Operation and maintenance will commence immediately following the construction phase and will continue to operate efficiently and safely for several decades and likely much longer with a well-maintained system. For the purpose of this EA Registration, it has been assumed that the operation and maintenance phase will begin in the fourth quarter of 2020. Decommissioning of the project would occur at the end of mill life following the completion of operations. Once the ETF or pipeline is nearing the end of a useful service life, a decommissioning plan will be developed and will be submitted for a separate review requiring NSE approval.

8.11.1.2 Significance Criteria

A significant adverse residual environmental effect on the harbour physical environment, water quality, and sediment quality is one where project-related activities:

- result in changes to water or sediment quality that cause acute or chronic toxicity to marine life that cannot be mitigated;
- result in changes to water or sediment quality that exceed relevant applicable CCME guidelines and cannot be mitigated; or
- result in non-compliance with the terms or conditions of a regulatory permit, approval or other form of provincial or federal regulatory authorization to operate the marine pipeline.

8.11.2 Existing Environment

The description of existing conditions for the harbour physical environment, water quality, and sediment quality in the Northumberland Strait, Caribou Harbour, and Pictou Harbour is based on the results of previous research and existing scientific literature and environmental assessments; no field work was conducted as part of this EA Registration.

8.11.2.1 *Northumberland Strait*

The Northumberland Strait is a long, narrow, shallow body of water located in the Southern Gulf of St. Lawrence (AMEC 2007). The bathymetry of the Northumberland Strait, including the marine PFA and LAA is shown in **Figure 8.11-1**.

The water of the Northumberland Strait is primarily derived from the surface layer of the Gulf of St. Lawrence. The Gulf generally exhibits features of an estuarine environment due to the freshwater input of the St. Lawrence River and the deep saline flow from the Gulf Stream that enters through the Cabot Strait (AMEC 2007).

In inshore areas of the Northumberland Strait, such as the LAA, water temperatures are typically below zero during the months with ice cover (i.e., January to March) (Petrie and Jordan 1993). Water temperatures begin increasing in March and peak in August with a maximum average water temperature of approximately 18 °C. Following the month of August, water temperature declines and again reaches 0 °C in December prior to the formation of sea ice.

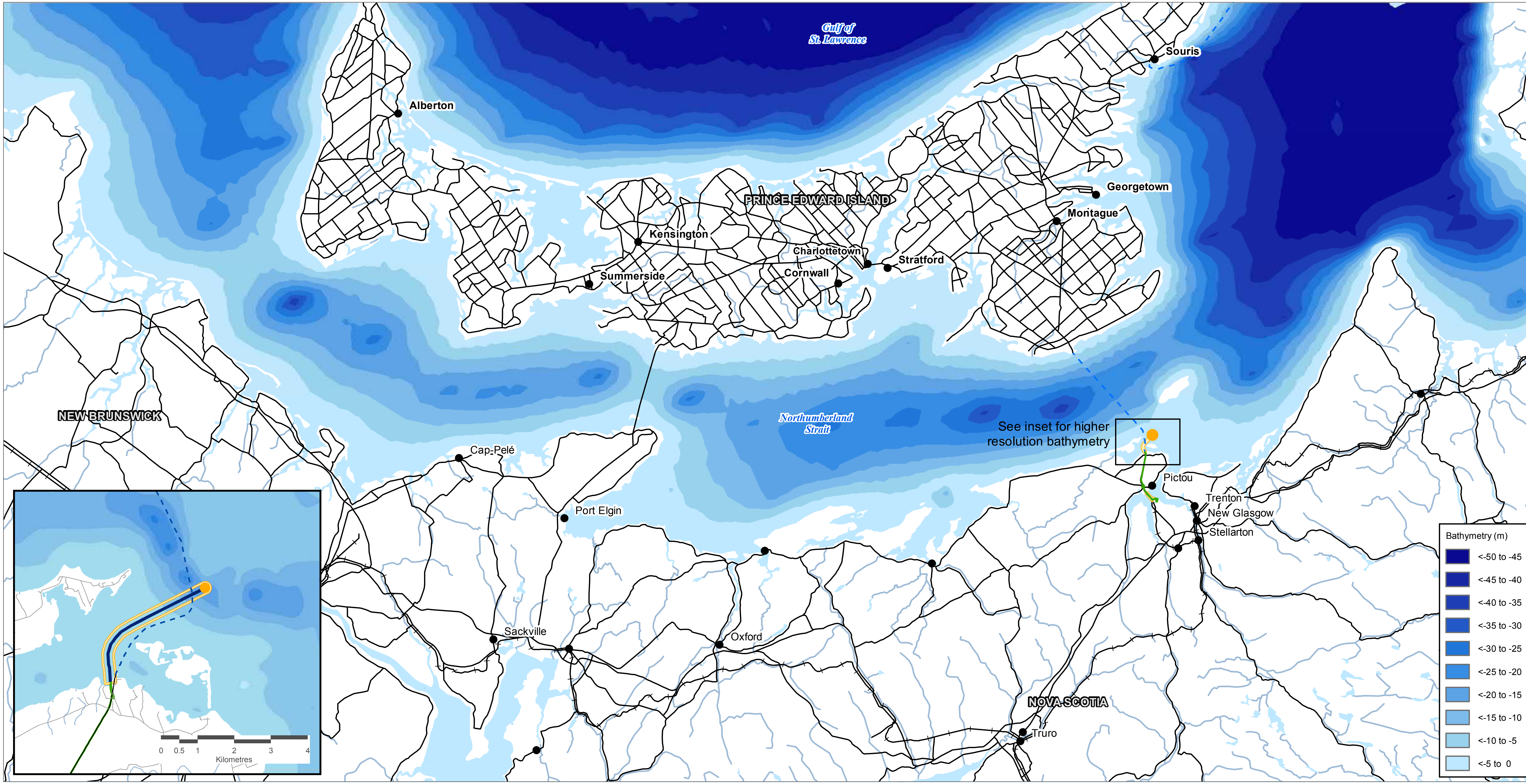
Inshore water temperature corresponds closely with sea surface temperatures in the area (Petrie and Jordan 1993). The average sea surface temperatures in May to December in the Northumberland Strait (1986-2012) are shown in **Figure 8.11-2**.

The warmest near-bottom water temperatures in the southern Gulf of St. Lawrence are typically found in the Northumberland Strait, where they can exceed 23 °C (Chassé et al. 2014).

From 1991 to 2010, average September bottom salinities in the Northumberland Strait ranged between 28 and 30 practical salinity units (psu) (Chassé et al. 2014). The summer warm surface layer is usually composed of waters with higher salinities ranging from 30-31 psu in the Northumberland Strait (JWEL 2001).

Tides in the Northumberland Strait follow a complex pattern, with variations in the tidal regime and magnitudes that are largely determined by the tidal characteristics of the Gulf of St. Lawrence and the dimension of the Strait itself (JWEL 1996). Tides are mixed semi-diurnal at the east end of the Northumberland Strait, including Pictou Harbour (Stantec 2015). Tidal wavelengths vary with depth, and main currents in the Strait reverse themselves near shore about one hour ahead of the main channel (Stantec 2015).

Currents in the Northumberland Strait are mainly driven by tidal and wind effects that are part of the larger circulation dynamics of the Gulf of St. Lawrence (Stantec 2015). The current in the Northumberland Strait generally flows in a southeasterly direction between New Brunswick and Prince Edward Island (PEI) (Nova Scotia Museum of Natural History 1996).



Northern Pulp Nova Scotia Corporation
Replacement Effluent Treatment Facility
Environmental Assessment

Bathymetry of the Northumberland Strait
Figure 8.11-1

NORTHERN PULP
NOVA SCOTIA CORPORATION
A PAPER EXCELLENCE COMPANY

Outfall Diffuser Location
Marine Local Assessment Area
Marine Project Footprint Area*
Terrestrial Project Footprint Area*

DILLON CONSULTING

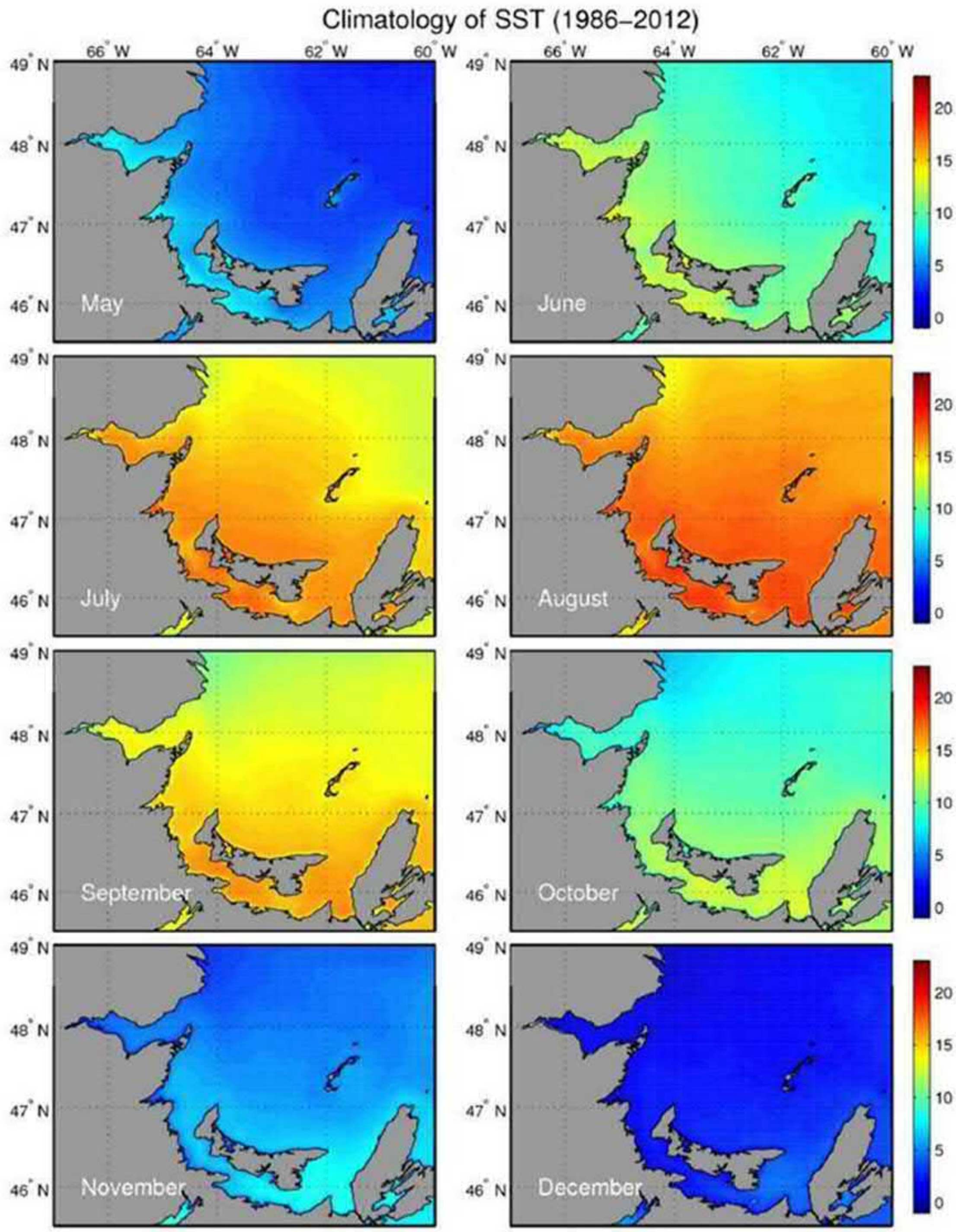
MAP CREATED BY: HW
MAP CHECKED BY: SS
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 2.5 5 10 15 20
Kilometres

*Precise Project Footprint to be determined following completion of detailed design

Sources:
Stantec, 2018
NOAA, 2019

PROJECT: 17-6461
Date: 1/24/2019

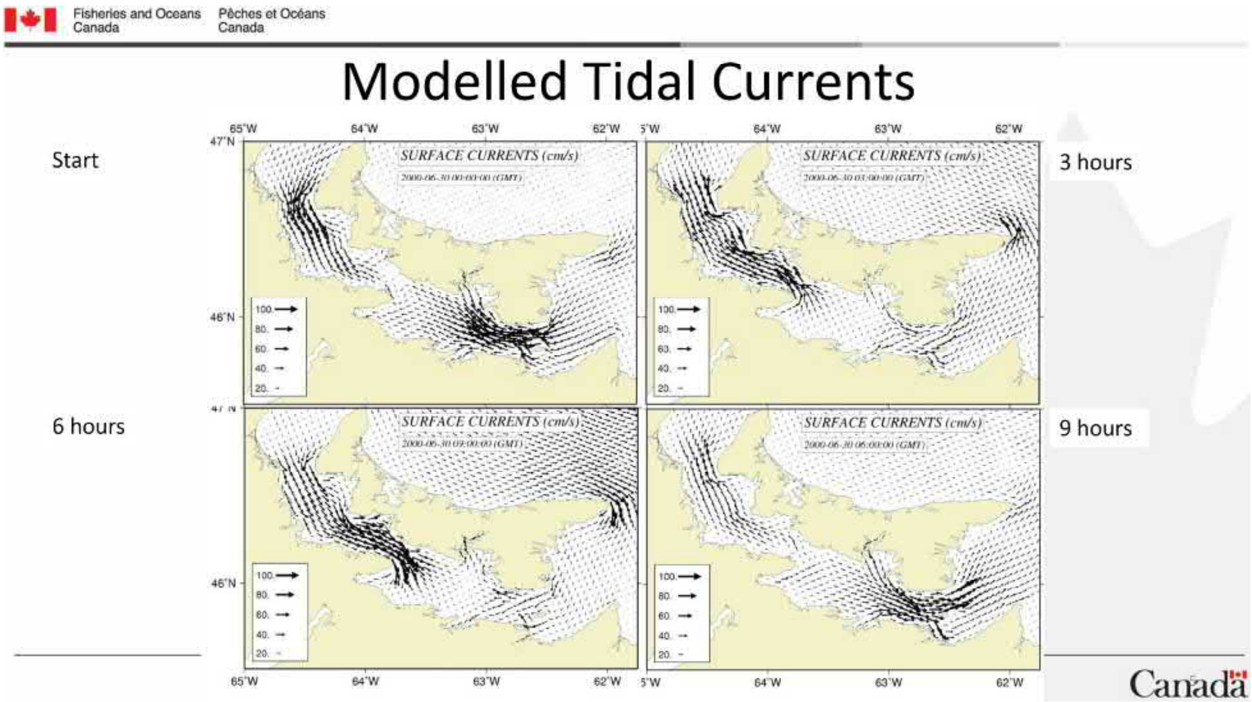


Source: Chassé et al. 2014

Figure 8.11-2: Average Sea Surface Temperatures from May to December in the Northumberland Strait (1986-2012)

Note: colour scales indicate sea surface temperatures in degrees Celsius.

Modelled tidal currents in the Northumberland Strait are presented in **Figure 8.11-3**. After the 12-hour period captured in **Figure 8.11-3**, the tidal cycle will repeat itself during a 24-hour period.



Source: DFO 2018a

Figure 8.11-3: Modelled Tidal Currents in the Northumberland Strait

In general, ice starts to develop in coastal areas of the Strait in the last week of December and the Strait is partially covered with grey and new ice by the end of December (Stantec 2015). By the first week of January, the entire Strait is typically covered with ice, the thickness of which increases to a maximum of approximately 1 m as the winter progresses (Stantec 2015). Ice concentrations generally begin to decrease during the third week of March near the western end of the Strait and ice breakup gradually progresses towards the east (Stantec 2015). Ice movement is mostly dominated by wind and tidal effects during this time (Stantec 2015). Most of the ice in the main channel of the Strait melts by mid-April, with only coastal fast ice remaining until it also typically melts by the last week of April (Stantec 2015). The total period of ice cover generally lasts up to 110 days along the north coast of PEI and along the Northumberland Strait (Chassé et al. 2014).

Ice movement can create ice ridges that are formed by the impact of ice floes with coastal fast ice; these ridges have keels that can extend to the seabed and, when transported, have the potential to create ice scour as the advancing keel pushes sediment to the sides (Stantec 2015).

8.11.2.2 *Caribou Harbour*

Caribou Harbour derives most of its freshwater from Three Brooks and Caribou River. Caribou Harbour is generally shallow. In the western portion of the harbour, south of Caribou and Gull Islands, water depths range from 1 to 8 m (Navionics 2018). The deepest part of the harbour is the main channel which forms in the centre and eastern portion of the harbour between Munroes Island and the mainland where water depths range from 1 to 12 m (Navonics 2018). Caribou Harbour flows into the Northumberland Strait south of Little Caribou split and Gull and Munroes Islands. Caribou Harbour has a maximum water depth of approximately 8.5 m within the LAA (Navionics 2018).

From 2001 to 2011, DFO collected water temperature data (for water depths ranging from 9 to 20 m) from a station located approximately 1 km off Caribou Point. These temperature data show that the mean water temperatures were 4 °C in early winter, 3 °C in spring, and 17 °C in late summer (DFO 2018b). Salinity was generally in the range of 28 psu in this area (Chassé et al. 2014).

Wind and wave patterns in Caribou Harbour vary by season. In the summer (i.e., July), a combination of southwesterly winds and tidal circulation occurs most frequently and is represented by moderate wind speeds (approximately 5 m/s) in addition to tidal circulation. In the winter (i.e., December), northwesterly winds and incident waves occur more frequently and include moderate wind speeds (approximately 5 m/s) and significant wave heights (e.g., 0.5 m). Northeasterly winds occur less frequently in winter (AMEC 2014).

Currents in Caribou Harbour vary according to tidal cycles. Modelled tidal currents during normal conditions indicate the following (AMEC 2014):

- a maximum tidal current of 0.4 to 0.8 m/s at neap tide and spring tide, respectively, at the deeper site; and
- a maximum tidal current of 0.25 to 0.45 m/s at neap tide and spring tide, respectively, at the shallower site.

Stronger currents may be observed during stormy conditions (AMEC 2014).

Within both Caribou Harbour and Pictou Harbour, the prevailing transport direction is expected to be influenced by tidal circulation in the Northumberland Strait, wind-driven currents, and, to a lesser and narrower extent, wave-driven currents in the limited shallow areas along the coast (AMEC 2014).

Sea ice formation in Caribou Harbour and Pictou Harbour typically occurs in January but can occur as early as mid-December (EC 2010). The sea ice forms close to land and spreads outward from the coast. The entire Northumberland Strait, including Caribou Harbour and Pictou Harbour, is typically frozen by mid-January and remains frozen until mid-March. Sea ice generally remains in Caribou Harbour and Pictou Harbour until early April, but infrequently has stayed as long as May (EC 2010). Coastal lagoons in the Northumberland Strait area are protected from ice scour (Nova Scotia Museum of Natural History 1996).

8.11.2.3 *Pictou Harbour*

Pictou Harbour is a natural harbour on the Northumberland Strait. It is a partially-mixed estuary that derives its freshwater from the East River, Middle River, and West River and flows into Northumberland Strait. A main channel is prevalent downstream of the Pictou Causeway (between Pictou and Pictou Landing) across East River in Pictou Bay (Navionics 2018). The maximum depth of the LAA in Pictou Harbour is approximately 9.75 m (Navionics 2018).

Tides in Pictou Harbour area are mixed by two dominant tidal components: a semi-diurnal (twice daily) component and a diurnal (daily) component (ENSR 1999). The combination of semi-diurnal and diurnal tidal components results in “mixed” tides in which relatively larger and smaller tides occur alternatively over time with successive highs and lows of unequal heights (Stantec 2017). Tides also have a bi-weekly cycle of spring and neap tides in which the spring tidal ranges are approximately double those of neap tides (Stantec 2017).

8.11.2.4 *Water Quality*

This section provides an overview of water quality sampling in Pictou Harbour in 1990, 1995 and 1998 (Dalziel et al. 1993; JWEL 1996; ENSR 1999). Pictou Harbour was used as a proxy for Caribou Harbour with respect to water quality, in the absence of available water quality data for Caribou Harbour. Pictou Harbour is similar to Caribou Harbour in terms of depth and geography, but likely has greater freshwater influence.

Water sampling was conducted in Pictou Harbour in 1990 and reported in Dalziel et al. (1993). Phosphate ranged from 1.38 to 3.66 µM (micromolar, or 131 to 348 µg/L) and nitrate ranged below the detection limit of 0.50 µM (31 µg/L). Silicate ranged from 3.11 to 8.92 µM (380 to 1,089 µg/L). Total organic carbon in surface water ranged from 1.67 to 4.87 mg/L. Particulate carbon ranged from 215 to 1,451 µg/L and particulate nitrogen ranged from 44 to 114 µg/L. Dissolved cadmium concentrations in water ranged from 0.015 to 0.05 µg/L, dissolved copper ranged from 0.45 to 1.46 µg/L, dissolved iron ranged from 3.65 to 18.8 µg/L, dissolved lead ranged from 0.025 to 0.094 µg/L, dissolved manganese ranged from 0.84 to 8.01 µg/L, dissolved nickel ranged from 0.30 to 0.52 µg/L and dissolved zinc ranged from 0.02 to 1.46 µg/L across 15 sampling stations (Dalziel et al. 1993). Salinity in Pictou Harbour was typically above 28 psu but was noted as low as 21 psu (Dalziel et al. 1993).

Surface water salinities measured in Pictou Harbour in 1995 were generally greater than 25 psu but varies with the tidal cycle (JWEL 1996). Peak salinities of 28 to 29 psu were recorded at high tide while lower salinity values were observed during low tides (JWEL 1996).

Salinity and temperature were measured in Pictou Harbour in December 1998, where salinity ranged from 23.5 to 27.5 psu, and water temperature ranged from 1 °C to 3.5 °C (ENSR 1999). It was also observed that typically, during ebb and flood tides, the water column was not stratified, and during some slack water events the water column was slightly stratified (ENSR 1999).

8.11.2.5 Sediment Quality

This section summarizes the results of sediment sampling previously conducted in Caribou Harbour and Pictou Harbour in 2008, 2014 and 2015 (AMEC 2014, 2015a, 2015b).

Caribou Harbour

Grain size analysis from sediment samples collected in 2008 indicate that sediment in Caribou Harbour is composed primarily of sand (51.5%), silt (27.9%), clay (16.9%), and gravel (3.6%) (AMEC 2014). Higher proportions of silt were generally observed in samples from the West Berth Area in comparison with samples from other areas (AMEC 2014). Large boulder substrate was noted at one location in Caribou Harbour (AMEC 2015a).

A Fisheries Habitat Survey was conducted in 2015 at a proposed Disposal at Sea (DAS) near the mouth of Caribou Harbour, to the southeast of the marine PFA (AMEC 2015a). The dominant substrate type observed in the footprint of the proposed DAS site was sand with varying amounts of cobble and rock. Cobble generally comprised 5-20% of the substrate but comprised over 30% of the substrate in rare instances (AMEC 2015a). Rock was observed but was generally a low percentage of the overall composition. Silt was observed throughout the whole area with a minimal contribution of 5-10% of the overall composition (AMEC 2015a). Shell hash was observed in most of the area (AMEC 2015a).

In Caribou Harbour, total organic carbon (TOC) and total inorganic carbon (TIC) content of sediment samples ranged from non-detectable (<0.15 g/kg) to 9.85 g/kg and non-detectable (<0.15 g/kg) to 10.3 g/kg respectively (AMEC 2015b). None of the sediment samples analyzed for metals exceeds the CEPA DAS Lower Level Screening Criteria for metals (AMEC 2015b).

Polycyclic aromatic hydrocarbons (PAHs) were not detected in any of the sediment samples from the inner channel and berth areas in Caribou Harbour. No exceedances of the CEPA DAS Lower Level Screening Criteria were recorded (AMEC 2015b).

No benzene, toluene, ethylbenzene, xylene (BTEX) or total petroleum hydrocarbons (TPH) were detected in the six sediment samples collected in Caribou Harbour. The modified TPH values that were detected resemble gasoline, diesel #2 and lube oil (AMEC 2015b).

No exceedances of the Atlantic Risk-Based Corrective Action (RBCA) Tier 1 Version 3.0 Risk-based Screening Levels (RBSLs) and Sediment Ecological Screening Levels (SESLs) for the Protection of Freshwater and Marine Aquatic Life were recorded (AMEC 2015b).

No polychlorinated biphenyls (PCB), DDT (Dichlorodiphenyltrichloroethane), DDE (Dichlorodiphenyldichloroethylene), or DDD (Dichlorodiphenyldichloroethane) concentrations were detected in any of the six samples analyzed (AMEC 2015b).

Pictou Harbour

Of the 13 sediment samples collected in Pictou Harbour that were submitted for grain size analysis in 1990:

- five samples were composed primarily of mud (>95% by weight <63 µm);
- two samples were composed primarily of sandy mud (5-30% by weight >63 µm and >70% of weight >63 µm);
- two samples were composed primarily of sand (>95% by weight >63 µm);
- two samples were composed primarily of muddy sand (5-30% by weight >63 µm and >70% of weight >63 µm); and
- two samples were composed primarily of very sandy mud (>30% by weight >63 µm and >30% by weight >63 µm) (Dalziel et al. 1993).

Table 8.11-1 presents the ranges of metal concentrations detected in sediment samples collected across 13 sampling stations in Pictou Harbour in 1990 (Dalziel et al. 1993).

Table 8.11-1: Metal Concentrations in Sediment Samples Collected in Pictou Harbour in 1990

Metal	Range of Concentrations Across 13 Sampling Stations
Cadmium	0.02 to 0.93 mg/kg
Chromium	4 to 95 mg/kg
Copper	1 to 5 mg/kg
Lead	5 to 57 mg/kg
Lithium	17 to 84 mg/kg
Mercury	0.01 to 0.85 mg/kg
Zinc	7 to 231 mg/kg

Source: Dalziel et al. 1993

In **Table 8.11-1**, mercury exceeded applicable CCME probable effect guidelines for sediment samples that contained high organic content and were fined grained, whereas some fine-grained samples also with high organic content exceeded CEPA DAS sediment screening criteria for cadmium and mercury.

8.11.3 Impact Evaluation/Effects Assessment

The potential effects of the project on harbour physical environment, water quality, and sediment quality are assessed in this section.

8.11.3.1 Potential Environmental Effects

This project will interact with the physical environment through physical disturbance/alteration of the seabed within the marine PFA, routine discharges from project vessels and equipment, and the discharge of treated effluent from the effluent diffuser, all of which have potential to affect water and/or sediment quality. The environmental effects assessment for this VEC focuses on changes in water quality and sediment quality, since these are the primary environmental effects of concern associated with this VEC.

For the purposes of this assessment, a change in water quality refers to any alteration to pH, dissolved oxygen (DO), temperature, total suspended solids (TSS), or contaminants in the water column. A change in sediment quality refers to the alteration of sediment characteristics including sand and silt size fractions, measured by particle size analysis (PSA), or changes to the chemical composition of sediment or release of contaminants that settle on the seafloor.

Water quality and sediment quality could be affected by project activities and components during the construction phase and operation and maintenance phase.

Construction Phase

Construction of the pipeline and associated works will include on-land activities and site preparation at the shoreline. These activities have the potential to cause sedimentation and run-off to enter the marine environment, thereby potentially affecting water quality and sediment quality in Caribou Harbour and Pictou Harbour.

In-water construction activities may also result in sediment resuspension from seabed disturbance during pipeline trenching and installation (including construction of a gravel access causeway/bridge to facilitate pipeline trenching and installation in the intertidal/nearshore zone) and outfall construction. This may cause a change in water and sediment quality by disturbing contaminated sediments, if they exist in Caribou Harbour. The disturbance of sediment may temporarily increase the concentrations of TSS in the water column as well as temporarily elevate levels of contaminated sediment (if present).

In-water activities (e.g., trenching and burial of the marine pipeline) will temporarily increase TSS levels in the water column in the marine PFA. The placement of infrastructure along the pipeline route, including the effluent diffuser, will also temporarily increase TSS and could cause a change in water and sediment quality in the marine PFA. If marine blasting is required during the construction phase, this would also represent a source of sediment resuspension.

The operation of project vessels and equipment in Caribou Harbour and the Northumberland Strait also has the potential to cause a temporary change in water quality due to routine discharges from project vessels (e.g., bilge water, ballast water, deck drainage, sewage).

Operation and Maintenance Phase

Routine effluent discharge from the effluent outfall diffuser will cause a project-related change in water quality. The treated effluent will contain the following water quality parameters of concern: absorbable organic halides (AOX), total nitrogen (TN), total phosphorus (TP), colour, biochemical oxygen demand (BOD), total suspended solids (TSS), dissolved oxygen (DO), pH, and water temperature. Potential effects could result from:

- an increase in temperature, nutrients (nitrogen and phosphorus), and/or TSS;
- a change in colour, chemical and BOD, DO, and/or pH; and/or
- a reduction in salinity from the discharge of relatively freshwater effluent into the Northumberland Strait.

The discharge of effluent containing elevated levels of TSS could also cause a change in sediment quality near the diffuser due to settlement of suspended sediment, which could cause a change in sediment characteristics such as sand and silt size fractions and/or a change in chemical composition of sediments.

Potential effects on the harbour physical environment, water quality, and sediment quality during the construction phase may also be applicable during the operation and maintenance phase if project maintenance activities generate sedimentation and/or runoff near the shoreline, require and operation of project vessels or equipment, or include seabed disturbance (e.g., for pipeline retrieval or reburial).

8.11.3.2 Mitigation

Table 8.11-2 identifies proposed mitigation measures to reduce or avoid project-related changes in water quality and sediment quality. Some or all the mitigation measures outlined in **Table 8.11-2** for the construction phase may also be applicable for the operation and maintenance phase if project maintenance activities generate sedimentation and/or runoff near the shoreline, require operation of project vessels or equipment, or include seabed disturbance (e.g., for pipeline retrieval or reburial).

In addition to the mitigation measures identified in **Table 8.11-2**, NPNS has had a Toxicity Prevention and Remediation Plan in place for many years that has been reviewed by ECCC to provide a structured approach for addressing treated effluent toxicity problems, should they occur. There will also be an Environmental Effects Monitoring (EEM) Program (**Appendix G**) developed to meet the terms of the PPER, as well as a Follow Up and Monitoring Plan that will include toxicity testing of treated effluent and water quality sampling to monitor the potential effects of the effluent discharge (**Appendix H**) and to implement an adaptive management approach, if required.

Table 8.11-2: Mitigation Measures to Reduce or Avoid a Change in Water or Sediment Quality

Potential Environmental Effect	Mitigation Measures
• Change in water quality • Change in sediment quality	• DFO's *Measures to Avoid Causing Harm to Fish and Fish Habitat* (DFO 2014) will be implemented, as applicable, including relevant measures pertaining to contaminant and spill management, erosion and sediment control, shoreline stabilization, and operation of machinery. • Work during the construction phase will be scheduled to the extent practicable to avoid periods of adverse weather (e.g., heavy winds or rain) or spring tides that may increase the transport of sediment depending on the construction method selected. • Duration of in-water work will be managed to the shortest time that is practical. • An Erosion and Sediment Control Plan will be developed for the site that reduces the risk of sedimentation to the marine environment. Environmental controls (e.g., silt curtains) will be employed as necessary to reduce sediment resuspension during construction in the intertidal/nearshore zone and marine outfall construction. • Machinery used on site will arrive in a clean condition free of fluid leaks. • All construction materials will be removed from site upon completion of pipeline installation. • Visual inspection will be conducted in the LAA to confirm that increases in turbidity are limited. If excessive changes in turbidity occur that differ from existing conditions of the surrounding waterbody (i.e., distinct colour difference) as a result of construction activities, an investigation will be performed to determine root cause and additional mitigation measures will be applied as needed. • Displaced substrate will be recovered to bury portions of the pipeline, wherever practical. • Routine effluents and operational discharges produced by project vessels (e.g., grey and black water, bilge water, deck drainage, discharges from machinery, and non-hazardous waste material) will be managed in accordance with *International Convention for the Prevention of Pollution from Ships* (MARPOL) and International Maritime Organization (IMO) guidelines, of which Canada has incorporated provisions under various sections of the *Canada Shipping Act*. No waste or garbage will be dumped overboard. • If gravel or rock is placed below highwater mark it will come from a clean source with less than 5% fines. • A project-specific EPP will be developed prior to the commencement of construction activities and will include measures to control sediment resuspension associated with seabed disturbance. • During operation, effluent will be treated to comply with all applicable regulatory requirements for effluent discharge quality, including compliance with federal and provincial permit requirements and regulatory requirements such as PPER. • A three-port diffuser has been selected for the effluent outfall diffuser to improve near-field dilution and mixing (compared with a one-port diffuser) during project operations (Stantec 2018; **Appendix E**).

8.11.3.3 Characterization of Residual Effects

Residual project-related environmental effects on the marine environment may occur during initial site preparation, construction and installation of the pipeline in the marine environment, and operation and maintenance of the marine portion of the pipeline.

Construction Phase

On-land activities and site preparation at the shoreline have the potential to cause sedimentation and runoff to enter the marine environment. With the implementation of a site-specific Erosion and Sediment Control Plan, the risk of sedimentation causing a change in water or sediment quality in the marine environment is considered low and, in the unlikely event that such a change did occur, it would be localized.

In-water activities could result in a change in water and sediment quality by disturbing contaminated sediments (if present). However, based on the results of previous sediment sampling in Caribou Harbour (see **Section 8.11.2.5**), sediments in and around the LAA are not expected to be contaminated and there is little risk of resuspension of deleterious substances during project activities.

With respect to project construction activities involving seabed disturbance, although there may be temporary and localized increases in turbidity, TSS levels are expected to dissipate to background levels within a matter of hours or days (depending on grain size and the level of wave and current action in the area).

If marine blasting is required in the marine environment, potential effects will be temporary, short in duration, and infrequent. The high currents in the Northumberland Strait will aid in the dispersion of re-suspended sediments. Compliance with the DFO *Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters* (Wright and Hopky 1998) will minimize effects due to blasting activities, if required.

The operation of project vessels in Caribou Harbour and the Northumberland Strait is unlikely to cause a change in water quality due to adherence to MARPOL, IMO and *Canada Shipping Act* guidelines.

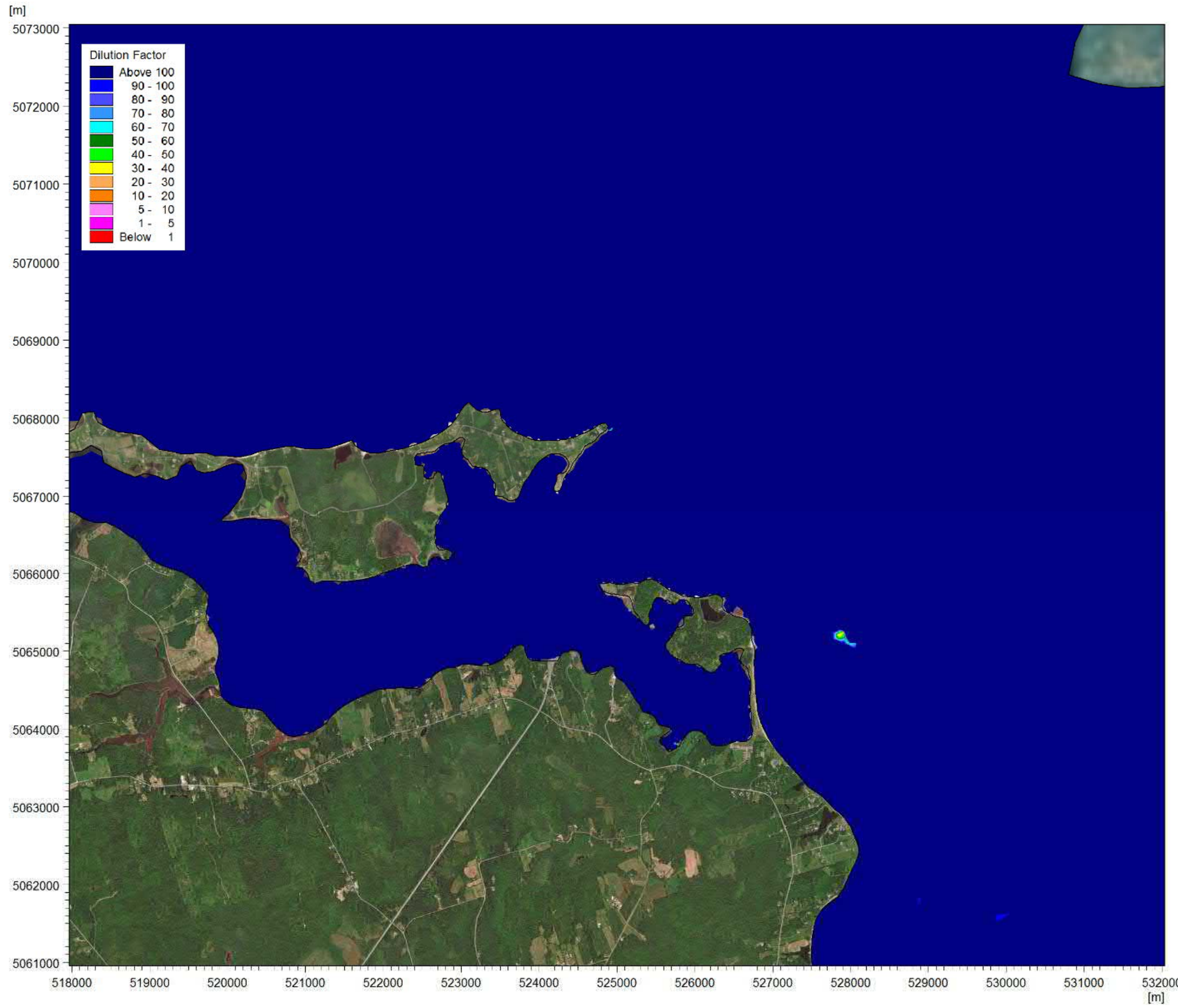
The potential residual change in water and/or sediment quality during construction is predicted to be adverse in direction, low to medium in magnitude, localized in spatial extent, temporary and limited to the duration of the construction phase, daily in frequency, reversible, and occurring in a context of previous disturbance.

Operation and Maintenance

The discharge of treated effluent from the ETF into the water column has the potential to cause a change in water and sediment quality. The effluent discharge quality for adsorbable organic halides (AOX), total nitrogen, total phosphorus, colour, biochemical oxygen demand, chemical oxygen demand, TSS, DO, pH, water temperature, and salinity are anticipated to meet compliance at the end of the mixing zone for applicable federal water quality guidelines.

Water quality parameters of concern in the treated effluent include total nitrogen, total phosphorus, colour, BOD, AOX, TSS, DO, pH, water temperature and salinity. Water quality for the three-port diffuser will reach ambient conditions within less than 2 m from the diffuser in terms of total nitrogen, total phosphorus, TSS, DO, pH, and salinity; colour will return to ambient conditions within 5 m of the diffuser. (Stantec 2018; **Appendix E**). Any effects due the discharge of treated effluent would be localized at the diffuser as the implementation of a three-port diffuser and the high currents present in the Northumberland Strait will aid in dispersion of treated effluent. Thus, significant residual effects to water quality or sediment quality as a result of treated effluent discharge are not likely.

To characterize the potential residual effects of effluent discharge on the receiving environment water quality, far-field modelling of the cumulative effects after a one-month simulation period of effluent discharge from the outfall location CH-B off Caribou Point was carried out by Stantec (2018) (**Appendix E**). The modelling results indicate that there are few traces of relatively high diluted effluent after a period of 30 days (**Figure 8.11-4**). The modelling of plume dispersion used very conservative assumptions, including maximum daily effluent flow rate for 30 days, summer conditions with lower wind speeds, waves and warmer ambient temperatures that are not favourable for plume mixing, and no decay of effluent quality, which represents an exaggerated condition where normally some decay is expected to occur (Stantec 2018).



Source: Stantec (2018)

Figure 8.11-4: Spatial Distribution of Simulated Effluent Dilution Factor at the End of a One-Month Simulation Period from the Outfall CH-B Located off Caribou Point

(assumes no particle degradation over the simulation period).

Elevated levels of TSS, and settlement of suspended sediment, could cause a change in sediment characteristics such as sand and silt size fractions and/or a change in chemical composition of sediments. Any increases in TSS, or changes in composition of sediments would be highly localized near the effluent diffuser due to the use of the three-port diffuser and the buoyant nature of the effluent.

The potential residual change in water and/or sediment quality during the operation and maintenance phase is predicted to be adverse in direction, low in magnitude, localized in spatial extent, permanent in duration, daily in frequency, reversible, and occurring in a context of previous disturbance.

The residual effects characterizations provided above for the construction phase may also be generally applicable for the operation and maintenance phase if project maintenance activities require the presence and operation of project vessels or equipment, seabed disturbance (e.g., for pipeline retrieval or reburial). However, any potential residual change in water and/or sediment quality associated with project maintenance would generally be expected to be relatively more localized in spatial extent, lower in magnitude, shorter in duration and limited to the operation and maintenance phase, and less frequent than the potential residual effects associated with project construction.

8.11.4 Summary

Table 8.11-3 summarizes the potential residual environmental effects of the project on the harbour physical environment, water quality, and sediment quality. The environmental effects assessment for this VEC focuses on changes in water quality and sediment quality since these are the primary environmental effects of concern associated with this VEC.

Table 8.11-3: Summary of Residual Environmental Effects to Harbour Physical Environment, Water Quality, and Sediment Quality

Project Activities	Potential Effects	Mitigation	Residual Effects	Significance of Residual Effects
Construction				
Pipeline trenching and installation, installation of effluent outfall diffuser, and associated marine construction activities, including barge anchoring	Change in water quality Change in sediment quality	• Implement DFO's *Measures to Avoid Harm to Fish and Fish Habitat* (DFO 2014), as applicable, including relevant measures pertaining to contaminant and spill management, erosion and sediment control, shoreline stabilization, and operation of machinery. • Work during the construction phase will be scheduled to the extent practicable to avoid period of adverse weather (e.g., heavy winds or rain) or spring tides that may increase the transport of sediment. • Duration of in-water work will be managed to the shortest time that is practical. • An Erosion and Sediment Control Plan will be developed for the site that reduces the risk of sedimentation to the marine environment. Environmental	No unmitigated interaction between the project and harbour physical environment, water quality, and sediment quality is expected to occur. *Direct, reversible.* *Direction – Adverse* *Magnitude – Low to Medium* *Geographic extent – Local* *Duration – Construction phase* *Frequency – Continuously during construction phase* *Reversibility – Reversible* *Context – Disturbed*	Not significant – Adverse

Project Activities	Potential Effects	Mitigation	Residual Effects	Significance of Residual Effects
		controls (e.g., silt curtains) will be employed as necessary to reduce sediment resuspension during construction in the intertidal/nearshore zone and marine outfall construction • Machinery used on site will arrive in a clean condition free of fluid leaks. • All construction materials will be removed from site upon completion of pipeline installation. • Visual inspection in the LAA to confirm that increases in turbidity are limited. If excessive changes in turbidity occur that differ from existing conditions of the surrounding waterbody (i.e., distinct colour difference) as a result of construction activities, an investigation will be performed to determine root cause and additional mitigation measures will be applied as needed. • Displaced substrate will be recovered to bury portions of the pipeline, wherever practical. • Routine effluents and operational discharges produced by project vessels will be managed in accordance with International Convention for the Prevention of Pollution from Ships (MARPOL) and International Marine Organization (IMO) guidelines, of which Canada has incorporated provisions under various sections of the *Canada Shipping Act*. No waste or garbage will be dumped overboard. • If gravel or rock is placed below highwater mark it will come		

Project Activities	Potential Effects	Mitigation	Residual Effects	Significance of Residual Effects
		from a clean source with less than 5% fines. • Develop a project-specific EPP prior to the commencement of construction activities that includes measures to control sediment resuspension associated with seabed disturbance.		
Operation and Maintenance				
Presence and operation of the marine pipeline and effluent outfall diffuser	Change in water quality Change in sediment quality	• Treat effluent to comply with all applicable regulatory requirements for effluent discharge. • Employ a three-port design for the effluent outfall diffuser. • Undertake effluent plume delineation study that is a component of the EEM program. • Undertake follow up and monitoring program. • Toxicity Prevention and Remediation Plan.	No unmitigated interaction between the project and harbour physical environment, water quality, and sediment quality is expected to occur. *Direct, reversible.* *Direction – Adverse* *Magnitude – Low* *Geographical extent – Local* *Duration – Permanent* *Frequency – Continuous* *Reversibility –Reversible* *Context – Disturbed*	Not significant – Adverse
Maintenance of the marine pipeline and effluent outfall diffuser	Change in water quality Change in sediment quality	• If required maintenance activities generate sedimentation and/or runoff from the shoreline, require operation of project vessels or equipment, or include seabed disturbance, implement mitigation measure identified above for pipeline trenching, installation of effluent outfall diffuser, and associated marine construction activities, including barge anchoring (as applicable). • Routinely inspect diffuser for proper functioning and maintenance.	No unmitigated interaction between the project and harbour physical environment, water quality and sediment quality is expected to occur. *Direct, reversible.* *Direction – Adverse* *Magnitude – Low* *Geographical extent – Local* *Duration – Permanent* *Frequency – N/A* *Reversibility – Reversible* *Context – Disturbed*	Not significant – Adverse

In summary, with the implementation of mitigation measures outlined in **Section 8.11.3.2**, significant adverse residual environmental effects on harbour physical environment, water quality, and sediment quality are not anticipated and the residual environmental effects of the project on the physical environment, water quality, and sediment quality during all phases of the project are rated not significant. An EEM program in the vicinity of the effluent outfall diffuser, such as that developed by EcoMetrix (2018; **Appendix G**) will improve the level of confidence in this prediction during the operation and maintenance phase. Further Follow Up and Monitoring as described in **Appendix H** will be completed. NPNS has a Toxicity Prevention and Remediation Plan that will continue to be used and updated as required for the duration of the project.

8.11.5 Follow-up and Monitoring

NPNS will conduct an EEM program in the vicinity of the effluent outfall diffuser, such as that developed by EcoMetrix (2018; **Appendix G**), in compliance with the PPER. Further Follow Up and Monitoring as described in **Appendix H** will be completed.

In addition, NPNS has had a Toxicity Prevention and Remediation Plan in place for many years that has been reviewed by ECCC to provide a structured approach for addressing treated effluent toxicity problems, should they occur.

8.12 Marine Fish and Fish Habitat

The potential effects of the project on marine fish and fish habitat (hereinafter referred to as the marine fish VEC, for brevity) are assessed in this section.

8.12.1 Scope of VEC

Marine fish was selected as a VEC in consideration of the ecological value provided to marine ecosystems, the socio-economic importance of fisheries resources, and potential interactions with the project and project activities on marine fish populations. Marine fish are protected under the federal *Fisheries Act*, which includes provisions to protect the productivity of, and prevent “serious harm” to, commercial, recreational, and Aboriginal (CRA) fisheries.

For the purposes of this assessment, the marine fish VEC includes marine plants, plankton, benthic invertebrates, and fish species with the potential to occur in the marine project area and greater Northumberland Strait.

This VEC is closely linked to the harbour physical environment, water quality and sediment quality VEC (**Section 8.11**) and the marine mammals, sea turtles, and marine birds VEC (**Section 8.13**). It is also closely linked to the commercial fisheries portion of the socio-economic environment VEC (**Section 8.14**) given the intrinsic relationship between fish and fish habitat and CRA fisheries within the Northumberland Strait. The main CRA fisheries are for lobster, sea scallop, herring and rock crab, among other lesser species fished.

Regulatory and Policy Context

The *Fisheries Act* focuses on protecting the productivity of CRA fisheries including a prohibition against causing “serious harm” to fish that are part of or support a CRA fishery (Section 35 of the *Fisheries Act*), and proponents of projects that cause serious harm to fish are required to offset that harm to maintain and enhance the productivity of the fishery. The deposition of a deleterious substance is also prohibited under Section 36(3) of the *Fisheries Act*.

Fish species at risk (SAR) are protected under the federal *Species at Risk Act* (SARA) and the Nova Scotia *Endangered Species Act* (NSESA).

The *Canadian Environmental Protection Act, 1999* (CEPA), and specifically Disposal at Sea (DAS) Regulations, also protect marine fish. These regulations stipulate that disposal in the marine environment requires a permit and that sediment be analyzed for potential contaminants.

In Canada, the discharge of wastewaters from pulp and paper mills into water frequented by fish is controlled by the *Pulp and Paper Effluent Regulations* (PPER), made under the authority of the *Fisheries Act*. These regulations aim to protect water quality that sustains fish, fish habitat, and the use of fisheries resources. The PPER set limits on the amounts of total suspended solids (TSS) and biochemical oxygen demand (BOD) and prohibit the discharge of effluents that display acute lethality to fish (ECCC 2016).

8.12.1.1 Boundaries

The spatial boundaries for the assessment of the environmental effects of the project on marine fish and fish habitat include the following:

- **Marine project footprint area (PFA):** The PFA is the area of anticipated physical disturbance associated with the project. The marine PFA (i.e., generally the PFA for the marine portion of the pipeline) consists of a corridor approximately 15 m wide and 4.1 km long that begins at the ordinary high-water mark and extends seaward into the Northumberland Strait until the pipeline terminates at the effluent outfall diffuser. This 15 m wide corridor contains the proposed 3 m wide excavated trench within which the pipe will be installed and also accounts for the temporary placement of excavated marine sediments along the length of the pipeline route, where required. The estimated total area of the marine PFA in the Northumberland Strait is approximately 6 ha.
- **Marine local assessment area (LAA):** The LAA the maximum area within which environmental effects from project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence (i.e., the potential zone of influence of project-related environmental effects). The marine LAA (i.e., generally the LAA for the marine portion of the pipeline) consists of a corridor approximately 300 m wide and 4.1 km long that begins at the ordinary high-water mark and extends seaward into the Northumberland Strait until the pipeline terminates at the effluent outfall diffuser including an area 300 m encircling the outfall. This 300 m wide corridor contains the marine PFA and also accounts for the most acute potential effects of sediment resuspension and underwater sound/vibration from physical activities in the marine PFA as well as the most acute potential effects of the effluent plume from the diffuser. The estimated total area of the marine LAA in the Northumberland Strait is approximately 126 ha.

Temporal boundaries for the assessment of environmental effects on the environment include periods of construction, operation and maintenance, and decommissioning. Construction is estimated to be approximately 21 months, beginning second quarter of 2019, commencing as soon as the EA review has been completed and the applicable permits, approvals or other forms of authorization have been obtained. Operation and maintenance will commence immediately following the construction phase and will continue to operate efficiently and safely for several decades and likely much longer with a well-maintained system. For the purpose of this EA Registration, it has been assumed that the operation and maintenance phase will begin in the fourth quarter of 2020. Decommissioning of the project would occur at the end of mill life following the completion of operations. Once the ETF or pipeline is nearing the end of a useful service life, a decommissioning plan will be developed and will be submitted for a separate review requiring NSE approval.

8.12.1.2 Significance Criteria

A significant adverse residual environmental effect on marine fish and fish habitat is one where project-related activities:

- cause a significant decline in abundance or change in distribution of a marine fish population within the Northumberland Strait such that natural recruitment may not re-establish the population to its original level within one generation;
- jeopardize the achievement of self-sustaining population objectives or recovery goals for a marine fish SAR such that the overall abundance, distribution and health of that species and its eventual recovery within the Northumberland Strait is adversely affected;
- result in permanent and irreversible loss of critical habitat as defined in a recovery plan or an action strategy under SARA for a marine fish SAR; or
- result in serious harm to fish or fish habitat as defined by the *Fisheries Act* that is unauthorized, unmitigated, or not compensated through offsetting measures in accordance with DFO's Fisheries Protection Policy Statement (DFO 2013).

8.12.2 Existing Environment

The following sections describe marine plants, plankton, invertebrates, and marine fish species with the potential to occur in the marine PFA and LAA in the Northumberland Strait. The description of existing conditions is based on the results of previous research and existing scientific literature and environmental assessments; no field work was conducted as part of this EA Registration.

8.12.2.1 *Marine Plants*

Sea grasses are found in coastal, shoreline, and intertidal areas in the Northumberland Strait, mostly in marine wetlands, salt marshes, and shallow-water eelgrass beds (AMEC 2007). The key species of sea grass in the Northumberland Strait is eelgrass, which plays an important role in stabilizing sediments, and in providing habitat and protection for a variety of marine organisms (AMEC 2007). For example, there is evidence that eelgrass beds play an important role in the spawning and rearing of white hake in the Northumberland Strait area (AMEC 2007). Eelgrass beds have been in decline over the past several years in the Northumberland Strait, and Atlantic Canada in general (Hanson 2004). An eelgrass bed in Caribou was sampled and losses of 8.7% and 23.6% were recorded in 2001 and 2002, respectively (AMEC 2007).

The most dominant seaweed in the coastal and nearshore areas of the Northumberland Strait is sea lettuce (*Ulva* sp.) (AMEC 2007). Other species in the nearshore and portions of the inshore include the kelp *Laminaria* and the red algae *Phyllophora*, while genera such as *Polyides*, *Desmarestia* and *Palmaria* occur in smaller amounts. The Northumberland Strait Ecosystem Overview Report Technical Workshop on Biota (2006) identified the following key issues with respect to marine plants in the Northumberland Strait: (1) excessive growth of some species (i.e., *Furcellaria*); (2) disappearance of kelp beds in some areas; (3) disappearance of Irish moss; (4) declining health and range of eelgrass beds; and (5) presence of anoxic areas.

During a fisheries habitat survey conducted by AMEC at Caribou Harbour in 2015 at a proposed disposal at sea site for dredged sediments, most areas had macrofloral life that consisted of a mix of false Irish moss and bladderwrack (AMEC 2015). Other less common species included red algae and eelgrass (AMEC 2015). Macroflora, in general, was sporadic with coverage ranging between 5% to 25% on the substrate; in some areas where cobble and rock comprised a larger percentage of the substrate, algal cover was as high as 80% (AMEC 2015). There was minimal eelgrass coverage with no observations of coverage over 10%.

8.12.2.2 *Plankton*

In terms of phytoplankton, the Northumberland Strait is a region of high primary productivity during the summer, but relatively low productivity during the winter (AMEC 2007).

According to AMEC (2007), the most complete recent identification of phytoplankton species in the Northumberland Strait was conducted on a representative sampling of 14 water samples taken during the plankton component of a marine environmental effects monitoring (MEEM) study conducted in 1993 (JWEL 1994). The samples were found to be rich in diatoms, a common group of marine phytoplankton (JWEL 1994). The Shannon-Weiner Index (H) analysis is a diversity measure that considers the number of species and the relative frequency of each species. H values for 13 of the 14 samples were between 2.0 to 2.7, which is indicative of a rich species diversity (JWEL 1994). According to AMEC (2007), phytoplankton studies in other areas of the Northumberland Strait are very limited.

There have been limited studies on the estuarial and nearshore plankton communities of the Northumberland Strait. Much of the available information on zooplankton in the Strait comes from a study related to the Confederation Bridge project. Hurley Fisheries Consulting Ltd. (1989) describe samples taken in the summer of 1988 that show a dominance of calanoid copepod, mostly medium-sized, warm water, and coastal species such as *Oithona*, *Acartia*, *Temora*, and to a lesser extent *Eurytemora* and *Pseudocalanus*.

8.12.2.3 *Benthic Invertebrates*

Benthic infauna in the Northumberland Strait has been described by Hurley (1989) as well as the MEEM study reports from 1993-1995 by JWEL (1993, 1994, 1995). Shannon-Weiner diversity indices for benthic fauna in those reports indicate that fauna were generally diverse. **Table 8.12-1** provides a summary of infauna in MEEM samples from 1993-1995 taken from AMEC (2007).

Table 8.12-1: Summary of Benthic Infauna in MEEM Samples from 1993 to 1995

Taxa	Comments
Polychaetes	Most common group, 54 genera and/or species identified
Other Vermiformes	Nematodes were abundant and present in most samples

Taxa	Comments
Crustaceans	13 species including amphipods, copepods and *Gammarus* sp.
Marine Spiders	Three unspecified Pycnogonid species
Molluscs	Common, particularly *Tellina* sp.; two unspecified nudibranch species also present
Echinoderms	Observed occasionally
Source: JWEL (1993), (1994), (1995); AMEC (2007).	

Epifauna identified in Ecological Overview Assessment Reports (EOAR) for the Shediac Bay, Bedeque Bay, Richibucto, and Baie Verte watersheds (LeBlanc and Turcotte-Lanteigne 2006, Turcotte-Lanteigne and Ferguson 2006) are listed below in **Table 8.12-2**. The nearshore epifauna of these areas are likely typical of what would be found throughout nearshore regions of Northumberland Strait (AMEC 2007).

Table 8.12-2: Epifauna Occurring in the Shediac Bay, Bedeque Bay, Richibucto, and Baie Verte Watersheds

Common Name	Scientific Name
Molluscs	
Razor clam	*Ensis directus*
Bar clam	*Spisula solidissima*
American oyster	*Crassostrea viriginica*
Softshell clam	*Mya arenaria*
Northern quahog	*Mercenaria mercenaria*
Blue mussel	*Mytilus edulis*
Creeper	*Stophitus undulates*
Gastropods	
Moon snail	*Lunatia* sp.
Channelled barrel-bubble	*Retusa canaliculata*
Crustaceans	
Grass shrimp	*Palaemonetes vulgaris*
Sand shrimp	*Crangon septemspinosa*
Rock crab	*Cancer irroratus*
Mud crab	*Neopanopeus sayi*
Lobster	*Homarus americanus*
Sponges	
Mermaid’s glove	*Haliclona oculata*

Common Name	Scientific Name
Boring sponge	*Cliona* spp.
Echinoderms	
Northern sea star	*Asterias vulgaris*
Sand dollar	*Echinarachnius parma*
Sources: LeBlanc and Turcotte-Lanteigne (2006), Turcotte-Lanteigne and Ferguson (2006), AMEC (2007).	

Hurley Fisheries Consulting Ltd. (1989) described the distribution and relative abundance of epifauna in the Abegweit Passage area based on scallop drag samples and underwater video, which are summarized in **Table 8.12-3**.

Table 8.12-3: Epifauna of the Abegweit Passage Area of the Northumberland Strait

Group	Species	Comments
Sand dollars	*Echinarchnius parma*	Highly abundant, distribution highly clumped and patchy
Starfish	*Asterias* sp., *Henricia snaguinolenta*	Common
Horse mussels	*Modiolus modiolus*	Two dense beds observed off Borden and Cape Tormentine, cobble and sand bottom at 10-15 m depth
Slipper limpets	*Crepidula* sp.	On dispersed rocks in sand close to New Brunswick coast
Rock crab	*Cancer irroratus*	Not associated with bottom type, common at depths greater than 15 m
Clams	*Astarte* sp.	Common
Sources: Hurley Fisheries Consulting Ltd. (1989); AMEC (2007).		

The results of September trawls in the eastern and western sections of the Northumberland Strait from 1971 to 2002 are described in Benoit et al. (2013). Taxa that were identified in at least one trawl season and location are provided in **Table 8.12-4**.

Table 8.12-4: Epifauna Collected During September Trawl in the West and East Sectors of Northumberland Strait

Taxa	West End	East End
Decapod shrimp	–	X
Pandalid shrimp	–	X
Atlantic rock crab	X	X

Taxa	West End	East End
Toad crab (*Hyas* sp.)	X	X
Lobster	X	X
Gastropods	X	X
Whelk (*Buccinum* sp.)	–	X
Bivalve molluscs	X	X
Cockles (Cardiidae)	–	X
Scallops (Pectinidae)	X	X
Sea scallop (*Placopecten magellenicus*)	X	X
Iceland scallop (*Chlamys islandicus*)	–	X
Mussels (Mytillidae)	–	X
Echinoderms	X	X
Starfish	X	X
Sunstar (*Solaster sp.*)	X	X
Mud star (*Ctenodiscus crispatus*)	–	X
Sea urchin (*Strongylocentrotus* sp.)	–	X
Sand dollar	X	X
Sea anemone	–	X
Large jellyfish (Scyphozoa)	–	X
Sponges (Porifera)	X	X

Notes:

X = Recorded in trawl catch.

– = Not recorded in trawl catch.

Sources: Benoit et al. (2003); AMEC (2007).

AMEC (2015) describes the macrofauna observed during a fisheries habitat survey at Caribou at a proposed DAS site. Species observed in most sections of the transects included Stimpson's whelk, periwinkle, sea scallop, and sand dollar. Species noted to a lesser extent included rock crab, northern moon snail, and bread crumb sponge. Species observed with an uncommon frequency included American lobster, soft shell clam, sea star, and eyed finger sponge (AMEC 2015).

As part of a marine sediment sampling program, AMEC (2015) collected underwater video in Caribou Harbour. Stills taken from these videos at the mouth of Caribou Harbour show a predominantly sandy substrate devoid of macrofloral and macrofaunal life (**Figure 8.12-1**). Stills from video taken near the Caribou ferry terminal berth show a substrate that is a mix of rock and gravel, with rock crab and northern rock barnacles (**Figure 8.12-2**).

Source: AMEC (2015)

Figure 8.12-1: Predominantly Sandy Substrate Devoid of Macrofauna and Macroflora Near Mouth of Caribou Harbour

Source: AMEC (2015)

Figure 8.12-2: Rock and Gravel Substrate with Rock Crab and Northern Rock Barnacles Near Caribou Ferry Terminal Berth

8.12.2.4 *Marine Fish*

The marine fish and fish habitat VEC considers secure species as well as species at risk (SAR) and species of conservation concern (SOCC).

For this VEC, SAR species include:

- Species listed as vulnerable, threatened, or endangered on the Categorized List of Species at Risk under the Nova Scotia *Endangered Species Act* (NSESA); and
- Species listed as endangered, threatened, or special concern on Schedule 1 of the federal *Species at Risk Act* (SARA).

SOCC species include:

- Species designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as endangered, threatened, or special concern, but not yet listed under Schedule 1 of SARA.

Secure marine fish species with potential to occur in the marine PFA and LAA are listed in **Table 8.12-5**. SAR and SOCC with potential to occur in the marine PFA and LAA and their listings under SARA, the NSESA and by COSEWIC are provided in **Table 8.12-6**, with a brief description of occurrence, life histories and threats faced by these species provided further below.

Table 8.12-5: Marine Fish Species with the Potential to Occur in Eastern Northumberland Strait

Common Name	Scientific Name	Occurrence
Alligatorfish	*Aspidophoroides monopterygius*	Demersal
Arctic rockling	*Gaidropsarus argentatus*	Demersal
Atlantic halibut	*Hippoglossus hippoglossus*	Demersal
Atlantic herring	*Clupea harengus*	Pelagic
Atlantic mackerel	*Scomber scombrus*	Pelagic
Atlantic silverside	*Menidia menidia*	Coastal
Atlantic tomcod	*Microgadus tomcod*	Demersal
Banded killifish	*Fundulus diaphanous*	Coastal
Blackspotted stickleback	*Gasterosteus wheatlandi*	Coastal
Brook trout	*Salvelinus fontinalis*	Coastal
Butterfish	*Peprilus tricanthus*	Demersal
Capelin	*Mallotus villosus*	Pelagic
Common oceanpout	*Zoarces americanus*	Demersal
Cunner	*Tautogolabrus adspersus*	Coastal
Eelpout	*Lycodes* sp.	Demersal
Fourbeard rockling	*Enchelyopus cimbrius*	Demersal
Fourline snakeblenny	*Eumesogrammus praecisus*	Demersal
Fourspine stickleback	*Apeltes quadracus*	Coastal

Common Name	Scientific Name	Occurrence
Gaspereau/Alewife	*Alosa pseudoharengus*	Pelagic
Greenland cod	*Gadus ogac*	Demersal
Greenland halibut	*Reinhardtius hippoglossoides*	Demersal
Longhorn sculpin	*Myoxocephalus octodecemspinsosus*	Demersal
Mailed sculpin	*Triglops murrayi*	Demersal
Mummichog	*Fundulus heteroclitus*	Pelagic
Northern sand lance	*Ammodytes dubius*	Demersal
Ninespine stickleback	*Pungitius pungitius*	Coastal
Northern pipefish	*Syngnathus fuscus*	Coastal
Rainbow smelt	*Osmerus mordax*	Coastal
Rainbow trout	*Salmo gairdneri*	Coastal
Sand lance	*Ammodytes americanus*	Demersal
Sea raven	*Hemitripterus americanus*	Demersal
Shorthorn sculpin	*Myoxocephalus scorpius*	Demersal
Silver hake	*Merluccius bilinearis*	Demersal
Snakeblenny	*Lumpenus lampretaeformis*	Demersal
Threespine stickleback	*Gasterosteus aculeatus*	Coastal
Windowpane	*Scophthalmus aquosus*	Demersal
Winter flounder	*Pseudopleuronectes americanus*	Demersal
Winter skate*	*Leucoraja ocellata*	Demersal
Wrymouth	*Cryptacanthodes maculatus*	Demersal
Yellowtail flounder	*Limanda ferruginea*	Demersal

*Southern Gulf of St. Lawrence population is secure
Sources: Benoit et al. (2003); AMEC (2007).

The Northumberland Strait is a known migration corridor for many species (Rondeau et al. 2016). American eel, alewife, butterfish, and spiny dogfish are all thought to migrate along the coasts in the Northumberland Strait to western Cape Breton (Rondeau et al. 2016), and a similar migration pattern in and out of the southern Gulf of St. Lawrence is used by Atlantic cod (Hanson 1996; Campana et al. 1999; Comeau et al. 2001).

8.12.2.5 *Commercially Important Species*

Commercially important species with potential to occur in the Marine LAA include rock crab, lobster, sea scallop, herring, mackerel, and tuna. Marine fish species that are targeted as CRA fisheries occur in the project area. The main CRA fisheries are for lobster, rock crab, herring, and scallop (AMEC 2007). Within Caribou Harbour there are four active aquaculture licenses for American oyster. NPNS has attempted to engage commercial and PLFN fish harvesters to obtain fisheries data in the area of the marine outfall, but there was little interest from the fish harvesters to participate or provide any data (see **Section 6** Public, Regulatory and Indigenous Engagement). Therefore, the Study Team only has access to coarse-scale fisheries catch data available from DFO and other historical information to identify commercial fisheries species and their habitats in the vicinity of the project. Data sets released from DFO are screened to comply with the Government of Canada's privacy policy to protect the identity or activity of individual vessels or companies. DFO conducts privacy assessments on all map layers to identify Northwest Atlantic Fisheries Organization (NAFO) unit areas containing data from less than five vessel IDs, license IDs, and fisher IDs; this is the threshold below which data is privacy-screened (i.e., the "rule of five"). The data that are publicly available from DFO omit confidential information (e.g., catch weight and fishing effort locations) for privacy-screened fisheries within these NAFO unit areas (Butler and Coffen-Smout 2017). As a result, for some marine fish species such as bluefin tuna, it is known that fishing occurs in the Northumberland Strait but DFO cannot provide information on catch weights in specific areas, for example. The data source for the distribution of fisheries species based on historical information was obtained from the Gulf of St. Lawrence Traditional Knowledge Mapping Series for DFO (J. Lee MacNeil and Associates 1998 in JWEL 2001)

While the majority of the commercial fishery for rock crab occurs in the central and western portions of the Northumberland Strait, there are areas in the eastern portion where rock crab is harvested, including Caribou Harbour where there is overlap with the proposed marine route of the effluent pipeline (**Figure 8.12-3**).

Lobster is caught throughout the central and eastern portions of the Northumberland Strait and there is overlap with the proposed route of the effluent pipeline and the location of the marine outfall (**Figure 8.12-4**).

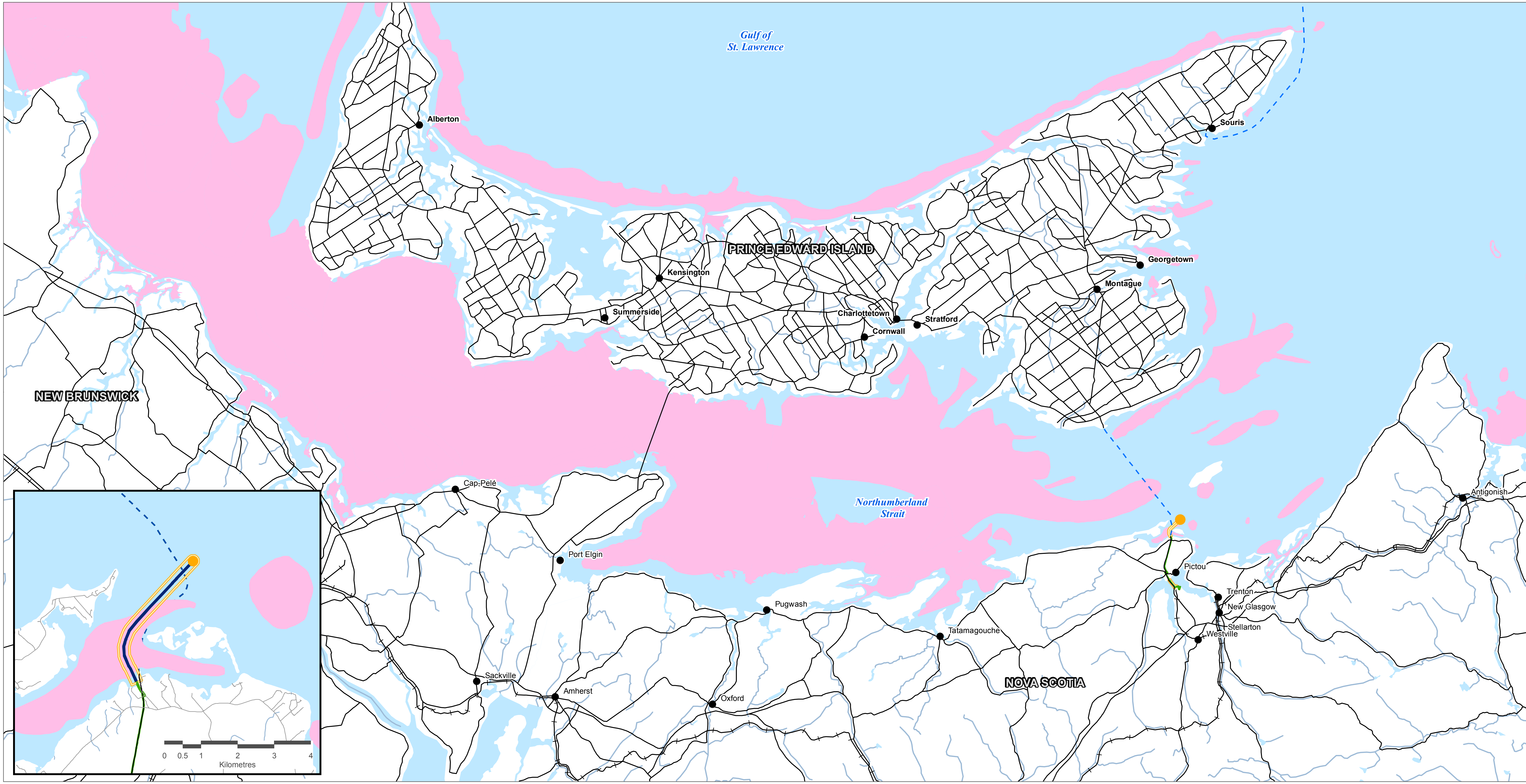
Figure 8.12-5 presents scallop catch weights from 2010-2014 in the Northumberland Strait where there is an overlap of the route of the pipeline and at the outfall location. Since 2014, a Scallop Buffer Zone in Scallop Fishing Area (SFA) 24, discussed further in **Section 8.12.2.7**, prevents scallop fishing in this area, except potentially at the location of the outfall.

Herring is caught along the shoreline of New Brunswick and Nova Scotia in the Northumberland Strait, including the Pictou area (**Figure 8.12-6**). There may be overlap with herring fishing and the location of the marine outfall. Concern has also been raised about the effects of the marine effluent pipeline on herring spawning as well as juvenile lobster (PEI Standing Committee on Agriculture and Fisheries 2018);

however, the main fisheries in the LAA are for scallop and rock crab. Nevertheless, herring stocks are currently of concern to DFO, and attempts are being made to manage this fishery to avoid becoming at risk in the area (PEI Standing Committee on Agriculture and Fisheries 2018). Herring spawn between August and October in the southern Gulf of St. Lawrence and DFO has identified fall spawning grounds for herring in the eastern Northumberland Strait (DFO 2018) (**Figure 8.12-7**).

Mackerel is also caught along the coast near the LAA, although most fishing occurs in the central and western portions of the Northumberland Strait (**Figure 8.12-8**).

Fishing for tuna occurs primarily on the north coast of PEI and southwest Cape Breton (**Figure 8.12-9**). Fishing for bluefin tuna occurs in the eastern Northumberland Strait (**Figure 8.12-7**), but it is not known if fishing activities occur in the same areas as the proposed marine route of the effluent pipeline or at the location of the marine outfall, based on privacy screening policies (Butler and Coffen-Smout 2017).



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Rock Crab Fishing in the Northumberland Strait
Figure 8.12-3

NORTHERN PULP
NOVA SCOTIA CORPORATION
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Outfall Diffuser Location
Rock Crab Fishing Resource [1]
Marine Local Assessment Area
Marine Project Footprint Area*
Terrestrial Project Footprint Area*

DILLON CONSULTING

MAP CREATED BY: HW
MAP CHECKED BY: SS
MAP PROJECTION: NAD 1983 UTM Zone 20N

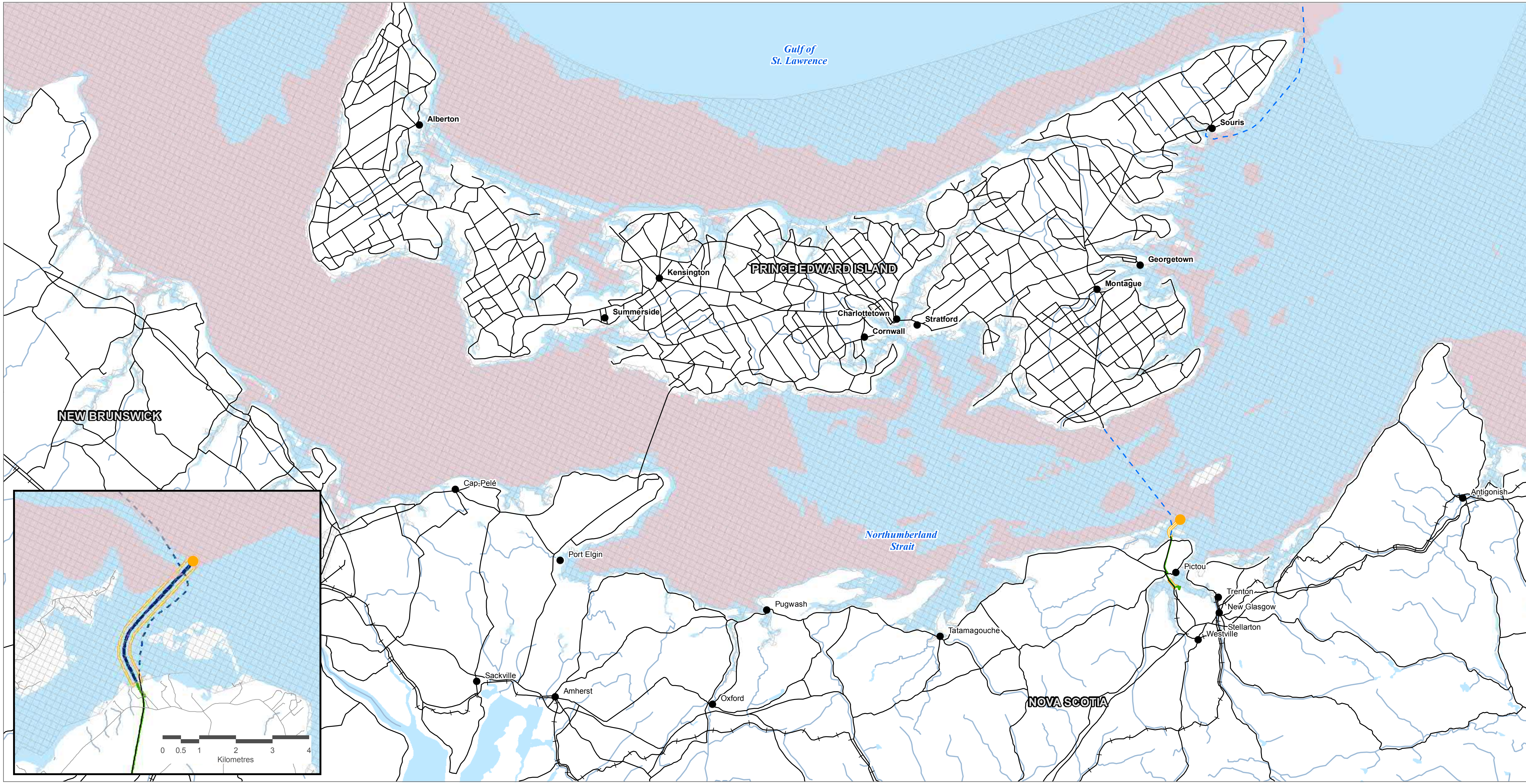
0 2.5 5 10 15 20
Kilometres

*Precise Project Footprint to be determined following completion of detailed design

Sources:
[1] JWEL (2001)

PROJECT: 17-6461

Date: 1/24/2019



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Environmental Assessment

Lobster Fishing and Distribution in the Northumberland Strait

Figure 8.12-4

NORTHERN PULP
NOVA SCOTIA CORPORATION
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Outfall Diffuser Location

Lobster Distribution [1]

Lobster Fishing Resource [1]

Marine Local Assessment Area

Marine Project Footprint Area*

Terrestrial Project Footprint Area*

DILLON CONSULTING

MAP CREATED BY: HW
MAP CHECKED BY: SS
MAP PROJECTION: NAD 1983 UTM Zone 20N

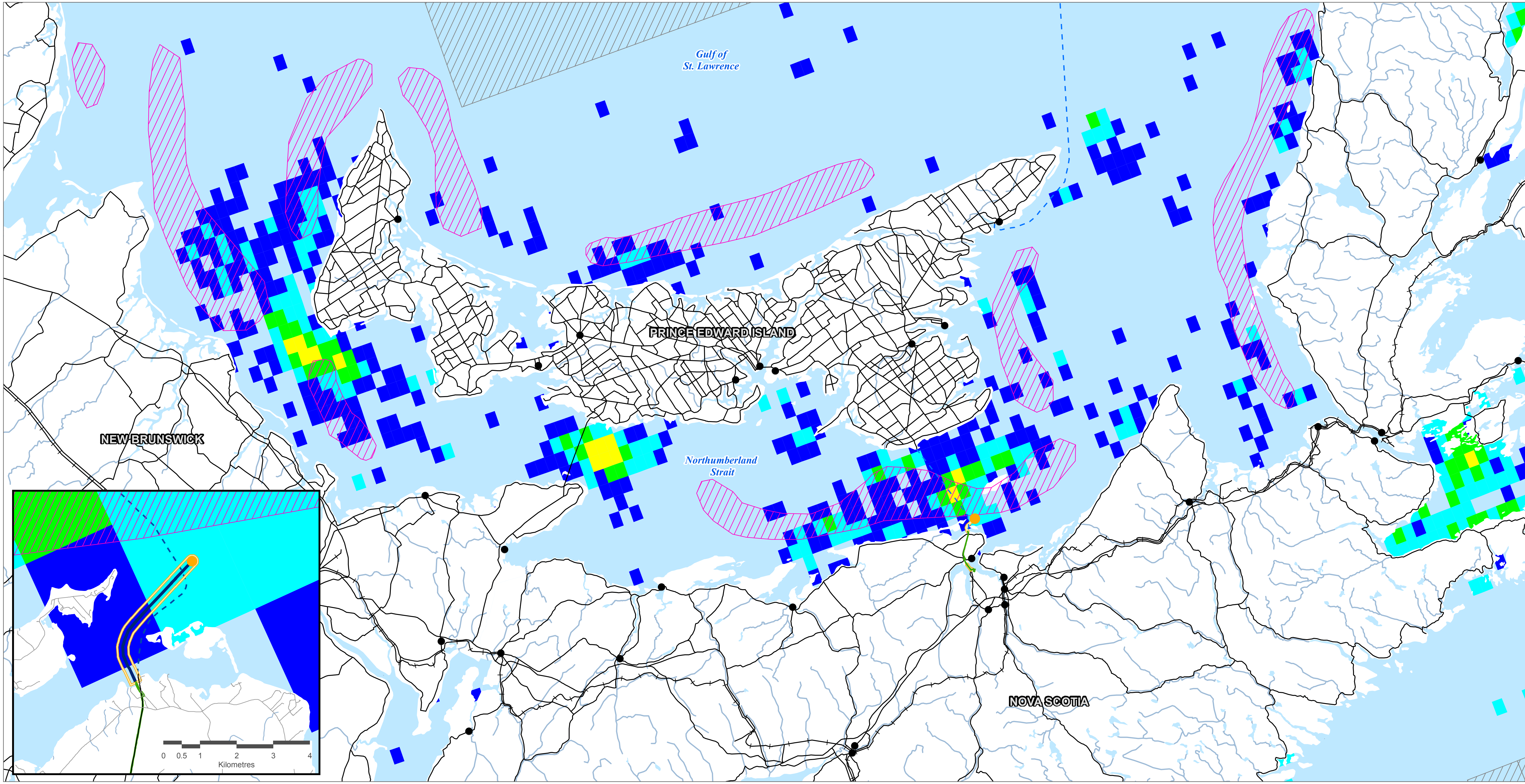
0 2.5 5 10 15 20
Kilometres

*Precise Project Footprint to be determined following completion of detailed design

Sources:
[1] JWEL (2001)

PROJECT: 17-6461

Date: 1/24/2019



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Scallop Catch Weight 2010-2014
and Distribution in the Northumberland Strait
Figure 8.12-5

NORTHERN PULP
NOVA SCOTIA CORPORATION
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DILLON
CONSULTING

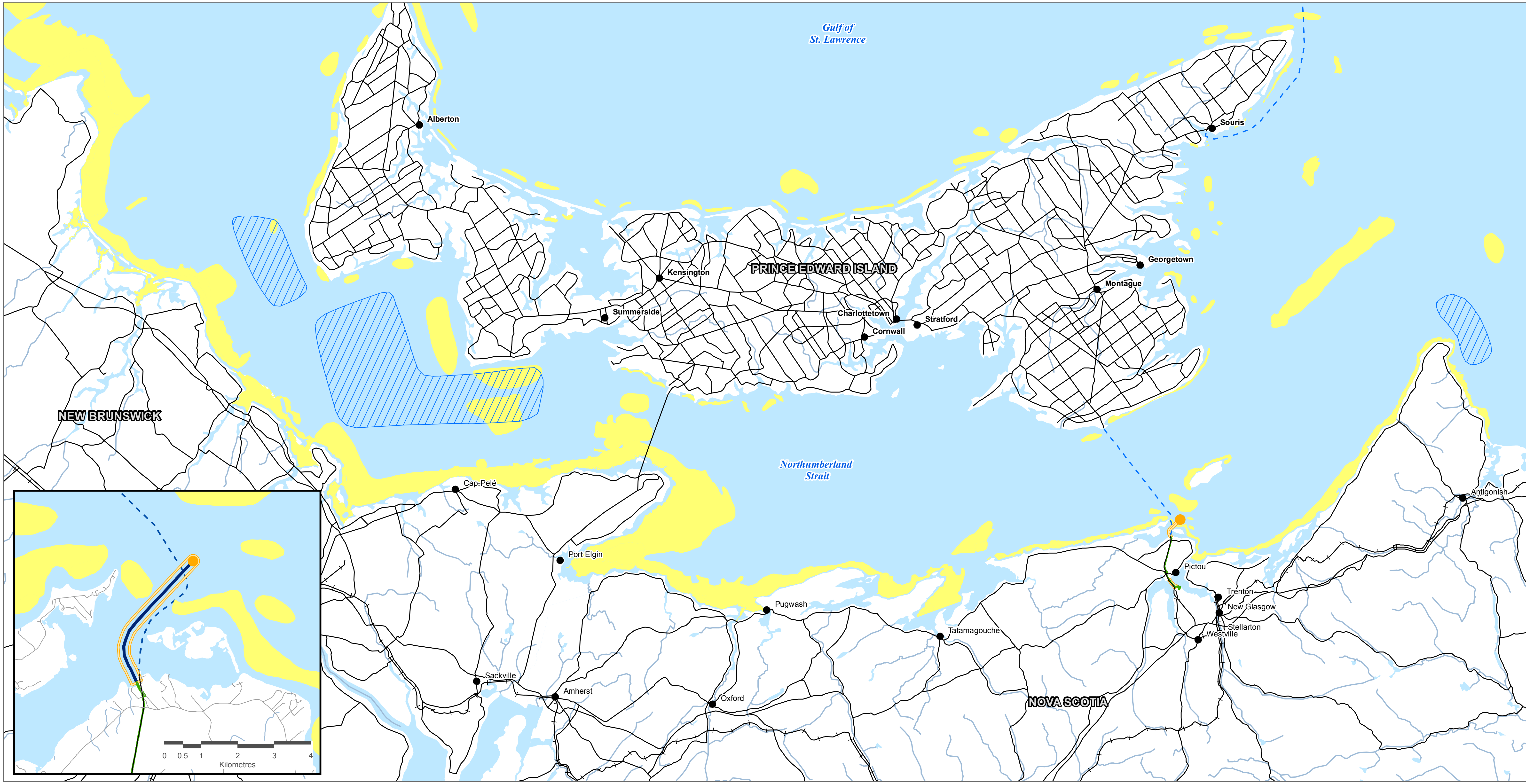
MAP CREATED BY: HW
MAP CHECKED BY: SS
MAP PROJECTION: NAD 1983 UTM Zone 20N

*Precise Project Footprint to be determined following completion of detailed design

Sources:
[1] Butler, S. and S. Coffen-Smout (2017)
[2] JWEL (2001)

PROJECT: 17-6461

Date: 1/24/2019



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Environmental Assessment

Herring Fishing and Nursing Areas in the Northumberland Strait
Figure 8.12-6

Outfall Diffuser Location
Herring Fishing Resource [1]
Herring Nursery Area [1]
Marine Local Assessment Area
Marine Project Footprint Area*
Terrestrial Project Footprint Area*

MAP CREATED BY: HW
MAP CHECKED BY: SS
MAP PROJECTION: NAD 1983 UTM Zone 20N

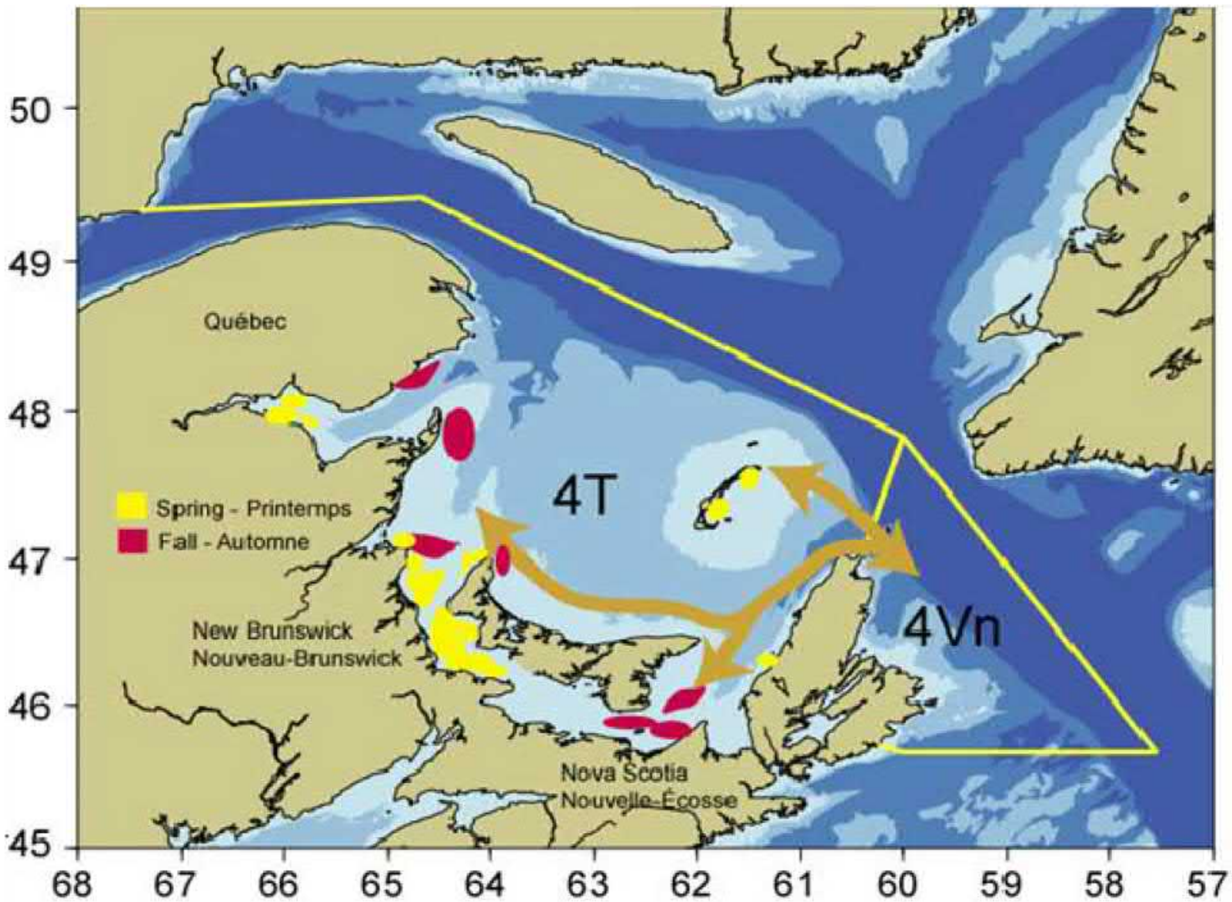
0 2.5 5 10 15 20
Kilometres

*Precise Project Footprint to be determined following completion of detailed design

Sources:
[1] JWEL (2001)

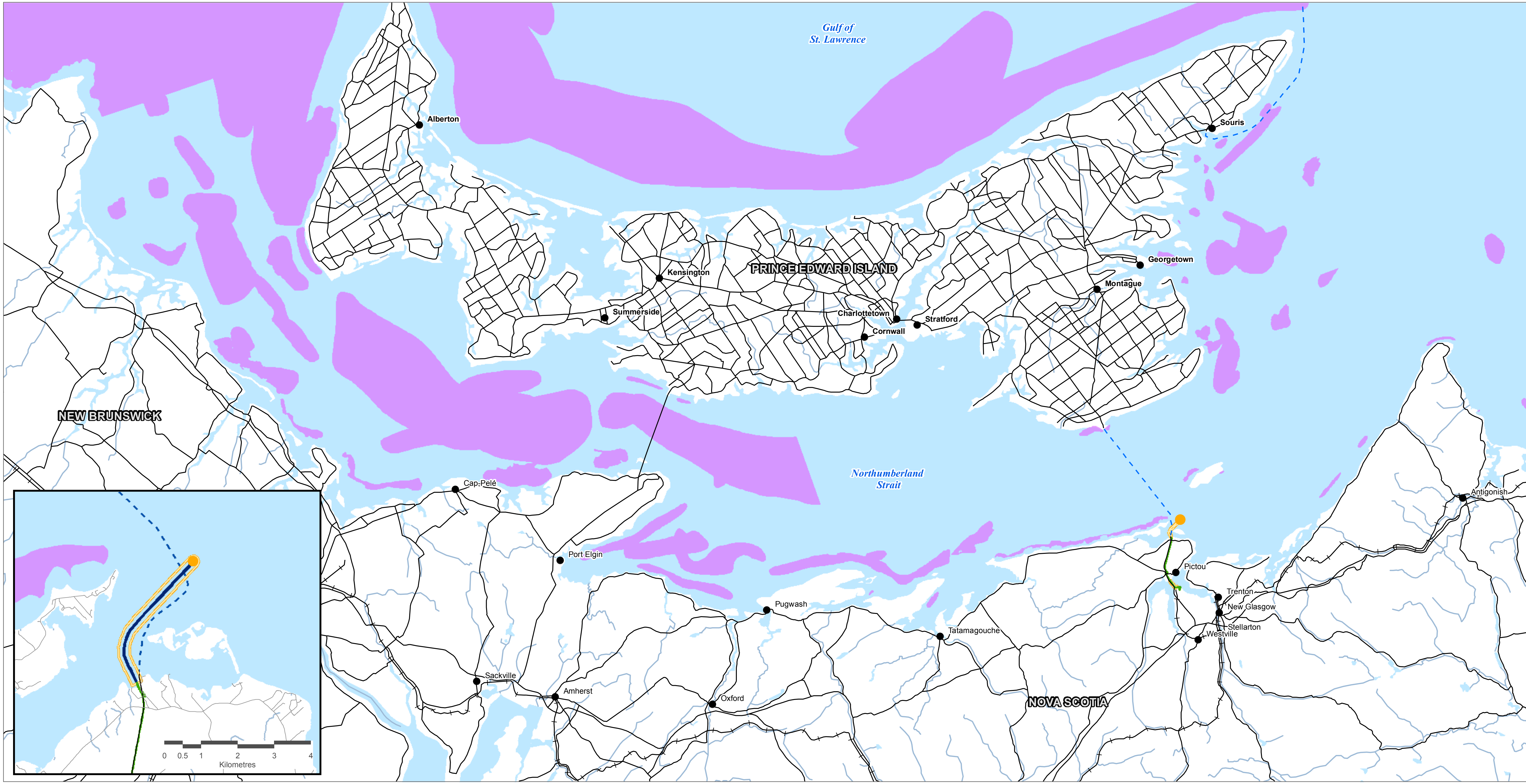
PROJECT: 17-6461

Date: 1/24/2019



Source: DFO (2018)

Figure 8.12-7: Principal Spring and Fall Herring Spawning Grounds in the Southern Gulf of St. Lawrence



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Mackerel Fishing in the Northumberland Strait
Figure 8.12-8

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Outfall Diffuser Location
Mackerel Fishing Resource [1]
Marine Local Assessment Area
Marine Project Footprint Area*
Terrestrial Project Footprint Area*

DILLON CONSULTING

MAP CREATED BY: HW
MAP CHECKED BY: SS
MAP PROJECTION: NAD 1983 UTM Zone 20N

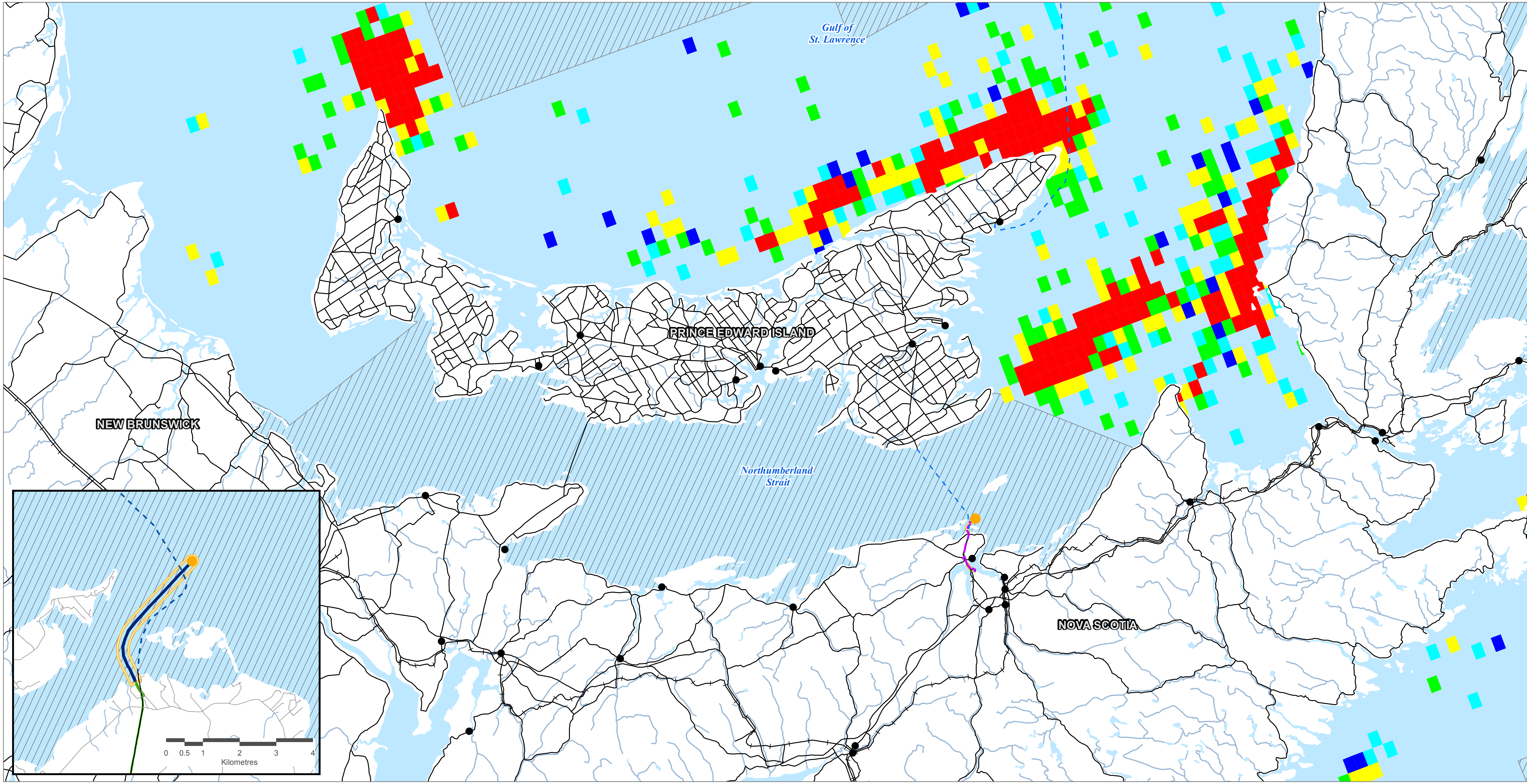
0 2.5 5 10 15 20
Kilometres

*Precise Project Footprint to be determined following completion of detailed design

Sources:
[1] JWEL (2001)

PROJECT: 17-6461

Date: 1/24/2019



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Bluefin Tuna Catch Weight 2010-2014 in the Northumberland Strait

Figure 8.12-9

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Outfall Diffuser Location

Bluefin Tuna, 2010-2014, Screened [1]

- 52 - 158
- 158 - 238
- 238 - 365
- 365 - 781
- 781 - 51,855

Privacy Screened Area

Marine Local Assessment Area

Marine Project Footprint Area*

Terrestrial Project Footprint Area*

DILLON
CONSULTING

MAP CREATED BY: HW
MAP CHECKED BY: SS
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 5 10 20 30 40
Kilometres

*Precise Project Footprint to be determined following completion of detailed design

Sources:
[1] Butler, S. and S. Coffen-Smout (2017)

PROJECT: 17-6461

Date: 1/24/2019

8.12.2.6 Species at Risk and Species of Conservation Concern

There are no known marine fish SAR with potential to occur in the LAA that are listed under SARA or the NSESA; however, there are ten species of SOCC listed by COSEWIC with potential to occur (**Table 8.12-6**). General occurrence, life histories, and threats to these species are described below.

Table 8.12-6: Marine Fish Species at Risk and Species of Conservation Concern with Potential to Occur in the LAA

Common Name	Scientific Name	NSESA Status	SARA Schedule 1 Status	COSEWIC Status
American eel	*Anguilla rostrata*	No Status	No Status	Threatened
American plaice (Maritime population)	*Hippoglossoides platessoides*	No Status	No Status	Threatened
Atlantic bluefin tuna	*Thunnus thynnus*	No Status	No Status	Endangered
Atlantic cod (Laurentian South population)	*Gadus morhua*	No Status	No Status	Endangered
Atlantic salmon (Gaspé-Southern Gulf of St. Lawrence population)	*Salmo salar*	No Status	No Status	Special Concern
Lumpfish	*Cyclopterus lumpus*	No Status	No Status	Threatened
Porbeagle	*Lamna nasus*	No Status	No Status	Endangered
Spiny dogfish (Atlantic population)	*Squalus acanthias*	No Status	No Status	Special Concern
Striped bass (Southern Gulf of St. Lawrence population)	*Morone saxatilis*	No Status	No Status	Special Concern
White hake (Southern Gulf of St. Lawrence population)	*Urophycis tenuis*	No Status	No Status	Endangered

American Eel

American eel is a migratory species that is widely distributed in freshwater habitat, estuaries, and coastal marine waters of the Northwest Atlantic coastline and is found from the Caribbean Sea north to Greenland and Iceland (COSEWIC 2012a). American eel occurs in the Northumberland Strait, including the eastern portion of the Strait where most landings were reported during the summer months (JWEL 2001).

American eel spawn in the Sargasso Sea once in their lives and eggs hatch roughly within one week; hatching occurs from March to October with a peak in August (COSEWIC 2012a). Larvae drift passively and are widely dispersed by the surface currents of the Gulf Stream (COSEWIC 2012a).

After approximately 7 to 12 months, larvae enter the Continental Shelf area and become glass eels taking on an eel shape while remaining transparent (COSEWIC 2012a). As glass eels migrate towards freshwater coastal streams they are known as elvers and will run into the freshwater streams (COSEWIC 2012a). Elvers eventually transform into yellow eels that spend years maturing in freshwater streams and coastal areas before making a major transformation and returning to the Sargasso Sea to spawn (COSEWIC 2012a).

Barriers erected in freshwater watercourses have severely impeded the upstream migrations of juvenile eels if no fish passage is possible (COSEWIC 2012a). The turbines of hydroelectric dams also cause substantial mortality as maturing fish migrate downstream (COSEWIC 2012a). Other threats to this species include bycatch in fisheries, bioaccumulation of contaminants, a swim bladder nematode parasite, and climate change and shifting oceanographic conditions (COSEWIC 2012a).

American Plaice

American plaice is a bottom-dwelling flatfish whose range in the Northwest Atlantic is from the deep waters off Baffin Island and western Hudson Bay in the north, to the Gulf of Maine and Rhode Island to the south (Scott and Scott 1988). American plaice occur in the Northumberland Strait, where it has been determined that the highest probability of capturing this species is in the eastern portion of the Strait (Rondeau et al. 2016).

American plaice are tolerant of a wide range of salinities and have been observed in estuaries (Scott and Scott 1988). American plaice are typically found at depths ranging from 90-250 m but have been found as deep as 713 m and prefer water temperatures between 0 to 1.5 °C (Scott and Scott 1988).

American plaice spawn during the spring and females release between 250,000 and 300,000 eggs on the seabed (Johnson 2004). Once fertilized, eggs are buoyant and drift into the upper water column where they are widely dispersed (Johnson 2004). Hatching time is temperature dependent and occurs between 11-14 days at temperatures of approximately 5 °C (Scott and Scott 1988). Larvae are 4-6 mm in length when they hatch and begin to settle on the seabed when they reach 13-34 mm in length (Fahay 1983).

Larval plaice feed on phytoplankton and zooplankton while in the upper water column, and once settled on the seafloor, their diet changes as they grow (Pitt 1989). Small plaice feed on crustaceans and small echinoderms and adult plaice generally consume large quantities of smaller fish (Pitt 1973) with feeding intensity highest during the spring and summer (Zamarro 1992).

The major cause of decline in American plaice is overfishing; however, there may be other contributing factors such as increased mortality from a period of unusually cold ocean temperatures in the 1990s (COSEWIC 2009).

Atlantic Bluefin Tuna

In the western Atlantic Ocean, Atlantic bluefin tuna occur from Newfoundland south to the Caribbean Sea and coastal waters of Venezuela and Brazil (COSEWIC 2011). Atlantic bluefin tuna are seasonal migrants to Canadian waters where they are fished from July through September over the Scotian Shelf, the Gulf of St. Lawrence, the Bay of Fundy, and off Newfoundland; however, they may remain in Canadian waters until December (COSEWIC 2011). Bluefin tuna occur in the Northumberland Strait (see **Figure 8.12-7**).

Atlantic bluefin tuna are a pelagic species that typically occupy waters up to 200 m in depth, though they can dive to depths of up 1,000 m and can tolerate a wide range of temperatures (3-30 °C) due to their ability to regulate their own body temperature (COSEWIC 2011).

Bluefin tuna typically feed on herring, mackerel, capelin, silver hake, white hake, and squid, but may also feed on jellyfish, salps, and other demersal and pelagic fish species (COSEWIC 2011).

In the Northwest Atlantic, spawning takes place in the Gulf of Mexico where females produce up to ten million eggs per year (COSEWIC 2011). These eggs are fertilized in the water column by males and may hatch as early as two days after spawning (COSEWIC 2011).

Historical and present-day overfishing remains the single largest threat to the Northwest Atlantic population on Atlantic bluefin tuna (COSEWIC 2011).

Atlantic Cod

In Atlantic Canada, Atlantic cod are found contiguously along the east coast from Georges Bank and the Bay of Fundy in the south, northward along the Scotian Shelf, throughout the Gulf of St. Lawrence, around Newfoundland and as far north as the eastern shores of Labrador and Baffin Island (COSEWIC 2010a). In the Northumberland Strait, the predicted probability of capturing Atlantic cod is highest in the eastern portion of the Strait (Rondeau et al. 2016).

Atlantic cod are generally found in water temperatures ranging from 2-11 °C (COSEWIC 2010a). In general, prey availability and temperature are the primary factors in determining habitat selection for cod (COSEWIC 2010a).

Atlantic cod have been observed to spawn at all times of the year in both offshore and inshore waters depending on the location, though peak spawning occurs in spring (COSEWIC 2010a). Eggs and larvae are pelagic and float on the surface, drifting with the oceanographic conditions at the time of spawning (COSEWIC 2010a).

Current threats to Atlantic cod include ongoing exploitation through directed commercial fisheries, recreational fisheries, and bycatch in fisheries for other groundfish (COSEWIC 2010a).

Atlantic Salmon

Atlantic salmon are anadromous fish whose life history begins in freshwater and may involve extensive migrations through freshwater and marine environments before returning to freshwater to spawn (COSEWIC 2010b).

In North America, the range for this species is from the Hudson River in the south to the outer Ungava Bay and eastern Hudson Bay in the north (COSEWIC 2010b). The Canadian range of Atlantic salmon is approximately one-third of the total global range (COSEWIC 2010b). Recent estimates suggest that there are at least 700 rivers in Canada which currently or previously supported Atlantic salmon populations (COSEWIC 2010b). Atlantic salmon return annually to their native river or tributary for spawning, and this species shows a high degree of site fidelity, despite completing ocean scale migrations (COSEWIC 2010b). There are three salmon rivers that flow into Pictou Harbour (JWEL 2001), none of which will be crossed by the marine route of the effluent pipeline.

While at sea, adult salmon spend a considerable amount of time in the upper portion of the water column, which has been supported by tagging studies (Reddin et al. 2006). These tagging studies showed that while Atlantic salmon spend most of their time near the surface, they also undergo deep dives, likely in search of prey (Reddin et al. 2006).

Adults at sea feed on euphausiids, amphipods, and smaller fish such as herring, capelin, small mackerel, sand lance, and small cod; salmon do not eat when they return to freshwater to spawn (Scott and Scott 1988). Atlantic salmon are known to be prey for seals, sharks, pollock and tuna (Scott and Scott 1988).

Salmon populations in Atlantic Canada, through tagging studies, have been shown to migrate up the coast of Labrador to Greenland or the Labrador Sea to overwinter (Lacroix et al. 2013).

Threats to Atlantic salmon include climate change, changes to ocean ecosystems, fishing (commercial, subsistence, recreational and illegal), dams and other obstructions in freshwater, agriculture, urbanization, acidification, aquaculture, and invasive species (COSEWIC 2010b).

Lumpfish

In the Northwest Atlantic, lumpfish range from Greenland south to Chesapeake Bay (Simpson et al. 2016). Lumpfish occur in the Northumberland Strait, though it has been determined they have a low probability of capture in the area (Rondeau et al. 2016).

Lumpfish are a benthic species found on rocky substrates at depths between 50-150 m but are occasionally found as deep as 400 m; this species prefers water temperatures of approximately 4 °C (Simpson et al. 2016). Lumpfish feed on a wide variety of pelagic and benthic prey including fish eggs and larvae, ctenophores, amphipods, copepods, euphausiids, mysids, small fish, polychaetes and molluscs (Simpson et al. 2016).

Lumpfish undergo a coastal migration to spawn in the months of May and June and males arrive at the spawning grounds several weeks in advance of the females in order to establish their territories (DFO 2006). Females lay two to three egg masses containing between 100,000 and 130,000 eggs at intervals ranging from 8-14 days, and once the eggs are deposited, females migrate back to deeper water, leaving the males to guard and fan the egg masses (DFO 2002, 2006). Juveniles remain in the top metre of the water column for the first year and are often associated with floating algae.

Threats to lumpfish include changes in seawater temperature and salinity, physical destruction of spawning/nesting habitat, pollution in shallow-water nursery grounds, and directed fishing and bycatch of adults (Simpson et al. 2016).

Porbeagle Shark

In the Northwest Atlantic, porbeagles occur from northern Newfoundland and Labrador south to New Jersey, and possible South Carolina; mature females range further south to the Sargasso Sea (COSEWIC 2014).

Porbeagles are a coastal and oceanic shark that lives in cold to temperate waters; juveniles are most common on continental shelves but can occur offshore as well (COSEWIC 2014). Most individuals are found in waters with temperatures ranging from 5 to 10 °C (COSEWIC 2014).

Mating in the northwest Atlantic occurs on the Grand Banks, south of Newfoundland and at the mouth of the Gulf of St. Lawrence (COSEWIC 2014). Females give birth to live young outside Canadian waters

(COSEWIC 2014). This species is rarely found in Canadian waters between January and June (COSEWIC 2014).

The main threat to porbeagle is occurrence as bycatch in swordfish and tuna longline fisheries, and longline, gillnet and bottom trawl fisheries for groundfish (COSEWIC 2014).

Spiny Dogfish

Spiny dogfish are a widely distributed boreal to warm temperate species that is typically distributed over continental and insular shelves and upper slopes of the Atlantic and Pacific Oceans (Kulka 2006). Their distribution in the Northwest Atlantic ranges from Florida to Labrador, with their centre of abundance located between the Scotian Shelf and Cape Hatteras (COSEWIC 2010b). The Atlantic Canadian population of spiny dogfish is thought to consist of both resident and migrating populations (COSEWIC 2010c). Spiny dogfish occur in the Northumberland Strait though a low probability of capture has been determined in the eastern section of the Strait (Rondeau et al. 2016).

Spiny dogfish most commonly occur at depths of 10-200 m, though they have been observed as deep as 730 m and prefer temperatures between 5-15 °C (COSEWIC 2010c). Spiny dogfish are omnivorous and opportunistic feeders whose diet consists of small fish such as capelin, cod, haddock, hake, and herring, and invertebrates such as krill, crabs, polychaete worms, jellyfish, ctenophores, amphipods, squid, and octopus (Campana 2007).

Spiny dogfish mate during the fall and early winter and have internal fertilization (COSEWIC 2010c). An average of six pups are born live in the winter following an 18-24 month gestation period (COSEWIC 2010c). Spiny dogfish is a slow-growing species and females mature later and grow larger than males (COSEWIC 2010c).

The main threat to this species at a population level is overfishing, both in Canadian waters and globally (COSEWIC 2010c). Life history characteristics of the spiny dogfish such as a long gestation period, low fecundity, and late age of maturity all contribute to this species vulnerability to fishing (COSEWIC 2010c).

Striped Bass

The natural range of striped bass goes from the St. Lawrence River in the north and St. Johns River, Florida in the south (COSEWIC 2012b). The Southern Gulf of St. Lawrence population occurs primarily on the east coast of New Brunswick, but also part of the coast of Nova Scotia, Prince Edward Island, and eastern Quebec; however, there is only a single spawning population (Northwest Miramichi River) (COSEWIC 2012b). The Northumberland Strait, including the eastern section of the Strait, is a migration corridor for striped bass that generally migrates very close to shore (Rondeau et al. 2016).

Striped bass are an anadromous species that use a wide variety of habitats, including estuaries and freshwater, depending on the life stage (COSEWIC 2012b). Female striped bass are highly fecund and average 50,000 eggs per kilogram of body weight (COSEWIC 2012b). Spawning commences in freshwater when water temperature rises above 10 °C (COSEWIC 2012b).

Threats to striped bass include overfishing (directed, bycatch, poaching), habitat loss and degradation (e.g., dredging), contaminants, migration barriers, and interannual variation in recruitment from unknown causes (COSEWIC 2012b).

White Hake

White hake occurs in the Northwest Atlantic from North Carolina to the Grand Banks (COSEWIC 2013). Within the Northumberland Strait, St. George's Bay and the eastern end of the Northumberland Strait constitute the only remaining spawning area for white hake as well as a critical summer feeding area (COSEWIC 2013). This species was determined to have a high probability of being caught during DFO research vessel trawl surveys in the eastern section of the Northumberland Strait, including the LAA (Rondeau et al. 2016).

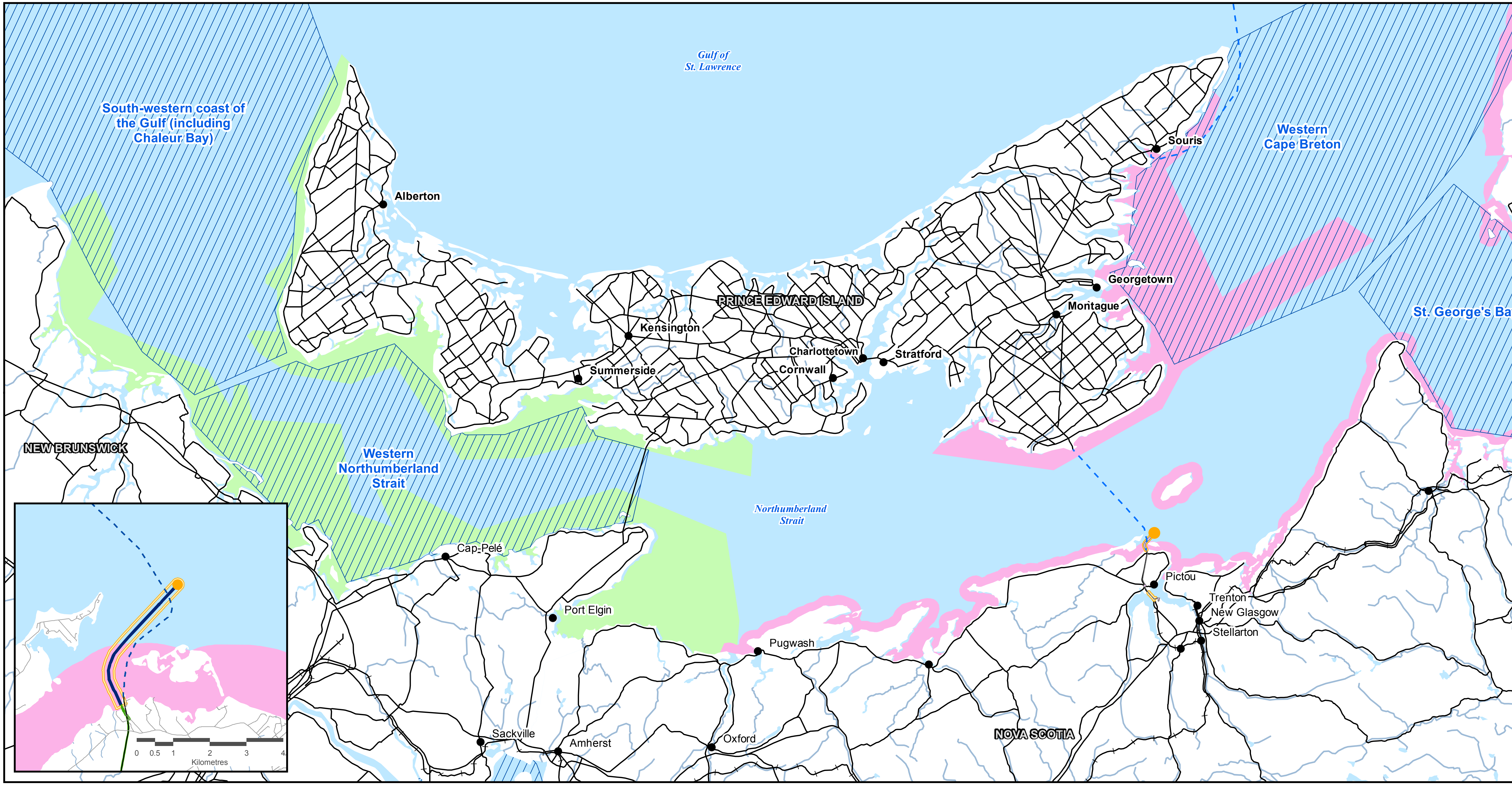
This species occurs near bottom and is commonly caught over fine sediment substrates including mud, sand, and gravel (COSEWIC 2013). White hake prefer water temperatures of 4-8 °C and occur in waters up to 800 m deep; larger fish typically occur in deeper waters while juveniles typically occur in shallow areas close to shore or on shallow offshore banks (COSEWIC 2013). Both juvenile and adult white hake feed on crustaceans and fish (COSEWIC 2013).

White hake have high fecundity and have buoyant eggs that generally occur in the upper water layer; spawning occurs in early spring (COSEWIC 2013). Juveniles remain in the upper water column for two to three months until reaching approximately 50 mm in length prior to settlement on the bottom (COSEWIC 2013). Newly settled juveniles are associated with a variety of substrates including gravel, mud, sand, and eelgrass (COSEWIC 2013).

The main reason for the decline of this species was overfishing in the late 1980s and early 1990s (COSEWIC 2013).

8.12.2.7 *Special Areas*

Special Areas with relevance to marine fish are shown in **Figure 8.12-10**. These include the Western Cape Breton Ecologically and Biologically Significant Area (EBSA), the St. George's Bay EBSA, the Western Northumberland Strait EBSA, the South-western Coast of the Gulf (including Chaleur Bay) EBSA, and the Scallop Buffer Zone in SFAs 22 and 24.



Outfall Diffuser Location

Ecolocially and Biologically Significant Area (EBSA)

Scallop Buffer Zone (SFA) 22

Scallop Buffer Zone (SFA) 24

Marine Local Assessment Area

Marine Project Footprint Area

Terrestrial Project Footprint Area

Northern Pulp Nova Scotia Corporation

Replacement Effluent Treatment Facility
Environmental Assessment

Special Areas of Importance for Marine Fish and Fish Habitat in and Around the Northumberland Strait
Figure 8.12-10

NORTHERN PULP
NOVA SCOTIA CORPORATION
A PAPER EXCELLENCE COMPANY

DILLON
CONSULTING

MAP CREATED BY: HW
MAP CHECKED BY: SS
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 2.5 5 10 15 20
Kilometres

*Precise Project Footprint to be determined following completion of detailed design

PROJECT: 17-6461

Date: 1/24/2019

The Western Cape Breton EBSA covers 8,192 km^2 (DFO 2007) and is located approximately 32 km to the northeast of the marine PFA. This area plays a major role for meroplankton (i.e., species which do not remain as plankton permanently but transition into larger organisms such as sea urchins, starfish, and crustaceans, for example) as well as groundfish (DFO 2007). The area is in the southern Gulf of St. Lawrence where the largest array and highest abundance of meroplanktonic species in the Gulf is observed (e.g., witch flounder, Atlantic cod, winter flounder, American plaice, decapod crustaceans, etc.) (DFO 2007). In terms of groundfish, the northern part of the EBSA has high biodiversity and high biomasses (DFO 2007). The Cape Breton Channel serves as a migration corridor for Atlantic cod and white hake and other groundfish species and is a summer feeding area for witch flounder and white hake (DFO 2007). A small area in the northern part of the EBSA is under the influence of the Gaspé Current where high biomass and production of phytoplankton has been observed (DFO 2007). The area also has large concentrations of macroinvertebrate species such as brittle stars, starfish, basket stars, hermit crabs, whelks, and squid (DFO 2007). The southern part of the EBSA is a spawning and nursery area for Atlantic herring and a wintering area for juveniles; it is also a feeding area where most pelagic species in the Gulf concentrate (e.g., alewife, spiny dogfish, Atlantic herring, Atlantic mackerel, capelin, rainbow smelt and silver hake) (DFO 2007).

The St. George's Bay EBSA covers 1,216 km^2 and is located approximately 59 km to the east of the marine PFA. The area is distinguishable mostly for its major role for meroplankton as well as for being visited by large numbers of several groundfish species and area where several pelagic fish species gather to feed (DFO 2007). The area also serves as a nursery and wintering area for juvenile Atlantic herring, the only feeding area in the Gulf for the butterfish population, and the main spawning and rearing area for white hake (coastal component of the stock) in the entire Gulf (DFO 2007). Because it is also the main summer feeding area for white hake, that species is particularly vulnerable in this area – especially during critical periods of their seasonal life cycle such as during spawning (DFO 2007).

The Western Northumberland Strait EBSA covers 2,194 km^2 (DFO 2007) and is located approximately 98 km to the west of the marine PFA. There is an isolated calico crab population (endemic subspecies) that spend their entire life cycle in this area (DFO 2007). The largest aggregation of winter skate in the Gulf occurs in this area in summer and early fall, and several other groundfish with a limited range, such as white hake and windowpane, are found in large quantities in the area (DFO 2007). There are also large scallop beds in the area, and conditions are favourable for an array and abundance of meroplankton (DFO 2007).

The South-western Coast of the Gulf (including Chaleur Bay) EBSA covers 13,506 km^2 (DFO 2007) and is located approximately 169 km to the west of the marine PFA. The southern part of this EBSA is characterized by its rare significance for several pelagic fish species, including the Atlantic herring, capelin, Atlantic mackerel, and American smelt that feed in the area. It is the main feeding area for Atlantic herring in the southern Gulf and also includes several spawning sites for the species as well as the principal wintering area for juvenile Atlantic herring (DFO 2007). The EBSA also serves multiple purposes (e.g., spawning, refuge, and feeding) for large concentrations of alewife, spiny dogfish, capelin, Atlantic mackerel and American smelt, and the southernmost part of the area is unique for the winter skate (DFO 2007). The EBSA contains the largest array of meroplankton species (including Atlantic cod, winter flounder, American plaice, yellowtail flounder, decapod crustaceans) that can be found in the area south of the Gulf as well as the greatest meroplankton abundances among all the identified areas in the Gulf and high phytoplankton concentrations (DFO 2007).

Scallop Buffer Zones SFA 22 and 24 are part of a system of Scallop Buffer Zones in SFA 21, 22, and 24 that covers a total area of 5,835 km^2 (DFO 2017). Scallop Buffer Zones were established to protect juvenile American lobster as they are known to contain lobster nursery habitat (DFO 2017). Scallop Buffer Zone SFA 22 is in the western Northumberland Strait, approximately 85 km to the west of the marine PFA. Scallop Buffer Zone SFA 24 is in the eastern Northumberland Strait and the effluent pipeline will cross through the Scallop Buffer Zone SFA 24 close to shore (**Figure 8.12-10**) in Caribou Harbour near Jessies Cove. The location of the outfall is outside this buffer zone.

8.12.3 Impact Evaluation/Effects Assessment

The potential environmental effects of the project and project activities on marine fish and fish habitat are assessed in the following section.

8.12.3.1 Potential Effects

Marine fish could be affected by activities and components of the project during the construction phase and operation and maintenance phase. If unmitigated, these changes have the potential to change marine fish populations and fish habitat (e.g., adult fish, juveniles, eggs and larvae, invertebrates and marine plants) through direct mortality or indirectly through alteration or destruction of habitat. The environmental assessment of marine fish is focused on changes in marine fish populations. For the purposes of this assessment, a change in marine fish populations includes any physical injury or mortality on fish attributable to the project, and any destruction or alteration of habitat from disturbance of the marine environment.

Construction Phase

During construction, marine fish may experience direct mortality or functional impairment resulting in eventual mortality. The placement of in-water infrastructure would have a direct effect on sessile or slow-moving demersal fish and invertebrates as they would be unlikely to avoid construction activities within the marine PFA and could experience mortality as a result of smothering or crushing.

The construction of marine-based infrastructure may affect marine fish populations through a change in available substrate and size distribution, a change in water and sediment quality, or changes to the acoustic qualities of the marine environment. The process of installing marine pipelines has a direct effect on the benthic environment.

In-water activities during the construction phase may also result in a change in sediment quality. The disturbance of marine sediments may temporarily increase the concentration of TSS in the water column. Suspended solids can reduce feeding and growth rates and can alter migration of salmon in nearshore habitats (Robinson and Cuthbert 1996). Reduced feeding rates, avoidance behaviour and suffocation due to effects on gill function have been observed in herring from suspended sediments (Robinson and Cuthbert 1996). There may also be indirect effects on fish through alterations within localized food web structures. The severity of the effect of suspended sediments increases as a function of sediment concentration and duration of exposure (Newcombe and Jensen 1996).

During the construction phase, vessel noise will be concentrated within the LAA and the majority of anthropogenic sound in the marine environment generated during construction will originate through trenching, pipe laying, and backfilling. There is also the potential for underwater sound if blasting is used during the construction phase. Some marine fish species may be affected when exposed to high intensity sounds (Popper 2003). The sound emitted to the marine environment during the construction phase could therefore temporarily reduce the quality of fish habitat in the marine PFA.

Operation and Maintenance Phase

Potential effects on marine fish and fish habitat during pipeline operation include the discharge of treated effluent from the ETF. These potential effects could result from: an increase in temperature, nutrients (nitrogen and phosphorus), or TSS; a change in colour, chemical and biochemical oxygen demand, dissolved oxygen (DO), or pH; or a reduction in salinity from the discharge of treated freshwater effluent into the Northumberland Strait.

Lobster harvesters in the Pictou region have expressed concern about the potential effects of the discharge of treated effluent on lobsters, particularly in the larval stage.

Potential effects to fish during the construction phase may also be applicable during the operation and maintenance phase if project maintenance activities require the presence and operation of project vessels or equipment, and in-water activities that include seabed disturbance (e.g., for pipeline retrieval or reburial).

8.12.3.2 Mitigation

Mitigation measures to reduce impacts on marine fish populations that are proposed during the construction and installation of the pipeline are discussed in this section. Mitigation measures that have been identified from DFO's *Measures to Avoid Harm to Fish and Fish Habitat* (DFO 2014) and will be incorporated, as required. These measures are related to timing, contaminant and spill management, sediment control, fish protection, and operation of machinery. Mitigation measures to reduce or avoid a change in marine fish populations are provided in **Table 8.12-7**. Some or all of the mitigation measures outlined in **Table 8.12-7** for the construction phase may also be applicable for the operation and maintenance phase if project maintenance activities require the presence and operation of project vessels or equipment, seabed disturbance (e.g., for pipeline retrieval or reburial), and/or marine blasting, if required.

In addition to the mitigation measures identified in **Table 8.12-7**, NPNS has a Toxicity Prevention and Remediation Plan to provide a structured approach for addressing treated effluent toxicity problems, should they occur. There will also be an Environmental Effects Monitoring (EEM) program for treated effluent discharge (**Appendix G**). Additionally Follow up and Monitioring will include: sublethal toxicity testing of treated effluent; phytoplankton and zooplankton community assessments; benthic invertebrate community sampling; water quality sampling; fish community and fisheries resource characterization; and fish and shellfish tissue chemistry investigations (EcoMetrix 2018; **Appendix H**). An adaptive management program will be implemented, as required.

Table 8.12-7: Mitigation Measures to Reduce or Avoid a Change in Marine Fish Populations

Potential Environmental Effect	Mitigation Measures
Change in Marine Fish Populations	• Work during the construction phase will be scheduled to the extent practicable to avoid periods of adverse weather (e.g., heavy winds or rain) or spring tides that may increase the transport of sediment depending on the construction method selected. • Duration of in-water work will be managed to the shortest time that is practical. • An Erosion and Sediment Control Plan will be developed for the site that reduces the risk of sedimentation to the marine environment. • Machinery used on site will arrive in a clean condition free of fluid leaks and invasive species. • All construction materials will be removed from site upon completion of pipeline installation. • Visual inspection in the area of Caribou Harbour to confirm that increases in turbidity are limited. If excessive changes in turbidity occur that differ from the existing conditions of the surrounding waterbody (i.e., distinct colour difference) from construction activities, an investigation will be performed to determine root cause and additional mitigation measures will be applied as needed. • Displaced substrate will be recovered to bury portions of the pipeline, wherever practical. • The implementation of timing windows to prevent harm during sensitive life stages will be considered during the construction phase (e.g., Atlantic herring are known to spawn in the eastern Northumberland Strait in the fall). • Marine blasting, if required, will be conducted in accordance with *DFO Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters* (Wright and Hopky 1998).

Potential Environmental Effect	Mitigation Measures
	• Routine effluents and operational discharges produced by project vessels (e.g., grey and black water, bilge water, deck drainage, discharges from machinery, and non-hazardous waste material) will be managed in accordance with *International Convention for the Prevention of Pollution from Ships* (MARPOL) and International Maritime Organization (IMO) guidelines, of which Canada has incorporated provisions under various sections of the *Canada Shipping Act*. No waste or garbage will be dumped overboard. • During operation, effluent will be treated to comply with all applicable regulatory requirements for effluent discharge quality. This includes compliance with federal and provincial permit requirements and regulatory requirements such as PPER. • Compliance with all permit conditions and regulatory requirements including requirements under the *Fisheries Act* that prohibits serious harm to CRA fisheries. Provision of habitat offsetting, if required. • A three-port design has been selected for the effluent outfall diffuser to improve near-field dilution and mixing (compared with a one-port diffuser) during project operations (Stantec 2018; **Appendix E**).

8.12.3.3 Characterization of Residual Effects

Residual project-related environmental effects on marine fish and fish habitat may occur during initial site preparation, the construction and installation of the pipeline, and during pipeline operation and maintenance activities.

Construction Phase

The risk of mortality of marine fish will be increased during construction and placement of the pipeline. This would occur in a localized area where infrastructure is placed and sediment deposition may occur. However, serious harm to fish and mobile invertebrates, such as lobsters, crabs, and shrimp is unlikely as these species are highly mobile and typically able to avoid burial or crushing. Slow-moving and sessile invertebrates such as sea stars and sea anemones are the most vulnerable to harm from physical disturbance because they are unable to avoid burial or crushing. The setting of anchors by project vessels involved with construction activities may also result in the mortality of sessile or slow-moving demersal fish and invertebrates.

Elevated concentrations of suspended sediments associated with bottom lay and trenched pipeline construction will likely be localized within the marine PFA. The potential effects of elevated TSS concentrations over extended periods of exposure on marine fish include decreased feeding success, reduced ability to see and avoid predators, damaged gills, reduce growth rates, decreased resistance to disease, and impaired development of embryos (Newcombe and Jensen 1996). Adult fish and highly mobile invertebrates typically avoid areas with elevated TSS levels and exposure durations are generally limited to minutes or hours (Newcombe and Jensen 1996; Wilber and Clarke 2001). Sessile invertebrates and the eggs and larval stages of fish can tolerate exposure to elevated TSS levels for periods of three to four days (Wilber and Clarke 2001). However, the strong currents in the Northumberland Strait will cause dispersion of suspended sediment. Once construction is complete, concentrations of TSS in the water column are expected to return to background levels within a relatively short period from several hours to a day.

Project construction is likely to initially result in a net loss of productivity in marine fish populations, including habitat-forming vegetation, with potential residual effects on fish species including those associated with CRA fisheries. In areas where project infrastructure is installed on the seabed in the marine PFA (i.e., the effluent outfall diffuser and any surface-laid segments of the marine pipeline in areas where burial is not feasible [if applicable]), the loss of benthic habitat in soft sediment will be offset by the creation of additional habitat on the hard infrastructure surfaces (refer to characterization of residual effects for the operation and maintenance phase below).

Physical disturbances to the seabed are typically followed by a temporary reduction in species abundance, population density, and biomass of benthic organisms in the affected area (Gilkinson et al. 2005; Newell et al. 1998). The recovery rate of benthic communities following cessation of physical disturbance to the seabed is highly variable and depends on the type of community affected and the extent to which the affected community is naturally adapted to sediment disturbance and suspended particle load. The impact of construction on the destruction and natural restoration of benthic invertebrate communities has been previously described by Lewis et al. (2002). Their study noted that recolonization and restoration of benthic invertebrates in the impacted area occurred six months after pipeline construction. The installation of the pipeline should not result in serious harm to CRA and supporting fish species once benthic species have become re-established within approximately six months, representing a temporary alteration. If an adverse effect to marine fish and fish habitat that supports a CRA fishery is considered “serious harm” by DFO, it will be addressed through a *Fisheries Act* Authorization and the application of offsetting measures.

The area immediately around the installation of marine infrastructure is subject to sound levels that would have the potential to cause physiological harm or behavioural change of fish during the construction phase. However, the brief period of in-water works, the localized area of potential environmental effects, and the ability of fish to actively move away from intense sounds reduce the risk of adverse effects on fish populations.

If marine blasting is required, potential effects associated with blasting will be temporary, short in duration, and infrequent. The risk of direct explosion-induced physical injury or mortality to marine fish will be highly localized around the marine PFA and, with the implementation of the *DFO Guidelines for the Use of Explosives In or Near Fisheries Waters* (Wright and Hopky 1998), is considered low since marine fish species are generally expected to avoid the immediate area where project activities take place. In the case of slow-moving or sessile species, blasting could result in physical injury or mortality.

Operation and Maintenance Phase

During the operation and maintenance phase, the presence of project infrastructure on the seabed in the marine PFA (i.e., the effluent outfall diffuser and any surface-laid segments of the marine pipeline in areas where burial does not occur) will transform a soft-bottomed benthic community into a hard-bottomed benthic community, which will likely result in a highly localized increase in biodiversity of species and overall productivity.

The benthic habitat created by new seabed infrastructure will also provide hard substrate for colonization of epiphytic marine organisms and macrophytes and will result in a change in benthic community assemblage in a localized area. Sessile benthic invertebrates such as anemones and sponges will colonize the in-water structures once installation is complete. Marine plants, which are important components of habitat for lobster and other commercially important species, will also colonize the hard substrate of in-water structures. Recolonization will attract other mobile species (e.g., marine fish) for feeding and refuge, ultimately creating a “reef effect”, thereby increasing fish biomass (Stantec 2012).

Effluent quality will necessarily comply with all federal and provincial permit conditions and regulatory requirements such as PPER. A three-port diffuser was selected for the project to promote mixing in the receiving environment and reduce the treated effluent concentration being discharged into the marine environment. It was determined in the receiving water study (Stantec 2018; **Appendix E**) that water quality at the end of the mixing zone for the three-port diffuser will reach ambient conditions within less than 2 m from the diffuser in terms of total nitrogen, total phosphorous, TSS, DO, pH, and salinity. Colour will return to baseline conditions within 5 m of the diffuser. Temperature will be within 0.1 °C of background at the end of the 100-m mixing zone. Thus, any potential effects on water quality during the operation phase will be highly localized.

In response to concerns expressed by lobster harvesters in the Pictou region about the potential effects of the discharge of treated effluent on lobster, particularly lobster larvae, a review of existing scientific literature on the effect of bleached mill effluent on the American lobster was conducted by Fraser Clark (**Appendix R**). Lobster exposure studies involving bleached Kraft mill effluent (BKME) were conducted in Nova Scotia in the 1960s by Sprague and McLeese (1968a,b) to examine the impact of BKME on adult and larval life stages. These studies used different dilutions of the historic BKME and found that the survival of stage I lobster larvae (the first post-hatch lobster life stage) is reduced slightly at 10% BKME, but not significantly at concentrations below 10% (Sprague and McLeese 1968b). The results of the 1968 research suggest that lobster larvae will not be affected by the treated effluent within the effluent plume 5 m from the diffuser; however, the chemical composition of modern treated effluent is different than that used in these studies (Clarke, 2019, **Appendix R**). When exposed to effluent plumes at different concentrations, adult lobster did not avoid concentrations of BKME as high as 20%; this suggests that exposure to dilute concentrations of BKME would not result in lobsters altering their local movement (McLeese 1970). There was considerable variability in individual adult lobster mortality during exposure to various dilutions of BKME over different time periods. As a result, it was not possible to determine the lethal concentration of historic BKME on adult lobsters (Sprague and McLeese 1968b). This study also examined the combined effects of salinity and DO during BKME exposure and found that reduced salinity and low oxygen were not found to be correlated with reduced susceptibility to BKME (Sprague and McLeese 1968b). For both larval and adult lobster, caution was advised in interpreting these results due to the high individual variability of lobster susceptibility, and the different chemical composition of historic BKME (Clarke, 2019 **Appendix R**).

Adult lobsters are mobile and can avoid temperatures that are not optimal, especially if the elevated temperature is highly localized (Clarke, 2019 **Appendix R**). The anticipated temperature of treated effluent, as modelled by Stantec (2017), proposed to be released into receiving waters would have very little impact on larval and adult lobsters if DO is higher than 1.75 mg/L and salinities are higher than 21 parts per thousand (ppt) (Clarke, 2019 **Appendix R**). The predicted DO of the treated effluent is 1.5 mg/L but this will improve to background concentration of 7.2 mg/L within 2 m of the diffuser off Caribou Point due to mixing with ambient seawater (Stantec 2018). The salinity of the effluent, which is closer to fresh water at 4 ppt, is anticipated to reach the background salinity of 28 ppt as a result of mixing with ambient seawater within 2 m from the diffuser at Caribou Point (Stantec 2019 **Appendix E**). This background salinity of the receiving water has not been found to affect lobster behaviour or physiology (Sprague and McLeese 1968a,b).

In summary, previous scientific studies conducted using historic effluent showed a high variability in survival rates but suggest adult lobsters are not likely to be impacted, particularly in the area where the effluent plume would be interacting with them (Clarke 2019, **Appendix R**). Lobster larvae present in the water column could come into contact with the treated effluent plume; however, these previous scientific studies suggest that lobster larvae are not expected to be affected by the treated effluent within 2 m of the diffuser at Caribou due to the predicted dilution at this distance. Based on the understanding of these scientific studies using historic effluent, and with the proposed and predicted improvements made to the NPNS mill facility, use of a diffuser for the marine outfall, and the BHETF, it was determined that it is unlikely that the temperature, DO and salinity interactions of the treated effluent will affect either larval or adult lobster (Clarke 2019 **Appendix R**).

Infrastructure inspection (e.g., ROV surveys of the pipeline and diffuser) will occur as needed. Any increase in vessel traffic related to maintenance of the pipeline will be negligible compared to current activity in Caribou Harbour and the Northumberland Strait. Noise emissions from vessels during maintenance activities may cause fish to move out of the affected areas close to the source; however, it is generally accepted that low-level underwater sound has little to no likelihood of causing any significant physical effects on marine fish populations. If in-water activities and seabed disturbance are required during maintenance, the potential effects on marine fish populations would be similar to, though lower than, those during the construction phase.

8.12.4 Summary

Table 8.12-8 summarizes the potential residual environmental effects of the project on marine fish populations.

Table 8.12-8: Summary of Residual Environmental Effects to Marine Fish

Project Activities	Potential Effects	Mitigation	Residual Effects	Significance of Residual Effects
Construction				
Pipeline trenching and installation, installation of effluent outfall diffuser, and associated marine construction activities, including barge anchoring	Change in marine fish populations	• Work during the construction phase will be scheduled to the extent practicable to avoid periods of adverse weather (e.g., heavy winds or rain) or spring tides that may increase the transport of sediment. • Duration of in-water work will be managed to the shortest time that is practical. • An Erosion and Sediment Control Plan will be developed for the site. • Machinery used on site will arrive in a clean condition free of fluid leaks and invasive species. • All construction materials will be removed from site upon completion of pipeline installation. • Visual inspection in the area of Caribou Harbour to confirm that increases in turbidity are limited. If excessive changes in turbidity occur that differ from the existing conditions of the surrounding waterbody (i.e., distinct colour difference) as a result of construction activities, an investigation will be performed to determine root cause and additional mitigation measures will be applied as needed. • Displaced substrate will be recovered to bury portions of the pipeline, wherever practical. • The implementation of timing windows to prevent harm during sensitive life stages will be considered during the construction phase (e.g., Atlantic herring are known to spawn in the eastern Northumberland Strait in the fall).	No unmitigated interaction between the project and marine fish populations is expected to occur. *Direct and indirect, reversible.* *Direction – Adverse* *Magnitude – Low to Moderated* *Geographic extent – Local* *Duration – Temporary, until recolonization by benthic organisms* *Frequency – Daily during construction phase* *Reversibility – Reversible* *Context – Disturbed*	Not Significant – Adverse

Project Activities	Potential Effects	Mitigation	Residual Effects	Significance of Residual Effects
		• Marine blasting, if required, will be conducted in accordance with DFO *Guidelines for the Use of Explosives in or Near Fisheries Waters* (Wright and Hopky 1998). • Routine effluents and operational discharges produced by Project vessels will be managed in accordance with *International Convention for the Prevention of Pollution from Ships* (MARPOL) and International Maritime Organization (IMO) guidelines, of which Canada has incorporated provisions under various sections of the *Canada Shipping Act*. No waste or garbage will be dumped overboard.		
Operation and Maintenance				
Presence and operation of the marine pipeline and effluent outfall diffuser	Change in marine fish populations	• Treat effluent to comply with all applicable regulatory requirements for effluent discharge quality. • Employ a three-port design for the effluent outfall diffuser. • Undertake effluent plume delineation study that is a component of the EEM program. • Follow up and Monitoring will include: sublethal toxicity testing of treated effluent; phytoplankton and zooplankton community assessments; benthic invertebrate community sampling; water quality sampling; fish community and fisheries resource characterization; and fish and shellfish tissue chemistry investigations (EcoMetrix 2018; **Appendix H**).	No unmitigated interaction between the project and marine fish populations is expected to occur. *Direct and indirect, reversible.* *Direction – Adverse* *Magnitude – Low* *Geographical extent – Local* *Duration – Permanent* *Frequency – Daily* *Reversibility- Reversible* *Context – Disturbed*	Not significant – Adverse
Maintenance of the marine pipeline and effluent outfall diffuser	Change in marine fish populations (if required maintenance activities entail the presence and operation of project vessels and equipment, seabed disturbance	• If required maintenance activities entail the presence and operation of project vessels and equipment, seabed disturbance, and/or marine blasting, implement mitigation measures identified above for pipeline trenching and installation, installation of effluent outfall diffuser, and associated marine construction activities, including barge anchoring (as applicable). • Routinely inspect diffuser for proper functioning and maintenance.	No unmitigated interaction between the project and marine fish populations is expected to occur. *Direct and indirect, reversible.* *Direction – Adverse* *Magnitude – Low* *Geographical extent – Local* *Duration- Permanent* *Frequency – N/A* *Reversibility – Reversible* *Context – Disturbed*	Not significant – Adverse

In summary, with implementation of the mitigation measures outlined in **Section 8.12.3.2**, significant adverse residual environmental effects on marine fish or their habitat are not anticipated and the residual environmental effects of the project on marine fish and fish habitat during all phases of the project are rated not significant. A project-specific EEM program in the vicinity of the effluent diffuser, such as that developed by EcoMetrix (2018; **Appendix G**), will confirm the prediction of effects and demonstrate compliance with regulatory and permit requirements during the operation and maintenance phase. NPNS has a Toxicity Prevention and Remediation Plan that will be in place and updated as required for the duration of the project.

Follow up and Monitioring will include: sublethal toxicity testing of treated effluent; phytoplankton and zooplankton community assessments; benthic invertebrate community sampling; water quality sampling; fish community and fisheries resource characterization; and fish and shellfish tissue chemistry investigations (EcoMetrix 2018; **Appendix H**).

The installation of the pipeline should not result in serious harm to CRA and supporting fish species once benthic species have become re-established. If an adverse effect to marine fish and fish habitat that supports a CRA fishery is considered "serious harm" by DFO, including temporary "serious harm", it will be addressed through a *Fisheries Act* Authorization and the application of offsetting measures. There will be no project-related serious harm to fish (including prey species) that is not mitigated through offsetting measures in accordance with DFO's Fisheries Protection Policy Statement (DFO 2013).

8.12.5 Follow-up and Monitoring

NPNS will conduct an EEM program in the vicinity of the effluent outfall diffuser, such as that developed by EcoMetrix (2018; **Appendix G**), in compliance with the PPER. A follow-up program for treated effluent discharge will also include: sublethal toxicity testing of treated effluent; phytoplankton and zooplankton community assessments; benthic invertebrate community sampling; water quality sampling; fish community and fisheries resource characterization; and fish and shellfish tissue chemistry investigations (EcoMetrix 2018; **Appendix H**).

In addition, NPNS has a Toxicity Prevention and Remediation Plan in place for the duration of the project.

8.13 Marine Mammals, Sea Turtles and Marine Birds

The potential environmental effects of the project on the marine mammals, sea turtles, and marine birds VEC (also sometimes referred to as the marine wildlife VEC, for brevity) are assessed in this section.

8.13.1 Scope of VEC

The marine mammals, sea turtles, and marine birds VEC includes: baleen whales, large toothed whales, dolphins, porpoises, and seals; sea turtles; and seabirds, waterfowl, and shorebirds that are protected under the *Migratory Birds Convention Act, 1994* (MBCA) as well as additional marine-associated birds that are not protected under the MBCA (i.e., cormorants). This VEC was selected in recognition of: the ecological value of these species to marine and coastal ecosystems; the cultural and recreational value placed on these species by Indigenous peoples and the general public; regulatory considerations; and potential interactions with the project. Project-related presence and operation of vessels and equipment (including associated emissions and discharges), seabed disturbance, marine blasting (if required), and effluent discharges have potential to cause a change in risk of injury or mortality and/or a change in habitat quality and use for marine mammals, sea turtles, and marine birds.

The marine mammals, sea turtles, and marine birds VEC considers secure species as well as species at risk (SAR) and species of conservation concern (SOCC).

For this VEC, SAR species include:

- species listed as Vulnerable, Threatened, or Endangered on the Categorized List of Species at Risk under the Nova Scotia *Endangered Species Act* (NS ESA); and
- species listed as Endangered, Threatened, or Special Concern on Schedule 1 of the federal *Species at Risk Act* (SARA).

SOCC species include:

- species determined by the Atlantic Canada Conservation Data Centre (AC CDC) as having provincial rarity rankings of S1 (extremely rare in Nova Scotia), S2 (rare in Nova Scotia), or S3 (uncommon in Nova Scotia); and
- species designated by the Committee on the Status of Wildlife in Canada (COSEWIC) as Endangered, Threatened, or Special Concern, but not yet listed under Schedule 1 of SARA.

Marine mammals and sea turtles and their habitats are protected under the federal *Fisheries Act*, which is administered by Fisheries and Oceans Canada (DFO), as well as under SARA, which is administered by Environment and Climate Change Canada (ECCC), DFO, and Parks Canada. The *Fisheries Act* defines "fish" as including marine animals (e.g., marine mammals and sea turtles). Section 35 of the Act contains provisions that prohibit unauthorized "serious harm" to fish that are part of a commercial, recreational, or Aboriginal (CRA) fishery or that support such a fishery. For the purposes of the *Fisheries Act*, serious harm to fish is *"the death of fish or permanent alteration to, or destruction of, fish habitat"* (Section

2(2)). The *Fisheries Act* also contains pollution prevention provisions under Section 36, including a prohibition against the deposit of deleterious substance in waters frequented by fish.

SARA contains provisions to protect species, including marine species, listed on Schedule 1 of the Act as well as their critical habitat, which is defined as *"habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in a recovery strategy or action plan for the species"* (Section 2(1)). Sections 32 and 33 of SARA provide a list of general prohibitions, including those pertaining to the killing, harming, harassment, capture, or taking of a wildlife species listed as Extirpated, Endangered, or Threatened, and the damage or destruction of their residences. Section 58 of SARA prohibits the destruction of any part of the critical habitat of any species listed as Endangered or Threatened, or of any species listed as extirpated if a recovery strategy has recommended its reintroduction.

Migratory birds are protected federally under the MBCA, which is administered by ECCC. The MBCA and associated regulations provide protection to all birds listed in the Canadian Wildlife Service (CWS) *Occasional Paper No. 1, Birds Protected in Canada under the MBCA*. Migratory and non-migratory birds protected by the MBCA include most seabirds (except cormorants and pelicans), all waterfowl, all shorebirds, and most landbirds (birds with principally terrestrial life cycles). Other bird species (and other wildlife) not protected under the federal MBCA, such as cormorants, are protected under the Nova Scotia *Wildlife Act*.

The MBCA and associated regulations state that no person may disturb, destroy, or take/have in their possession a migratory bird (alive or dead) or part thereof, or its nest or eggs, except under authority of a permit. Section 5.1 of the MBCA describes prohibitions related to depositing substances harmful to migratory birds: *"No person or vessel shall deposit a substance that is harmful to migratory birds, or permit such a substance to be deposited, in waters or an area frequented by migratory birds or in a place from which the substance may enter such waters or such an area"*.

The NS ESA provides protection to species listed as Endangered, Threatened, or Vulnerable under the Act, as well as their core habitat. The Act prohibits killing or disturbing a listed species, destroying or disturbing the residence of a listed species, and destroying or disturbing the core habitat of a listed species. The conservation and recovery of species assessed and listed under the NS ESA is the responsibility of the Nova Scotia Department of Lands and Forestry (NSDLF).

8.13.1.1 Boundaries

The spatial boundaries for the assessment of the environmental effects of the project on marine mammals, sea turtles, and marine birds include the following (refer to **Figure 8.13-1**):

- **Marine project footprint area (PFA):** The PFA is the area of anticipated physical disturbance associated with the project. The marine PFA (i.e., generally the PFA for the marine portion of them pipeline) consists of a corridor approximately 15 m wide and 4.1 km long that begins at the ordinary high-water mark and extends seaward into the Northumberland Strait until the pipeline terminates at the effluent outfall diffuser. This 15 m wide corridor contains the proposed 3 m wide excavated trench within which the pipe will be installed and also accounts for the temporary placement of excavated marine sediments along the length of the pipeline route. The estimated total area of the Marine PFA in the Northumberland Strait is approximately 6 ha.

- **Marine local assessment area (LAA):** The LAA is the maximum area within which VEC-specific environmental effects from project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence (i.e., the potential zone of influence of the project-related environmental effects on marine mammals, sea turtles, and marine birds). The LAA for this VEC consists of a corridor approximately 300 m wide and 4.1 km long that begins at the ordinary high-water mark and extends seaward into the Northumberland Strait until the pipeline terminates at the effluent outfall diffuser. This 300 m wide corridor contains the marine PFA and also accounts for the most acute potential effects of sediment resuspension and underwater sound/vibration from physical activities in the marine PFA as well as the most acute potential effects of the effluent plume from the diffuser. The estimated total area of the LAA in the Northumberland Strait is approximately 126 ha.

The LAA for this VEC additionally includes a corridor approximately 300 m wide and 1.5 km long that contains the portion of the PFA located on land near Pictou Harbour and also accounts for the potential effects of noise and other sensory disturbance from physical activities in that portion of the PFA. Although this part of the LAA is located partially above the ordinary high-water mark and entirely outside of the Northumberland Strait, it is considered part of the LAA for this VEC in consideration of potential effects on marine birds associated with project activities related to the causeway crossing in Pictou Harbour. The estimated total area of the LAA in Pictou Harbour is approximately 53 ha.

The temporal boundaries for the assessment of the environmental effects of the project on marine mammals, sea turtles, and marine birds include the following:

Temporal boundaries for the assessment of environmental effects on the environment include periods of construction, operation and maintenance, and decommissioning. Construction is estimated to be approximately 21 months, beginning second quarter of 2019, commencing as soon as the EA review has been completed and the applicable permits, approvals or other forms of authorization have been obtained. Operation and maintenance will commence immediately following the construction phase and will continue to operate efficiently and safely for several decades and likely much longer with a well-maintained system. For the purpose of this EA Registration, it has been assumed that the operation and maintenance phase will begin in the fourth quarter of 2020. Decommissioning of the project would occur at the end of mill life following the completion of operations. Once the ETF or pipeline is nearing the end of a useful service life, a decommissioning plan will be developed and will be submitted for a separate review requiring NSE approval. For the purposes is of this EARD:

- land-based pipeline construction will begin late in the third quarter of 2019 and will take approximately five months to complete, including winter weather delays and avoidance of environmentally sensitive periods (the temporal boundaries for land-based pipeline construction are

relevant in consideration of potential effects on marine birds associated with project activities related to the causeway crossing in Pictou Harbour); and
- marine pipeline construction will occur over several seasons, including winter weather delays and acknowledgement of potential reduced or avoided construction activities during sensitive periods.

8.13.1.2 Significance Criteria

A significant adverse residual environmental effect on marine mammals, sea turtles, and marine birds is one where project-related activities:
- cause a detectable decline in abundance or change in distribution of a marine mammal, sea turtle or marine bird population within the Northumberland Strait such that natural recruitment may not re-establish the population to its original level within one generation;
- jeopardize the achievement of self-sustaining population objectives or recovery goals for a marine mammal, sea turtle, or marine bird SAR such that the overall abundance, distribution and health of that species and its eventual recovery within the Northumberland Strait is adversely affected; or
- result in permanent and irreversible loss of critical habitat as defined in a recovery plan or an action strategy under SARA for a marine mammal, sea turtle, or marine bird SAR.

8.13.2 Existing Environment

The description of existing conditions for marine mammals, sea turtles, and marine birds in the Northumberland Strait is based on the results of previous research and existing scientific literature and environmental assessments; no field work was conducted as part of this EA Registration. In particular, this section relies substantially on the EIA Registration for the PEI-NB Cable Interconnection Upgrade Project (Stantec 2015), including descriptions of species life histories and ranges.

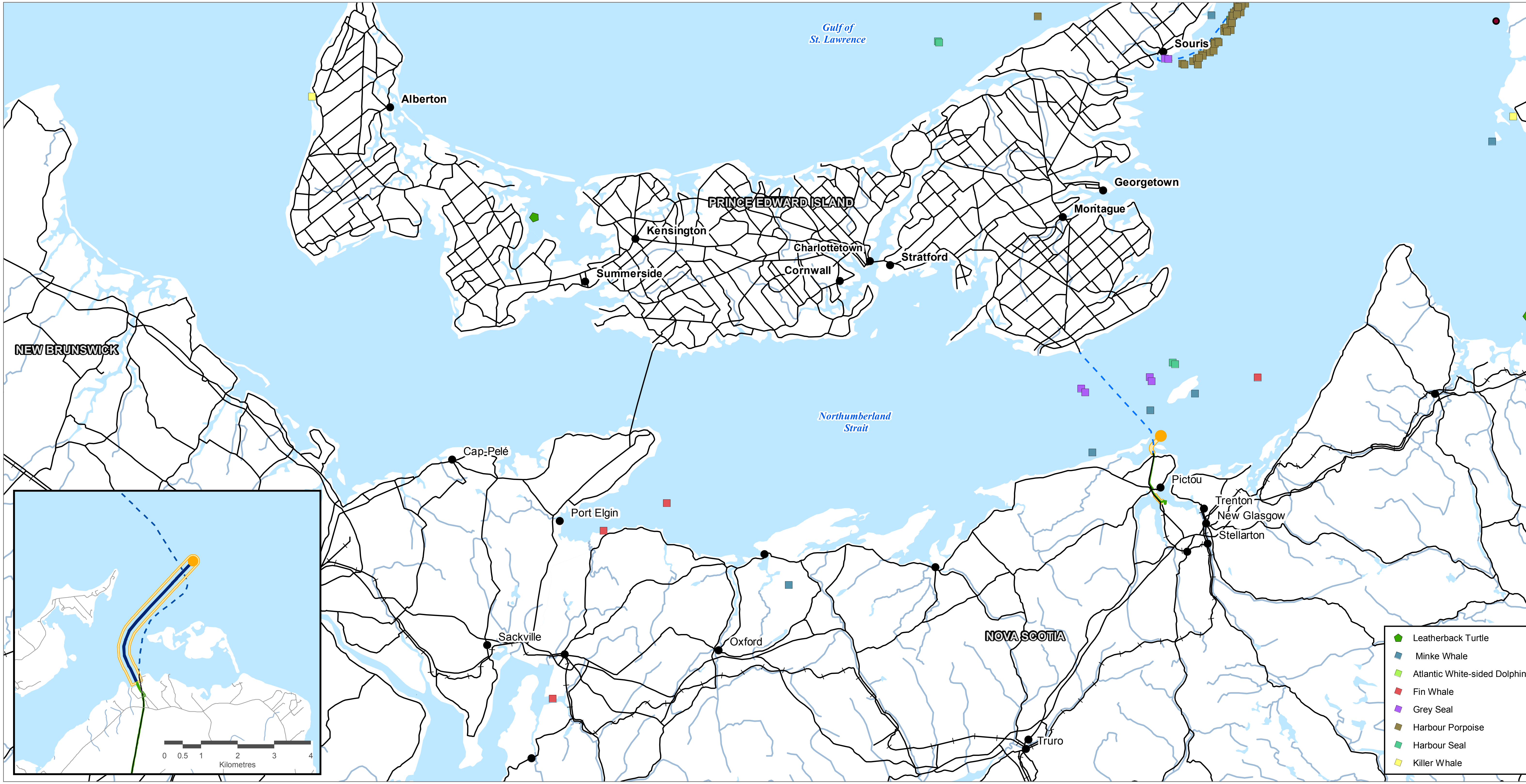
8.13.2.1 Marine Mammals

The Gulf of St. Lawrence provides habitat for several marine mammal species, including 13 recorded species of whales and four species of seals (DFO 2005a). Ten species of marine mammals have been recorded within the Northumberland Strait (AMEC 2007 and OBIS 2018); **Table 8.13-1** identifies these species and indicates the frequency of their occurrences in the Strait. Several of the marine mammal species identified in **Table 8.13-1** have been historically observed near the LAA, according to data obtained from the Ocean Biogeographic Information System (OBIS) (2018). The locations of these historical observations are shown on **Figure 8.13-1**.

Table 8.13-1: Marine Mammal Species Known to Occur in the Northumberland Strait

Common Name	Scientific Name	NS ESA Status	SARA Status (Schedule 1)	COSEWIC Status	AC CDC Rank	Frequency of Occurrence in the Northumberland Strait
Pinnipeds						
Grey Seal	*Halichoerus grypus*	–	–	Not at Risk	SNR	Frequent
Harbour Seal (Atlantic subspecies)	*Phoca vitulina*	–	–	Not at Risk	SNR	Frequent (spring, summer and fall); year-round resident in the Gulf of St. Lawrence
Harp Seal	*Pagophilus groenlandicus*	–	–	–	SNR	Occasional
Hooded Seal	*Cystophora cristata*	–	–	Not at Risk	SNR	Occasional
Cetaceans						
Atlantic White-sided Dolphin (Gulf of St. Lawrence population)	*Lagenorhynchus acutus*	–	–	Not at Risk	S4	Frequent (summer and fall)
Fin Whale (Atlantic population)	*Balaenoptera physalus*	–	Special Concern	Special Concern	S2S3	Occasional
Harbour Porpoise* (Northwest Atlantic population)	*Phocoena phocoena*	–	–	Special Concern	S4	Frequent (summer and fall)
Long-finned Pilot Whale	*Globicephala melaena*	–	–	Not at Risk	S2S3	Rare
Minke Whale (Atlantic subspecies)	*Balaenoptera acutorostrata acutorostrata*	–	–	Not at Risk	S4	Occasional
Sperm Whale	*Physeter macrocephalus*	–	–	Not at Risk	SNA	Rare

Notes:
– = Not listed.
* = Listed as Threatened on Schedule 2 of SARA.
SNR = Not yet assessed in Nova Scotia.
SNA = Ranking not applicable in Nova Scotia.
Sources: AMEC (2007), NS ESA (2010), Government of Canada (2011), AC CDC (2017), AC CDC (2018), and OBIS (2018).



Northern Pulp Nova Scotia Corporation
Replacement Effluent Treatment Facility
Environmental Assessment

Historical Marine Mammal and Sea Turtle Observations In and Around the Northumberland Strait
Figure 8.13-1

NORTHERN PULP NOVA SCOTIA CORPORATION A PAPER EXCELLENCE COMPANY

Outfall Diffuser Location
Marine Local Assessment Area
Marine Project Footprint Area*
Terrestrial Project Footprint Area*

DILLON CONSULTING

MAP CREATED BY: HW
MAP CHECKED BY: SS
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 2.5 5 10 15 20
Kilometres

*Precise Project Footprint to be determined following completion of detailed design

Sources:
1. OBIS (2019)
2. DFO (2017)

PROJECT: 17-6461

Date: 1/24/2019

Of the ten marine mammal species that have been known to occur in the Northumberland Strait (**Table 8.13-1**), one is a SAR (fin whale) and two are SOCC (harbour porpoise and long-finned pilot whale). Life history information regarding these marine mammal species of conservation interest is provided below.

The North Atlantic right whale (*Eubalaena glacialis*) is another marine mammal SAR (listed as Endangered under Schedule 1 of SARA) that can be found in the Gulf of St. Lawrence (JWEL 2001). Twelve North Atlantic right whales died in the Gulf of St. Lawrence (outside of the Northumberland Strait) during the summer of 2017. This unprecedented level of right whale mortality in the Gulf has been attributed primarily to vessel collisions and fishing gear entanglement (DFO 2018a). However, North Atlantic right whales are not known to occur in the vicinity of the LAA (AC CDC 2018) and no historical observations of this SAR have been recorded in the Northumberland Strait, according to data obtained from DFO (2017) and OBIS (2018).

Fin Whale

The fin whale (*Balaenoptera physalus*) is the second largest species of whale in the world, after the blue whale (*Balaenoptera musculus*). It can range in size from 20 to 27 m in length and weigh between 60 and 80 tonnes (t). Females typically reproduce every two to three years, giving birth to a single calf. There are two main populations of fin whales that are found in Canadian waters: the Pacific population and the Atlantic population. The Atlantic population has a wide distribution and can be found in waters as far north as Greenland, down into the Bay of Fundy and the Gulf of Maine (DFO 2016). Fin whales generally do not travel together and will often migrate alone or in very small pods. The fin whale uses baleen to filter food from the ocean water, and its typical diet consists of krill and small fish such as herring and capelin. While there is a general distribution pattern for fin whales throughout the North Atlantic, there is little information regarding their distribution throughout the Gulf of St. Lawrence. During a series of aerial surveys conducted in 1995/1996, fin whales were observed in the Gulf, but none were reported in the southern Gulf (Kingsley and Reeves 1998, in Hammill et al. 2001). Observations of fin whales from whale-watching companies between May and October in 2000 indicate that this species frequently visit the waters of the southern Gulf, including the Northumberland Strait (Hammill et al. 2001). The Atlantic population of fin whale is listed as a species of Special Concern on Schedule 1 of SARA and is currently the only marine mammal known to occur in the Northumberland Strait that has been listed on Schedule 1 of SARA.

Harbour Porpoise

The harbour porpoise (*Phocoena phocoena*) is one of the smallest whales in the world and is found in two distinct populations: the Pacific population and the Northwest Atlantic population. The range of the Northwest Atlantic population spreads out along the north coast of Labrador down to the Bay of Fundy/Gulf of Maine (DFO 2018b). Harbour porpoises are well adapted to cold water and are rarely found in waters warmer than 16 °C. They average approximately 1.6 m in length and 50 kg at full growth, with females tending to be larger than males, and they often travel in small pods of about 10 individuals. Females reach sexual maturity at three years and will often give birth to a single calf after a

10- to 11-month gestation period. The calf is then nursed for an additional eight months before being weaned from its mother. The typical diet of the harbour porpoise consists of herring, capelin, cod, hake and sand lance (DFO 2008, in Stantec 2015). Since many of these fish in the porpoise's diet are commercially fished species, bycatch is one of the main threats to the species population. The harbour porpoise is not listed on the SARA Schedule 1 list of species at risk; however, it was assessed by COSEWIC in 2006 as a species of Special Concern, due to the high rate of bycatch from commercial fisheries. The Northwest Atlantic population of harbour porpoise occurs throughout the Gulf of St. Lawrence and is also known to occur frequently in the Northumberland Strait. Unlike the Pacific population of harbour porpoise, the Atlantic population has not been listed under Schedule 1 of SARA; however, it is currently listed as Threatened under Schedule 2 of SARA (Stantec 2015).

Long-finned Pilot Whale

The long-finned pilot whale (*Globicephala melaena*) has been known to visit the waters of the Northumberland Strait during the summer and fall months, while spending the winter months at lower latitudes such as the Gulf of Maine and the Northeast United States coast (Hammill et al. 2001). This is a medium-sized species, with males growing up to 8 m and weighing over 2,000 kg. Females typically tend to be smaller, reaching up to 6 m and weighing between 1,000 to 1,500 kg (NOAA 2014b, in Stantec 2015). Females reach sexual maturity at eight years of age and will give birth to a calf after a 12- to 18-month gestation period. Pilot whales typically prefer deep pelagic temperate to sub-polar ocean waters but have been known to occur in some coastal bodies. They can dive to depths of around 600 m to find food, which consists of a variety of fish, cephalopods, and crustaceans (NOAA 2014b, in Stantec 2015). There are currently two global populations of pilot whales: one in the southern hemisphere and one in the North Atlantic. The North Atlantic population was known to occupy all areas of the Gulf of St. Lawrence; however, the southern Gulf is recognized as its main area of concentration. Pilot whales represented approximately 20% of strandings off the coast of PEI between 1988 and 2001 (Hammill et al. 2001). During the construction of the Confederation Bridge, pilot whale observations were recorded during marine environmental effects monitoring programs (JWEL 1994). The long-finned pilot whale is considered a SOCC because it has been determined by AC CDC to have a provincial rarity ranking of S2S3.

8.13.2.2 Sea Turtles

The only marine reptile that is known to visit the Northumberland Strait is the leatherback sea turtle (*Dermochelys coriacea*) (AMEC 2007). This is the most widely distributed and largest of all marine turtle species. The leatherback sea turtle undertakes annual migrations into Atlantic Canadian waters during the summer months. The main reason for the turtle's migration into Northern Atlantic waters is to feed on jellyfish, which are seasonally abundant in temperate shelf and slope waters off of Eastern Canada. The Atlantic population of leatherback sea turtle is a listed as Endangered under Schedule 1 of SARA.

Based on satellite telemetry data from 70 leatherback sea turtles tracked in Atlantic Canadian waters, DFO (2011) identified the southeastern portion of the Gulf of St. Lawrence as a primary area of important habitat for this species. Peak use occurs in the summer and fall and it is believed that this area is likely important for leatherback sea turtles because it serves as foraging habitat (DFO 2011). The movements of satellite tagged turtles were widely distributed throughout Atlantic Canadian waters, with turtles sampling habitat across a broad area. However, the Northumberland Strait was not sampled by tagged turtles. Opportunistic sightings of leatherback sea turtles have occurred in the Strait, but such records are rare relative to those corresponding to the high-use areas identified via satellite telemetry (DFO 2011). Although no concentration of leatherback sea turtles has been documented directly in the Northumberland Strait, this species is known to occur in the Abegweit Passage (AMEC 2007). No historical AC CDC observations of leatherback sea turtle (or any other sea turtle species) have been recorded near the LAA. **Figure 8.13-2** presents the location of the nearest historical leatherback sea turtle observation recorded by DFO (2017).

8.13.2.3 Marine Birds

The Northumberland Strait provides habitat for a wide variety of marine birds that are present both annually and seasonally. A terrestrial environmental effects monitoring survey conducted in 1995 during construction of the Confederation Bridge identified 69 different species of aquatic and marine birds in the Abegweit Passage portion of the Northumberland Strait and in nearby marshes at wetlands (**Table 8.13-2**).

Table 8.13-2: Summary of Aquatic and Marine Birds Identified During 1995 Confederation Bridge Terrestrial Environmental Effects Monitoring Studies

Bird Group (Guild)	Number of Species
Dabbling Ducks	13
Diving Ducks	3
Sea Ducks	13
Sea Birds	9
Diving Birds	9
Shore Birds	18
Waders	2
Geese	2
Total	**69**

Source: AMEC (2007)

Common inshore seabirds that inhabit the Northumberland Strait include various species of gulls, terns, and cormorants. These are birds that spend substantial time at sea in shallow bodies of water, where food is easily accessible, and then they will return to land at night to rest. Offshore seabirds are less common in the Northumberland Strait due to the lack of islands or rocky cliffs, which these birds use as nesting grounds (AMEC 2007). Some examples of offshore birds include auks and petrels.

Waterfowl are generally classified as being of the order Anseriformes (e.g., geese, swans, ducks and mergansers), and marine waterfowl (i.e., seaducks) which are found in the marine environment outside the breeding season. Of the 69 species of marine birds observed during the 1995 terrestrial environmental effects monitoring for the Confederation Bridge project (AMEC 2007), 45% were ducks and geese and 32% were seabirds or sea ducks **(Table 8.13-2**). Many of these species of waterfowl are migratory and present in the Strait through the spring and fall as they make their transition between breeding and wintering grounds. Spring migration usually spans from March to May, and fall migration lasts from September to November. Some common species of waterfowl that are found in the Strait include all three species of scoter (i.e., Black [*Melanitta Americana*], White-winged [*Melanitta fusca*] and Surf [*Melanitta perspicillata*] scoter), Long-tailed Duck (*Clangula hyemalis*), Common Eider (*Somateria mollissima*), American Black Duck (*Anas rubripes*), Green-winged Teal (*Anas crecca*), Greater Scaup (*Aythya marila*), Canada Goose (*Branta canadensis*), Red-breasted Merganser (*Mergus serrator*) and Common Goldeneye (*Bucephala clangula*).

The Northumberland Strait ranks second only to the Bay of Fundy in importance as a stopover location for migrating shorebirds. It is estimated that over 30 species of shorebirds will gather in the Strait during the spring and fall migrations (JWEL 2001). The extensive mudflats that are present throughout the Strait provide a crucial food source that the birds need to gather fat reserves and energy for migration to breeding grounds. Migrating shorebirds typically have staging areas that they will return to year after year, which make them more sensitive to disturbance and habitat loss. Common shorebirds that can be found in abundance during the migrating period include Semipalmated Sandpiper (*Calidris pusilla*), Semipalmated Plover (*Charadrius semipalmatus*), Sanderling (*Calidris alba*), Short-billed Dowitcher (*Limnodromus griseus*), Black-bellied Plover (*Pluvialis squatarola*), Least Sandpiper (*Calidris minutilla*), Greater Yellowlegs (*Tringa melanoleuca*), Dunlin (*Calidris alpina*) and Red Knot (*Calidris canutus*) (JWEL 2001).

While the Northumberland Strait typically serves as a stopping point for a large majority of species during their migration period, there are some species that are found year-round and breed in the Strait. Areas of the Strait support sensitive nesting areas for certain species. Species that have been known to breed in the Northumberland Strait include terns (i.e., Common Tern [*Sterna hirundo*] and Arctic Tern [*Sterna paradisaea*]), plovers (e.g., Piping Plover [*Charadrius melodus*] and Semipalmated Plover), cormorants (e.g., Double-crested Cormorant [*Phalacrocorax auratus*] and Great Cormorant [*Phalacrocorax carbo*]), Razorbills (*Alca torda*), Willets (*Tringa semipalmata*), Ring-billed Gulls (*Larus delawarensis*), Great Blue Heron (*Ardea herodias*), and Black Guillemot (*Cepphus grylle*). Large numbers of Double-crested Cormorants are known to nest in Pictou Harbour, on the old pilings adjacent to the Pictou Causeway. These birds arrive as early as the first week in April and start to build nests almost immediately (Cohrs 1991). **Table 8.13-3** provides an overview of the historical observations of Double-crested Cormorant colonies recorded by AC CDC (2018) and CWS (2019) in and around Pictou Harbour between 1972 and 1987. The locations of these colonies are presented on **Figure 8.13-2**. Piping Plover has also been historically observed in Pictou Harbour (AC CDC 2018) and is known to nest on sandy beaches in Pictou County (Cohrs 1991). Other species historically observed in Pictou Harbour include: Semipalmated and Black-bellied plovers; Common Loon (*Gavia immer*); Barrow's Goldeneye (*Bucephala islandica*); Common Goldeneye; Common Tern; Killdeer (*Charadrius vociferous*); Ruddy Turnstone (*Arenaria interpres*); Sanderling; Short-billed Dowitcher; Greater and Lesser (*Tringa flavipes*) yellowlegs; and Spotted (*Actitis macularius*), and Semipalmated and Pectoral (*Calidris melanotos*) sandpipers (AC CDC 2018). In the late winter, various species of waterfowl are known to congregate in estuarine areas on either side of the Pictou Causeway due to the availability of open water for foraging (M. Crowell, pers. comm., 2018).

Table 8.13-3: Historical Colonial Double-crested Cormorant Observations Recorded In and Around Pictou Harbour

Date	Location	Colony Size	Approximate Distance from LAA
1972	Pictou Wharf	100 breeding pairs and active nests	361 m
June 6, 1974	Pictou Causeway	143 breeding pairs and active nests	Within LAA
July 10, 1975	Pictou Causeway	101 breeding pairs and active nests	Within LAA
June 19, 1976	Pictou Causeway	153 breeding pairs and active nests	Within LAA
April 5, 1977	Pictou Causeway	159 breeding pairs and active nests	Within LAA
May 26, 1978	Pictou Causeway	137 breeding pairs and active nests	Within LAA
June 21, 1979	Pictou Causeway	88 breeding pairs and active nests	Within LAA
June 24, 1980	Pictou Causeway	180 breeding pairs and active nests	Within LAA
May 27, 1987	Pictou Causeway	160 breeding birds	Within LAA
May 27, 1987	Pictou Landing	71 breeding birds	4,114 m
May 27, 1987	Pictou Oil Pier	172 breeding birds	332 m

Source: AC CDC (2018) and CWS (2019).

Table 8.13-4 identifies the marine bird species that have been historically observed near the LAA (including the portion of the LAA that is in the Northumberland Strait as well as the portion of the LAA that is in Pictou Harbour), as recorded by the AC CDC. Of these 24 marine bird species, three are SAR (Barrow's Goldeneye, Piping Plover [*melodus* ssp.], and Red Knot [*rufa* ssp.]), and 21 are SOCC (i.e., all but Double-crested Cormorant, Blue-winged Teal, Red-breasted Merganser, and Spotted Sandpiper). **Figure 8.13-4** presents the locations of these historical marine bird observations.

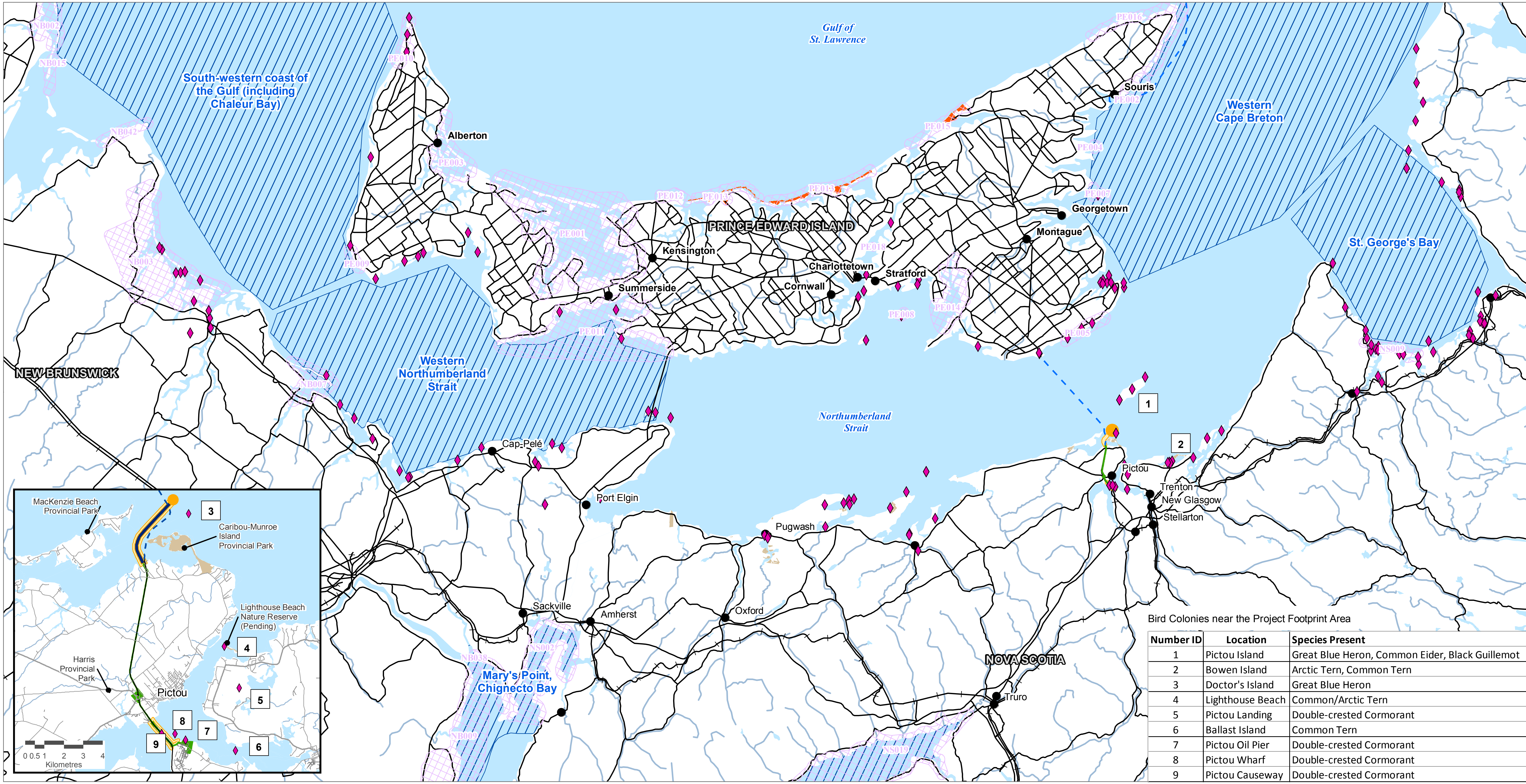
Table 8.13-4: Historical Marine Bird Observations Recorded by the AC CDC Near the LAA

Common Name	Scientific Name	NS ESA Status	SARA Status (Schedule 1)	COSEWIC Status	AC CDC Rank	Habitat Considerations
Seabirds						
Common Tern	Sterna hirundo	–	–	Not at Risk	S3B	Inhabits mainly coastal habitats
Double-crested Cormorant	Phalacrocorax auritus	–	–	Not at Risk	S5B	Inhabits mainly coastal habitats
Waterfowl						
Barrow's Goldeneye (Eastern population)	Bucephala islandica	–	Special Concern	Special Concern	S1N	Overwinters in protected coastal waters
Blue-winged Teal	Anas discors	–	–	–	S3S4B	Migrates along coastal habitat
Common Goldeneye	Bucephala clangula	–	–	–	S2B, S5N	Overwinters in protected coastal waters
Common Loon	Gavia immer	–	–	Not at Risk	S3B, S4N	Overwinters in coastal waters
Red-breasted Merganser	Mergus serrator	–	–	–	S3S4B, S5N	Overwinters in coastal waters
Shorebirds						
Black-bellied Plover	Pluvialis squatarola	–	–	–	S3M	Coastal shorebird
Greater Yellowlegs	Tringa melanoleuca	–	–	–	S3B, S3S4M	Inhabits freshwater wetlands and can

Common Name	Scientific Name	NS ESA Status	SARA Status (Schedule 1)	COSEWIC Status	AC CDC Rank	Habitat Considerations
						be found in coastal habitats during migration
Hudsonian Whimbrel	Numenius phaeopus hudsonicus	–	–	–	S2S3M	Coastal shorebird
Killdeer	Charadrius vociferus	–	–	–	S3B	Can be found in terrestrial or coastal habitats
Lesser Yellowlegs	Tringa flavipes	–	–	–	S3M	Inhabits freshwater wetlands and can be found in coastal habitats during migration
Pectoral Sandpiper	Calidris melanotos	–	–	–	S2S3M	Inhabits freshwater wetlands and can be found in coastal habitats during migration
Piping Plover (melodus subspecies)	Charadrius melodus melodus	Endangered	Endangered	Endangered	S1B	Coastal shorebird
Purple Sandpiper	Calidris maritima	–	–	–	S3?N	Coastal shorebird
Red Knot (rufa subspecies)	Calidris canutus rufa	Endangered	Endangered	Endangered	S2M	Coastal shorebird
Ruddy Turnstone	Arenaria interpres	–	–	–	S3M	Coastal shorebird
Sanderling	Calidris alba	–	–	–	S3M, S2N	Coastal shorebird

Common Name	Scientific Name	NS ESA Status	SARA Status (Schedule 1)	COSEWIC Status	AC CDC Rank	Habitat Considerations
Semipalmated Plover	Charadrius semipalmatus	–	–	–	S1B, S3S4M	Coastal shorebird
Semipalmated Sandpiper	Calidris pusilla	–	–	–	S3M	Coastal shorebird
Short-billed Dowitcher	Limnodromus griseus	–	–	–	S3M	Inhabits freshwater wetlands and can be found in coastal habitats during migration
Spotted Sandpiper	Actitis macularius	–	–	–	S3S4B	Inhabits freshwater and coastal habitats
White-rumped Sandpiper	Calidris fuscicollis	–	–	–	S3M	Coastal shorebird
Willet	Tringa semipalmata	–	–	–	S2S3B	Coastal shorebird

Notes:
– = Not listed.
S1 = extremely rare in Nova Scotia; S2 = rare in Nova Scotia; S3 = uncommon in Nova Scotia; S4 = widespread, common and apparently secure in Nova Scotia; S5 = widespread, abundant and demonstrably secure in Nova Scotia.
S#S# = a numeric range rank used to indicate any range of uncertainty about the status of the species or community.
B= Breeding, N = Nonbreeding, M = Migrant.
Sources: AMEC (2007), NS ESA (2010), Government of Canada (2011), AC CDC (2017), and AC CDC (2018).



Bird Colonies near the Project Footprint Area

Number ID	Location	Species Present
1	Pictou Island	Great Blue Heron, Common Eider, Black Guillemot
2	Bowen Island	Arctic Tern, Common Tern
3	Doctor's Island	Great Blue Heron
4	Lighthouse Beach	Common/Arctic Tern
5	Pictou Landing	Double-crested Cormorant
6	Ballast Island	Common Tern
7	Pictou Oil Pier	Double-crested Cormorant
8	Pictou Wharf	Double-crested Cormorant
9	Pictou Causeway	Double-crested Cormorant

Northern Pulp Nova Scotia Corporation
Replacement Effluent Treatment Facility
Environmental Assessment

Special Areas of Importance for Marine Mammals, Sea Turtles, and Marine Birds
Figure 8-13.2

NORTHERN PULP NOVA SCOTIA CORPORATION A PAPER EXCELLENCE COMPANY

Legend:
- Bird Colony
- Outfall Diffuser Location
- Marine Local Assessment Area
- Marine Project Footprint Area*
- Terrestrial Project Footprint Area*
- Important Bird Area
- National Park
- Parks and Protected Areas
- Ecolgically and Biologically Significant Area (EBSA)

DILLON CONSULTING

MAP CREATED BY: HW
MAP CHECKED BY: SS
MAP PROJECTION: NAD 1983 UTM Zone 20N

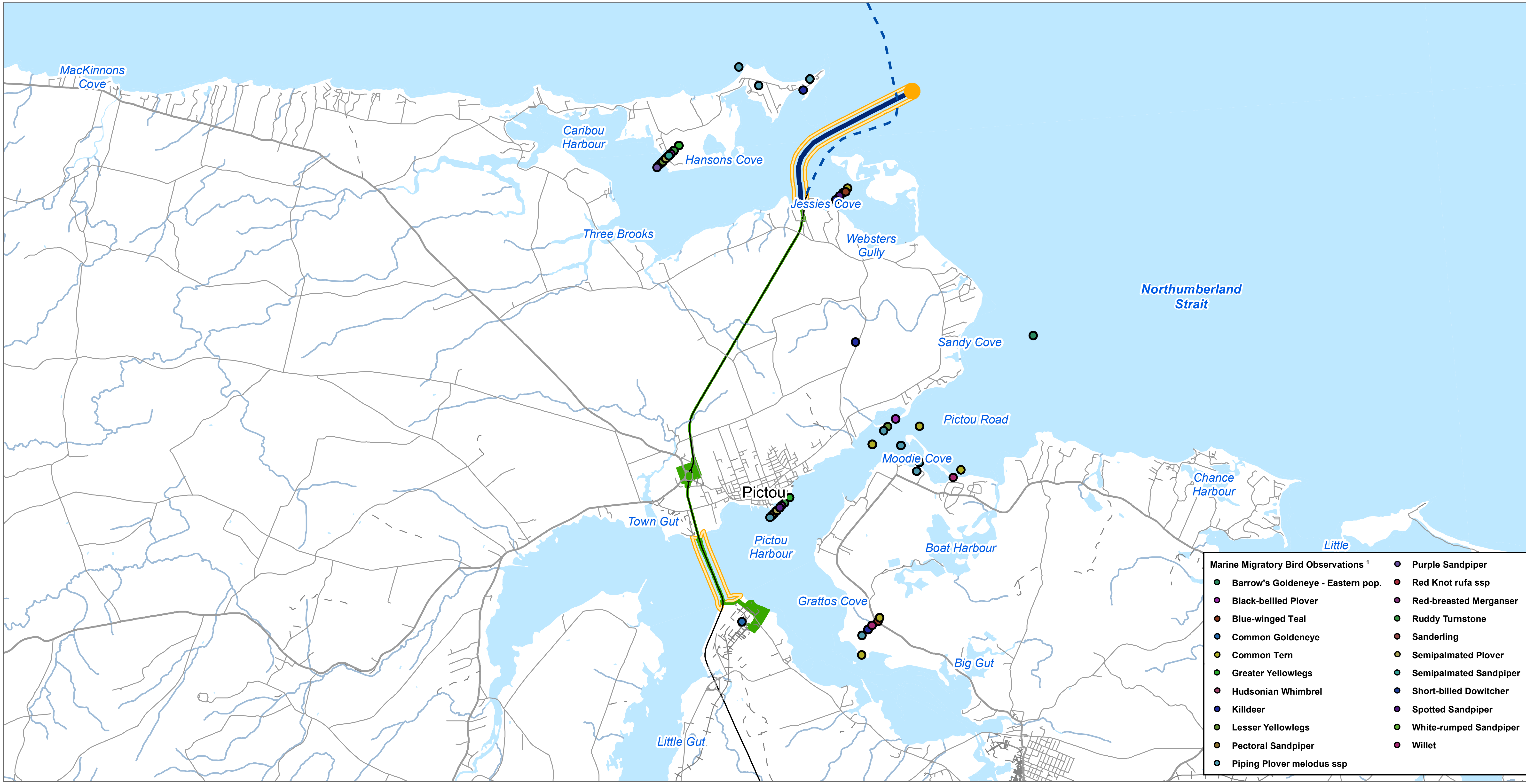
0 2.5 5 10 15 20
Kilometres

*Precise Project Footprint to be determined following completion of detailed design

Sources:
1. AC CDC (2018)
2. CWS (2019).

PROJECT: 17-6461

Date: 1/24/2019



Northern Pulp Nova Scotia Corporation

Replacement Effluent Treatment Facility
Environmental Assessment

Historical Marine Bird Observations

Figure 8.13-3

NORTHERN PULP
NOVA SCOTIA CORPORATION
A PAPER EXCELLENCE COMPANY

Outfall Diffuser Location

Marine Local Assessment Area

Marine Project Footprint Area*

Terrestrial Project Footprint Area*

DILLON CONSULTING

MAP CREATED BY: HW
MAP CHECKED BY: SS
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 0.5 1 2 3 4
Kilometres

*Precise Project Footprint to be determined following completion of detailed design

Sources:
1. AC CDC (2018)

PROJECT: 17-6461

Date: 1/24/2019

In addition to Barrow's Goldeneye, Piping Plover (*melodus* ssp.), and Red Knot (*rufa* ssp.) (**Table 8.13-4**), the following other SAR are also known to occur in the Northumberland Strait:

- Harlequin Duck (eastern population) (Histrionicus histrionicus), which is listed as Endangered on the Categorized List of Species at Risk under the NS ESA and is listed as a species of Special Concern on Schedule 1 of SARA; and
- Roseate Tern (Sterna dougalli), which is listed as Endangered on the Categorized List of Species at Risk under the NS ESA as well as on Schedule 1 of SARA.

Thus, a total of five marine bird SAR have been identified as having potential to be found near the LAA and/or in the Northumberland Strait. The following paragraphs provide life history information regarding these SAR.

The Barrow's Goldeneye (listed as a species of Special Concern on Schedule 1 of SARA) is a medium-sized diving duck that feeds on aquatic invertebrates, fish eggs, and occasionally small fish and vegetation. This species breeds along lakes in parkland and winters along rocky coasts (Cornell Lab of Ornithology 2017). In Canada, the eastern population breed in Québec; however, a small number of this population winter on sheltered shores of the Maritimes. Approximately 400 birds winter in the Atlantic Provinces and Maine (Environment Canada 2012, in Stantec 2015).

The Piping Plover (listed as Endangered under the NS ESA and on Schedule 1 of SARA) is a small, thrush-sized shorebird that blends well into its setting because it is primarily the colour of dry sand, although it also has distinctive black markings (i.e., a black collar or breastband, a black band above the white forehead, and a partially black tail). The melodus subspecies of the Piping Plover is a North American bird that breeds along the Atlantic coast from Newfoundland to South Carolina. It winters along the Atlantic coast, from South Carolina to Florida, and in the Caribbean (e.g., Cuba, Bahamas). In Canada, the *melodus* subspecies breeds on the Magdalen Islands of Québec, New Brunswick, Nova Scotia, PEI, and Newfoundland. They nest above the normal high-water mark on exposed sandy or gravelly beaches. About 25% of Canada's Piping Plovers are found in the Atlantic Provinces, where they often nest in coastal areas associated with small cobble and other small beach debris on ocean beaches, sand spits, or barrier beaches. They also forage for food on these beaches (Government of Canada 2015b, in Stantec 2015). Piping Plovers arrive at their breeding grounds in Atlantic Canada in late April or May. Clutches usually contain four eggs and both parents participate in the incubation of eggs and care of nestlings. Females can begin to breed at one year of age and will re-nest once or twice in a season if the eggs are destroyed (Government of Canada 2015b, in Stantec 2015).

The Red Knot *rufa* subspecies (listed as Endangered under the NS ESA and on Schedule 1 of SARA) is a medium-sized shorebird whose breeding range falls entirely within the central parts of the Canadian Arctic and that overwinters in South America (COSEWIC 2007). The Red Knot uses coastal areas with extensive sand flats during migration and is considered a fairly common transient along the coastline of Nova Scotia during fall migration (Tufts 1986). In Nova Scotia this species first appears in July, peaking in August and again in September to October (LGL 2014). There are ten areas in Eastern Canada identified in the status assessment for this species as being important sites for Red Knot migration, of which four are in the Gulf of St. Lawrence: Mingan Archipelago; Miscou Island; Magdalen Islands; and the north shore of PEI (COSEWIC 2007). Based on surveys conducted in the wintering range in South America, the estimated Red Knot *rufa* subspecies population in 2006 was 18,000 to 20,000 birds, decreasing 73.4% since 1982. The principal threats to the Red Knot include deterioration of food resources during spring migration (particularly the dwindling supply of horseshoe crab eggs in Delaware Bay which is the most important food used during the final spring stopover) and habitat loss and degradation (COSEWIC 2007).

Harlequin Duck (eastern population listed as Endangered under the NS ESA and as a species of Special Concern on Schedule 1 of SARA) is a small to medium-sized diving duck that breeds adjacent to fast-flowing streams and winters along rocky marine coastlines. This species feeds primarily on marine invertebrates and occasionally on fish, which it catches while diving (Robertson and Goudie 1999, in Stantec 2015). Two populations of Harlequin Duck are found in Canada: the western population along the Pacific Coast, and the eastern population along the Atlantic Coast. Harlequin Ducks of the eastern population mostly breed throughout much of Labrador, along eastern Hudson Bay, and the Great Northern Peninsula of the island of Newfoundland. There are known breeding populations along the north shore of the Gulf of St. Lawrence, the Gaspé Peninsula, northern New Brunswick, and southeastern Baffin Island in Nunavut. Small groups may spend the winter along the Gaspé Peninsula and Anticosti Island of Québec, and a few individuals may spend the winter in PEI (Stantec 2015).

The Roseate Tern (listed as Endangered under the NS ESA and on Schedule 1 of SARA) is a medium-sized seabird that is related to gulls. It is very similar to the Common Tern and the Arctic Tern and is frequently found in their company, but is distinguished from these two other tern species primarily by its shorter wings, longer tail and paler grey plumage. In North America, two populations of Roseate Tern breed on the Atlantic coast in distinct locations. The northeastern population extends from the Magdalen Islands, in the Gulf of St. Lawrence, south to New York. The Canadian population of Roseate Terns breeds almost exclusively on a few islands off the Atlantic coast of Nova Scotia, although small numbers of birds breed on islands in Québec and New Brunswick. They feed on small saltwater fish, most frequently sand lance, herring, Atlantic silversides, and hake. Roseate Terns nest in colonies almost exclusively on small coastal islands. They breed at sites covered with vegetation dominated by beach grass and herbaceous plants (Government of Canada 2015a, in Stantec 2015).

8.13.2.4 Special Areas of Importance for Marine Mammals, Sea Turtles and Marine Birds

The locations of special areas in the Northumberland Strait that are important for marine mammals, sea turtles, and marine birds are illustrated on **Figure 8.13-2**, including Ecologically and Biologically Significant Areas (EBSAs), Important Bird Areas (IBAs), bird colonies, and parks and protected areas. Overviews of these areas are provided below.

EBSAs

The Northumberland Strait is situated entirely within the Gulf of St. Lawrence Integrated Management (GOSLIM) Area, which encompasses approximately 240,000 km^2 (Benoît et al. 2012).

As part of the GOSLIM planning process, DFO has designated EBSAs that may require management measures. EBSAs are identified according to pre-established criteria, including uniqueness, aggregation, fitness consequences, sensitivity/resilience, and naturalness (DFO 2005b). In total, 10 EBSAs have been identified within the GOSLIM Area (DFO 2007), of which four are located in or near the Northumberland Strait (**Figure 8.13.3**). These three EBSAs are identified in **Table 8.13-5**, which also indicates their distances from the LAA and their relevance to marine mammals. However, these EBSAs were primarily established due to their importance for marine fish (refer to **Section 8.12**), with limited information available regarding their importance for marine mammals. DFO did not appear to specifically establish the GOSLIM Area EBSAs on the basis of sea turtles or marine birds (DFO 2017).

Table 8.13-5: EBSAs In and Around the Northumberland Strait

EBSA	Total Area	Relevance to Marine Mammals	Approximate Distance from LAA
South-Western Coast of the Gulf (including Chaleur Bay)	13,506 km^2	This EBSA includes an important feeding area for several marine mammal species (opportunistic, planktivorous) such as the harbour seal in winter and the blue whale. This area is located outside of the Northumberland Strait, offshore from the Gaspé Peninsula.	169 km
Western Northumberland Strait	2,194 km^2	This EBSA is located entirely within the Northumberland Strait and represents a well-known area of importance for marine mammals such as seals.	98 km
Western Cape Breton	8,198 km^2	Data on marine mammals are incomplete for this area even though it represents a well-known area of importance for the reproduction of grey, hooded and harp seals. There are only two or three known reproductive areas for these species in the Northwest Atlantic, including the ice in the southern gulf where this EBSA is located.	32 km
St. George's Bay	1,216 km^2	The area is known to provide important habitat for marine mammals in general. In particular, the Gulf ice in this area represents an important reproductive area in the Northwest Atlantic for grey, hooded and harp seals.	59 km

Source: DFO (2007)

DFO has also identified an additional candidate winter EBSA, referred to as the Southern Gulf Shelf, which is comprised of the southern Northumberland Strait, St. Georges Bay, Cape Breton, western Cape Breton, and the waters surrounding the Îles-de-la-Madeleine (Lesage et al. 2007). This candidate winter

EBSA overlaps the entire Western Cape Breton EBSA and extends further beyond the established EBSA in multiple directions, including into the eastern Northumberland Strait. The Southern Gulf Shelf represents a whelping and breeding area for three species of pinnipeds. Grey seals reproduce on small islands in this area (including Amet Island in the Northumberland Strait) as well as on the pack ice between PEI and Cape Breton, including the southern Northumberland Strait. Harp seals whelp on ice in this candidate winter EBSA, including in the eastern Northumberland Strait, from January through April. Hooded seals also whelp in the same general area as harp seals. This area is considered highly important for aggregation as it supports for thousands of individuals of each of the three species and, in some cases (e.g., possibly hooded seal), a totally independent population. However, the ecological and biological significance of the shelf of the southern Gulf for the three pinniped species is strongly associated with ice quality and is therefore applicable in winter only (Lesage 2017). The Marine PFA and LAA overlap the Southern Gulf Shelf candidate winter EBSA in the Northumberland Strait.

IBAs

IBAs are discrete areas that support nationally or globally important groups of birds. The IBA program is coordinated by BirdLife International and administered by Bird Studies Canada and Nature Canada (IBA Canada n.d.[a]). The criteria used to identify important habitat are internationally standardized and are based on the presence of threatened species, species with restricted range, habitats holding an assemblage of species restricted to a biome, or a congregation of a significant proportion of a species' population during one or more season (Moore and Couturier 2011). IBAs are not legally protected but are often found within areas that have been designated as protected areas by federal or provincial authorities.

There are several IBAs in and around the Northumberland Strait (**Figure 8.13-2**). It is generally assumed that many of the marine birds that inhabit or visit these IBAs also have potential to visit the LAA. The IBA in closest proximity to the project is High Bank (PE005), which is located approximately 21 km away from the LAA. In recent years, High Bank has supported an average of 92 nests of Great Cormorants annually, which represents almost 1.5% of the estimated North American population of the species. A peak of 317 nests was recorded in 1983, while a low of six nests was recorded in 1993. Other species that have nested at this colony include a few pairs of Double-crested Cormorants, Black Guillemots, and Rock Doves (*Columba livia*) (IBA n.d.[b]).

Bird Colonies

Table 8.13-6 identifies several areas in and around Pictou Harbour and Caribou Harbour that either currently support, or have previously supported, breeding colonial seabird species other than Double-crested Cormorants. Refer to **Table 8.13-3** in **Section 8.13.2.2** for a list of the Double-crested Cormorant colonies recorded in this area. The locations for the bird colonies identified in **Table 8.13-5** and **Table 8.13-6** are presented on **Figure 8.13-2**.

Table 8.13-6: Bird Colonies In and Around Pictou Harbour and Caribou Harbour

Year	Location	Species	Colony Size	Approximate Distance from LAA
1960	Doctors Island (Gulf of St. Lawrence), NS	Great Blue Heron	30 pairs	0.9 km
1980	Pictou Island East Point, NS	Great Blue Heron	53 pairs	1.3 km
1987	Pictou Island West Point, NS	Great Blue Heron	60 pairs	6.6 km
1995	Bowen Island, NS	Common/Arctic Tern	3 individuals	13.3 km
1995	Little Harbour, NS	Common Tern	300 individuals	14 km
2007	End of Lighthouse Beach, NS	Common/Arctic Tern	39 pairs	5.2 km
2007	Little Harbour, sandspit between Bowen Island and Mainland, NS	Common/Arctic Tern	54 pairs	13.4 km
2007	Sandbar northeast of Powell Point, NS	Common Tern	Unspecified	13 km
2008	Pictou Island West Point, NS	Common Eider	Unspecified	6.6 km
2008	Pictou Island, NS	Black Guillemot	16 individuals	9.8 km
2008	Pictou Island, NS	Great Blue Heron	Unspecified	9.8 km
2011	Ballast Island, NS	Common Tern	77 pairs	3 km

Source: CWS (2019)

Several other bird colonies (in addition to those identified in **Table 8.13-5** and **Table 8.13-6**) occur in and around the Northumberland Strait (CWS 2019) and are also depicted on **Figure 8.13-2**. However, the nearest of these colonies is located approximately 20 km from the LAA. The species recorded at these farther colonies include: Arctic Tern, Black Guillemot, Black Tern (*Chlidonias niger*), Common Eider, Common Tern, Double-crested Cormorant, Great Black-backed Gull (*Larus marinus*), Great Blue Heron, Great Cormorant, Herring Gull (*Larus argentatus*), and Ring-billed Gull.

<u>Parks and Protected Areas</u>

There are several parks and protected areas within approximately 100 km of the LAA that are known to provide important habitat for, and/or be frequented by, marine birds, including the following:

- Multiple coastal provincial parks in Nova Scotia that border the Northumberland Strait are known for birdwatching, including Blue Sea Beach Provincial Park, Caribou-Munroes Island Provincial Park, Gulf Shore Provincial Park, Heather Beach Provincial Park, and Powell's Point Provincial Park (Tourism Nova Scotia 2017a, 2017b, 2017c, 2017d, 2017e).

- Bird species classified as critically imperiled and/or vulnerable to extirpation or extinction are known to occur at Amherst Shore Provincial Park, Blue Sea Beach Provincial Park, Fox Harbour Provincial Park, Melmerby Beach Provincial Park, Rushton's Beach Provincial Park, and Waterside Beach Provincial Park; however, the relevant species are not identified in readily available information from the Province of Nova Scotia (2013a, 2013b, 2013c, 2013d, 2013e, 2013f).
- There has been recorded potential for Piping Plover (a SAR) at the Cape John Beach Provincial Park and Lighthouse Beach Nature Reserve (Province of Nova Scotia 2013g, 2013h).
- The Pugwash River Estuary Conservation Lands contain forest and marsh habitat for a variety of staging and migrating waterfowl, such as Canada Goose, American Black Duck, Great Blue Heron, and Green-winged Teal. This estuary is also home to the Piping Plover and Barrow's Goldeneye, both of which are SAR. There have been 27 species of shorebirds documented in the region during spring and fall migration periods (Nature Conservancy of Canada 2018).
- The Wallace Bay National Wildlife Area (NWA) provides important habitat for migrating and nesting waterfowl. American Black Duck, Green-winged Teal, and Northern Pintail (Anas acuta) all regularly breed at this NWA. The marine wetland portion of this NWA is composed of tidal channels and salt marsh (Government of Canada 2017a).
- Key species known to inhabit or frequent PEI National Park include Piping Plover (a SAR), Great Blue Heron, Bald Eagle (Haliaeetus leucocephalus), and Osprey (Government of Canada 2018).

The locations of the above-listed parks and protected areas are depicted on **Figure 8.13-2**. It is generally assumed that many of the marine birds that inhabit or visit these parks and protected areas also have potential to visit the LAA.

8.13.3 Impact Evaluation/Effects Assessment

8.13.3.1 Potential Environmental Effects

There is potential for project activities and components to interact with marine mammals, sea turtles, and marine birds to result in a change in risk of injury or mortality and a change in habitat quality and use during the construction and operation and maintenance phases of the project.

During the construction phase of the project:

- Marine mammals and sea turtles could be adversely affected by a project-related change in risk of injury or mortality associated with:
  - potential collisions with project vessels and equipment;
  - potential entanglement in anchor lines; and
  - potential direct explosion-induced physical damage and/or exposure to harmful levels of underwater sound and vibration during marine blasting (if required).
- Marine birds could be adversely affected by project-related changes in risk of injury or mortality associated with:
  - potential exposure to residual hydrocarbons in routine discharges from project vessels (e.g., bilge water, ballast water, deck drainage, sewage);

  - potential collisions with vessel structures;
  - potential attraction to artificial night lighting onboard project vessels resulting in disorientation, exhaustion, stranding, and increased exposure to other vessel-based hazards;
  - potential direct explosion-induced physical damage to diving marine birds and/or exposure of diving marine birds to harmful levels of underwater sound and vibration during marine blasting (if required) in the Northumberland Strait; and
  - potential direct explosion-induced physical damage to non-diving marine birds and/or exposure of non-diving marine birds to harmful levels of underwater sound and vibration during marine blasting (if required) at the Pictou Causeway.
- Marine mammals, sea turtles, and marine birds could be adversely affected by project-related changes in habitat quality and use associated with:
  - interference with pinniped access to, or use of, islands or pack ice for whelping or breeding;
  - a change in water quality caused by routine discharges from project vessels;
  - sediment resuspension from seabed disturbance during pipeline trenching and installation (including construction of a gravel access causeway/bridge to facilitate pipeline trenching and installation in the intertidal/nearshore zone) and outfall construction;
  - acoustic emissions (i.e., atmospheric acoustic emissions affecting non-diving marine birds and underwater acoustic emissions affecting marine mammals, sea turtles and diving marine birds), artificial night lighting, and other sensory disturbance from the presence and operation of project vessels and equipment;
  - emissions of underwater sound and vibration potentially affecting marine mammals, sea turtles, and diving marine birds if marine blasting is required in the Northumberland Strait; and
  - emissions of atmospheric sound and vibration potentially affecting non-diving marine birds if blasting on land is required at the Pictou Causeway.
- During the operation and maintenance phase of the project:
  - marine mammals, sea turtles, and marine birds could be adversely affected by a project-related change in habitat quality and use associated with a change in water quality caused by routine treated effluent discharge from the effluent outfall diffuser; and
  - some or all of the mechanisms identified above for potential project-related changes in risk of injury or mortality and potential project-related changes in habitat quality and use during the construction phase may also be applicable during the operation and maintenance phase if project maintenance activities require the presence and operation of project vessels or equipment, seabed disturbance (e.g., for pipeline retrieval or reburial).

The potential environmental effects identified above for the construction and operation and maintenance phases of the project could affect secure species of marine mammals, sea turtles, and marine birds as well as SAR and SOCC.

For the reasons provided below, the following potential environmental interactions do not warrant inclusion in the environmental effects assessment for marine mammals, sea turtles, and marine birds and are therefore not considered further in **Sections 8.13.3.2** or **8.13.3.3**:

- Underwater sound levels from project vessel traffic during construction and operation and maintenance are not anticipated to exceed the thresholds for direct injury to marine mammals from non-impulsive sound (i.e., a cumulative sound exposure level of 201 dB re 1 µPa2s over a 24-hour period or a peak sound pressure level of 218 dB re 1 µPa [NMFS 2016]). Typical vessel traffic (e.g., barges, tugs, and bulk carriers) produces sound levels of between 168 and 193 dB re 1 µPa at 1 m (Richardson et al. 1995). Nedwell et al. (2003; cited in Vize et al. 2008) reported an example from the United Kingdom in which subsea trenching in sandy gravel produced noise at a source level of 178 dB re 1 µPa at 1 m (Vize et al. 2008). Project vessels used for construction and for potential maintenance and repairs during operation will be relatively small in size and draft and will not be present in large numbers. Underwater noise emitted from the operation of the barge-mounted excavator and/or crane during trenching operations is expected to be similar in nature to the operation of bottom otter trawl fishing gear.
- In consideration of the results of the assessment of potential project-related environmental effects on water quality and sediment quality (**Section 8.11**), routine discharge from the effluent outfall diffuser are not anticipated to result in contamination of water or sediment at concentrations that would cause a change in risk of injury or mortality affecting marine mammals, sea turtles, or marine birds during construction or operation and maintenance.
- Given that the Marine PFA does not cross any areas known to contain contaminated sediments (refer to **Section 8.11**), and that marine species are generally expected to avoid the immediate area where project activities are taking place, the resuspension of sediments during pipeline trenching and excavation activities (as well as during maintenance activities entailing seabed disturbance, if applicable) is not anticipated to cause a change in risk of injury or mortality for marine mammals, sea turtles, or marine birds.

In consideration of the results of the assessment of potential project-related environmental effects on marine fish and fish habitat (**Section 8.12**), the project is not anticipated to adversely affect the quality or availability of food sources (i.e., prey species) for marine mammals, sea turtles, or marine birds during construction or operation and maintenance and there will be no project-related serious harm to fish (including prey species) that is not mitigated through offsetting measures in accordance with DFO's Fisheries Protection Policy Statement (DFO 2013). As described in **Section 8.12** and **Appendix G**, EEM will be conducted near the effluent outfall diffuser. The results of this EEM program are expected to confirm that any potential contamination of prey species will be negligible and unlikely to adversely affect the marine mammals, sea turtles, and marine birds that ingest them.

8.13.3.2 Mitigation

The following mitigation measures will be implemented to reduce project-related environmental effects on marine mammals, sea turtles, and marine birds during the construction phase:

- The barge-mounted excavator and/or crane will operate at slow maneuvering speeds while engaged in pipeline trenching and installation and project vessels will have a maximum speed of 10 knots during transit to reduce the risk of lethal strikes to marine wildlife (Laist et al. 2001). No high-speed maneuvers will be conducted by vessels engaged in project activities.
- If required, Marine Mammal Observers (MMOs) equipped with 7x35-power binoculars will monitor and report on marine mammal and sea turtle sightings during project construction activities. This is typically only required during marine blasting operations.
- Project vessels will adhere to the general guidelines for vessels operating near marine mammals that are specified in section A2 of the annual edition of Notices to Mariners (DFO 2018c). Adherence to these guidelines includes, but is not limited to, the following measures:
  - Project vessels will approach areas of known or suspected marine wildlife activity with extreme caution.
  - Project vessels will reduce their speeds to less than 7 knots when within 400 m of the nearest marine mammal and avoid abrupt changes of course.
  - Project vessels will not approach any marine mammals and will maintain a distance of at least 100 m from the nearest marine mammal.
- Project vessels will maintain a distance of at least 300 m from islands or pack ice where seals are actively whelping or breeding.
- The risk of marine mammal or sea turtle entanglement in anchor lines will be reduced by (U.S. Maritime Administration and Coast Guard 2009):
  - only deploying anchor lines as necessary to complete the task and then promptly removing them,
  - keeping anchor lines as taut as possible during use (although some slack is necessary to account for currents, tides, and other factors), and
  - taking in the slack or removing the line as quickly as possible or in the unlikely event that entanglement appears likely.
- The operator will notify the Maritime Animal Rescue Society (MARS) immediately (by phone at 1-866-567-6277, by email at marineanimalresponse@gmail.com, and/or by radio on VHF Channel 16) in the unlikely event that a marine mammal or sea turtle becomes entangled.
- In accordance with DFO Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters (Wright and Hopky 1998), no marine blasting (if required) will be conducted within 500 m of a marine mammal or sea turtle.
- Routine effluents and operational discharges produced by project vessels (e.g., grey and black water, bilge water, deck drainage, discharges from machinery, and non-hazardous waste material) will be managed in accordance with International Convention for the Prevention of Pollution from Ships (MARPOL) and International Maritime Organization (IMO) guidelines, of which Canada has incorporated provisions under various sections of the Canada Shipping Act. No waste or garbage will be dumped overboard.
- Lighting is required for navigational and safety purposes; however, deck lighting on project vessels will be reduced whenever it is safe and practical to do so, and the use of unnecessary lighting will be

avoided. If possible, waste lighting will be further reduced using directional overhead lighting focused on work areas, rather than floodlights.

- Project vessels will adhere to ECCC guidelines for avoiding disturbance to seabird and waterbird colonies (Government of Canada 2017b). Adherence to these guidelines includes, but is not limited to, the following measures:
  - Blasting on land (if required) will be avoided within 1 km of active bird colonies;
  - All other project construction activities will be avoided where possible within 300 m of active bird colonies. Project vessels will maintain a distance of at least 300 m from active breeding islands where possible;
  - Project vessels will travel at steady speeds near active bird colonies, moving parallel to the shore rather than approaching the colony directly; and
  - Project vessels will avoid making sharp or loud noises (e.g., blowing horns or whistles) and will maintain constant engine noise levels near active bird colonies.
- Bird deterrent devices will be used prior to blasting (if blasting is required in the marine environment or on land).
- Given the seasonal presence of a colony of Double-crested Cormorants adjacent to the Pictou Causeway and the potential for other migratory birds to be nesting in the area (including SAR), no blasting (if required) or other intrusive construction activities related to the Pictou Causeway crossing will be carried out during the nesting period for migratory birds (April 1st to August 31st), or as agreed to by the Canadian Wildlife Service (CWS).
- A permit to handle storm-petrels will be obtained from CWS and held onboard project vessels to cover personnel involved in bird collision and stranding incidents. These designated crew members will conduct routine checks of project vessels for stranded seabirds. If any Leach's Storm-petrel becomes stranded on a project vessel, it will be handled and released in accordance with the procedures outlined in *The Leach's Storm-Petrel: General Information and Handling Instructions* (Williams and Chardine n.d.).
- A project-specific EPP will be developed prior to the commencement of construction activities and will include measures to control sediment resuspension associated with seabed disturbance.
- Environmental controls (e.g., silt curtains) will be employed as necessary to reduce sediment resuspension during construction in the intertidal/nearshore zone and marine outfall construction.

The following mitigation measures will be implemented to reduce project-related environmental effects on marine mammals, sea turtles, and marine birds during the operation and maintenance phase:

- Effluent will be treated to comply with all applicable regulatory requirements for effluent discharge quality.
- A three-port design has been selected for the effluent outfall diffuser to improve near-field dilution and mixing (compared with a one-port diffuser) during project operations (Stantec 2018; **Appendix E**).

Some or all of the mitigation measures outlined above for the construction phase may also be applicable for the operation and maintenance phase if project maintenance activities require the presence and operation of project vessels or equipment, seabed disturbance (e.g., for pipeline retrieval or reburial).

8.13.3.3 Characterization of Residual Environmental Effects

Change in Risk of Injury or Mortality

Injury or mortality of marine mammals and sea turtles can occur from vessel strikes or entanglement in anchor lines. Although there are no known concentration areas for marine mammals near the LAA, it is possible that groups of foraging marine mammals may be encountered in the area, particularly during summer months. Among marine mammals, mysticetes are known to be more vulnerable to vessel strikes than odontocetes and pinnipeds (Laist et al. 2001; Jensen and Silber 2003; Vanderlaan and Taggart 2007). Most lethal and severe injuries to large whales resulting from documented ship strikes have occurred when vessels were travelling at ≥14 knots (25.9 km/hour; Laist et al. 2001). Reducing vessel speed has been shown to reduce the number of marine mammal deaths and severe injuries due to vessel strikes (Vanderlaan and Taggart 2007; Vanderlaan et al. 2008, 2009; van der Hoop et al. 2015). Lethal strikes are considered infrequent at vessel speeds <14 knots and rare at speeds <10 knots (18.5 km/h; Laist et al. 2001).

As noted in **Section 8.13.2.1**, several North Atlantic right whales were killed by vessel collisions and fishing gear entanglement in the Gulf of St. Lawrence (outside of the Northumberland Strait) during the summer of 2017. However, this SAR is not known to occur in the Northumberland Strait and is therefore unlikely to be at increased risk of injury or mortality from vessel strikes or entanglement from the project.

Propeller and collision injuries from boats and ships are common in sea turtles, at least in U.S. waters (NMFS 2008). However, sea turtles are considered rare in the Northumberland Strait. In Australia, Hazel et al. (2007) demonstrated that the proportion of green sea turtles maneuvering to avoid a vessel decreased with increased vessel speed, suggesting that turtles may not avoid faster moving vessels.

The relatively slow speed of vessel movements during transit (i.e., maximum of 10 knots) and pipeline trenching and installation operations will increase the ability of marine mammals, sea turtles, and marine birds to avoid potential collisions with project vessels and equipment. The mitigation measures listed in **Section 8.13.3.2** will also reduce the risk of entanglement. Entanglement in anchor lines is a relatively rare occurrence in comparison with entanglement in lost/discarded fishing gear and other marine debris (Laist 1997), and it is considered unlikely to occur from project activities.

Discharges from project vessels are expected to be temporary, localized, non-bio-accumulating, non-toxic, and will be subject to dilution; organic matter will be quickly dispersed and degraded by bacteria. Marine birds are vulnerable to potential injury or mortality when exposed to hydrocarbon contamination. If residual hydrocarbons are present in routine discharges from project vessels, they would be at low volumes and concentrations and are expected to comply with MARPOL requirements. Residual hydrocarbons in discharges released in accordance with MARPOL are generally not associated with the formation of a slick (potentially affecting marine birds) and are therefore unlikely to cause a measurable change in risk of injury or mortality for marine birds.

Project vessels may operate up to 24 hours a day, 7 days a week during construction. Marine vessel lighting will be required for navigational aids and illumination of work areas during nighttime vessel operations. Although operation of project vessels and equipment will have a deterrent effect on most marine species, there is potential for nocturnally migrating marine birds to be attracted and disoriented by artificial night lighting. Disoriented birds may fly into vessel lights or infrastructure, injuring themselves and becoming stranded. Birds have been observed flying continuously around lights, consuming energy and delaying foraging or migration (Husky Oil 2000).

Among marine birds, attraction to artificial lighting and related grounding appears to be widespread among procellariiform species such as fulmarine and gadfly petrels, shearwaters, and prions (Procellariidae), storm-petrels (Hydrobatidae), and diving-petrels (Pelecanoididae), except for albatrosses (Diomedeidae). This behaviour has been observed in more than 40 species (Imber 1975; Reed et al. 1985; Telfer et al. 1987; Le Corre et al. 2002; Black 2005; Montevecchi 2006; Rodríguez and Rodríguez 2009; Miles et al. 2010; Rodríguez et al. 2015) and suggests that some aspect of the orientation system common to procellariform birds may be disoriented by artificial light. Light attraction has also been reported in the Atlantic puffin in coastal areas near nesting colonies in both Scotland and Newfoundland (Miles et al. 2010; Wilhelm et al. 2013). However, procellariiform species are generally uncommon in the Northumberland Strait and puffins are not expected to occur in the Strait, thus reducing the risk of potential marine bird attraction to project-related artificial night lighting. This risk will be further reduced through the application of mitigation measures specific to vessel lighting and the handling of stranded birds, as outlined in **Section 8.13.3.2**.

If blasting is required, potential effects associated with marine blasting in the Northumberland Strait and/or blasting on land at the Pictou Causeway will be temporary, short in duration, and infrequent. The risk of direct explosion-induced physical damage from blasting will be highly localized around the marine PFA and is considered very low since marine species are generally expected to avoid the immediate area where project activities are taking place. However, auditory injury from blasting could occur within a larger spatial extent. Although the risk of permanent or temporary threshold shifts for marine mammals may extend beyond the LAA, the avoidance of marine blasting within 500 m of a marine mammal or sea turtle will substantially reduce or eliminate this risk such that only temporary behavioural effects are expected. This 500 m buffer zone is in accordance with DFO guidelines (Wright and Hopky 1998) that are intended to be protective of marine mammals. Similarly, the use of bird deterrent devices prior to blasting, the seasonal avoidance of blasting on land during the nesting period for migratory birds, and the avoidance of blasting on land within 1 km of active bird colonies in accordance with ECCC guidelines [Government of Canada 2017b] that are intended to be protective of colonial marine birds) will substantially reduce or eliminate the risk of auditory harm to marine birds. In the unlikely event that a diving marine bird remains in the area despite the presence and operation of project vessels and equipment and the use of bird deterrent devices prior to marine blasting, it is expected that any potential effects would be at least somewhat attenuated by the water prior to reaching the bird. Thus, a residual change in risk of injury or mortality for marine mammals, sea turtles, and marine birds from blasting (if required) is anticipated to be low in magnitude and unlikely to occur.

The potential residual change in risk of injury or mortality for marine mammals, sea turtles, and marine birds during construction is predicted to be adverse in direction, low in magnitude, localized in spatial extent, temporary and limited in duration to the construction phase, daily in frequency, reversible, and occurring in a context of previous disturbance.

The residual effects characterizations provided above for the construction phase may also be generally applicable for the operation and maintenance phase if project maintenance activities require the presence and operation of project vessels or equipment, seabed disturbance (e.g., for pipeline retrieval or reburial), and/or marine blasting. However, any potential residual change in risk of injury or mortality associated with project maintenance would generally be expected to be relatively more localized in spatial extent, lower in magnitude, shorter in duration and limited to the operation and maintenance phase, and less frequent than the potential residual effects associated with project construction. If project maintenance activities do not require the presence and operation of project vessels or equipment, seabed disturbance, or marine blasting, no residual change in risk of injury or mortality is predicted to affect marine mammals, sea turtles, or marine birds.

Change in Habitat Quality and Use

Marine species may temporarily exhibit changes in behaviour in localized areas where water quality is affected by routine discharges from project vessels. For example, if routine discharges from project vessels produce a sheen, this could result in avoidance by marine birds. Conversely, Northern Fulmar, shearwaters and storm-petrels are attracted to sheens, and the visual appearance of a hydrocarbon sheen could resemble a sheen of biological origin that may initially attract such species (Nevitt 1999); however, these species are uncommon in the Northumberland Strait. The production of sheens from routine vessel discharges will be unusual given adherence to MARPOL requirements for waste management, and adherence to MARPOL is also anticipated to generally mitigate the potential water quality effects of routine vessel discharges such that the magnitude of the residual change in habitat quality and use for marine mammals, sea turtles, and marine birds is predicted to be low. Also, as noted above regarding a potential residual change in risk of injury or mortality, routine discharges from project vessels are predicted to disperse quickly, causing only short-term and localized effects on water quality around the source.

With respect to project construction activities involving seabed disturbance, although there may be temporary and localized increases in turbidity, levels of TSS are expected to dissipate to background levels within a matter of hours or days (depending on grain size and the level of wave and current action in the area).

Sensory disturbance to marine species from the presence and operation of project vessels and equipment and blasting (if required) could lead to behavioural responses in marine mammals, sea turtles, and marine birds, such as temporary habitat avoidance/displacement or attraction and temporary changes in movements, communications, feeding, or activity state. Sensory disturbance also has potential to disrupt reproductive, foraging and feeding, and/or migratory behaviour for marine mammals, sea turtles, and marine birds if the availability of important habitat areas, including the special areas illustrated on **Figure 8.13.2**, is affected. However, such disruptions are considered unlikely to occur given the short-term, transient and relatively localized nature of anticipated project-related sensory disturbances (and the infrequency of blasting-related sensory disturbances, if blasting is required) as well as:

- the avoidance of project activities in Pictou Harbour during the nesting period for migratory birds (April 1st to August 31st), to the extent possible (See **Section 8.10** and **Section 8.13.3.2**);
- the avoidance of project activities within 300 m of active bird colonies in the Northumberland Strait, to the extent possible;
- where required, the employment of MMOs, adherence to the general guidelines for vessels operating near marine mammals that are specified in the annual edition of Notices to Mariners (DFO 2018c), maintenance of a 300 m buffer around pack ice where seals are actively whelping or breeding, and adherence to DFO blasting guidelines (Wright and Hopky 1998);
- if blasting is required, the implementation of mitigation measures to reduce a potential change in risk of injury or mortality for marine wildlife associated with blasting (i.e., maintenance of a 500 m buffer zone around marine mammals and sea turtles in which marine blasting [if required] will be avoided and maintenance of a 1 km buffer around active bird colonies in which blasting on land [if required] will be avoided), which will also reduce potential blasting-related sensory disturbance and associated behavioural effects on marine wildlife; and
- the distances between the LAA and most special areas of importance to marine mammals, sea turtles, and marine birds.

The residual environmental effects characterizations provided above for the construction phase may also be generally applicable for the operation and maintenance phase if project maintenance activities require the presence and operation of project vessels and equipment, seabed disturbance (e.g., for pipeline retrieval or reburial). However, any potential residual change in habitat quality and use associated with project maintenance would generally be expected to be relatively more localized in spatial extent, lower in magnitude, shorter in duration and limited to the operation and maintenance phase, and less frequent than the potential residual effects associated with project construction.

The results of modelling that was conducted for the project-specific receiving water study (Stantec 2018; **Appendix E**) indicate that potential water quality effects associated with routine discharges of treated effluent from the three-port effluent outfall diffuser during the operation and maintenance phase of the project will generally be limited to the immediate area of the diffuser. The concentrations of most water quality parameters of concern (i.e., TN, TP, TSS, DO, pH, and salinity) are predicted to be diluted to approximately background levels or ambient conditions within less than 2 m of the diffuser. At 5 m from the diffuser, the concentration of the treated effluent in the receiving water is predicted to be diluted sufficiently to meet the colour of the background water in the Northumberland Strait. Water temperature is anticipated to meet compliance for applicable federal water quality guidelines within approximately 2 m of the diffuser and be within 0.1 °C of background at the end of the 100-m mixing zone. Although there are no applicable federal water quality guidelines for the remaining parameters (i.e., AOX, BOD, and COD), the proposed daily maximum discharge of AOX adheres to international guidelines for effluent discharge from pulp mills, and the anticipated concentrations of BOD and COD at the end of the 100-m mixing zone are well below levels at which they would be considered polluted as a result of the project, based on literature from ECCC (McNeely et al. 1979, in Stantec 2018) and UNESCO (2006, in Stantec 2018). The top part of the plume from the effluent outfall diffuser is expected to reach the surface water approximately 25 m from the diffuser but is not expected to be visible at the surface. In consideration of these modelling results, any potential change in habitat quality and use for marine mammals, sea turtles, or marine birds associated with routine discharges from the effluent outfall diffuser would be expected to be negligible in magnitude and highly localized in spatial extent.

8.13.4 Summary

Table 8.13-7 summarizes the potential residual environmental effects of the project on marine mammals, sea turtles, and marine birds.

Table 8.13-7: Summary of Residual Environmental Effects to Marine Mammals, Sea Turtles and Marine Birds

Project Activities	Potential Effects	Mitigation	Residual Effects	Significance of Residual Effects
Construction				
Marine pipeline trenching and installation, installation of effluent outfall diffuser, and associated marine construction activities, including barge anchoring	Change in risk of injury or mortality Change in habitat quality and use	• Operate the barge-mounted excavator and/or crane at slow maneuvering speeds during pipeline trenching/installation and limit the speed of project vessels to 10 knots during transit. • Where required,	No unmitigated interaction between the project and marine mammals, sea turtles, and marine birds is expected to occur. *Direct, reversible.* *Direction – Adverse* *Magnitude – Low* *Geographic extent – Local* *Duration – Construction phase* *Frequency – Daily*	Not Significant – Adverse

Project Activities	Potential Effects	Mitigation	Residual Effects	Significance of Residual Effects
		employ MMOs to monitor and report on marine mammal and sea turtle sightings. • Adhere to general guidelines for vessels operating near marine mammals, as specified in section A2 of the annual edition of Notices to Mariners (DFO 2018c). • Maintain a distance of at least 300 m from islands or pack ice where seals are actively whelping or breeding. • Implement measures to reduce the risk of marine mammal or sea turtle entanglement in anchor lines (as listed in Section 8.13.3.2) and notify MARS immediately in the event of an entanglement incident. • Avoid marine blasting within 500 m of a marine mammal or sea turtle. • Comply with	*Reversibility – Reversible* *Context – Disturbed*	

Project Activities	Potential Effects	Mitigation	Residual Effects	Significance of Residual Effects
		MARPOL and IMO guidelines. • Reduce deck lighting on project vessels, avoid unnecessary lighting, and use directional overhead lighting rather than floodlights wherever safe and practical to do so. • Adhere to ECCC guidelines for avoiding disturbance to seabird and waterbird colonies (Government of Canada 2017b). • If blasting is required, use bird deterrent devices prior to blasting. • Schedule construction activities related to the Pictou Causeway crossing to avoid the nesting period for migratory birds (April 1st to August 31st), unless otherwise approved. • Obtain a permit from CWS to handle storm-petrels and		

Project Activities	Potential Effects	Mitigation	Residual Effects	Significance of Residual Effects
		conduct routine checks of project vessels for stranded birds. • Comply with procedures outlined in The Leach's Storm-Petrel: General Information and Handling Instructions (Williams and Chardine n.d.) in the event that a Leach's Storm-petrel becomes stranded on a project vessel. • Develop a project-specific EPP prior to the commencement of construction activities. • Employ environmental controls (e.g., silt curtains) as necessary to reduce sediment resuspension during construction in the intertidal/nearshore zone and marine outfall construction.		

Project Activities	Potential Effects	Mitigation	Residual Effects	Significance of Residual Effects
Operation and Maintenance				
Presence and operation of the marine pipeline and effluent outfall diffuser	Change in habitat quality and use	• Treat effluent to comply with all applicable regulatory requirements for effluent discharge quality. • Employ a three-port design for the effluent outfall diffuser. • Undertake effluent plume delineation study that is a component of the EEM program. • Routinely inspect diffuser for proper functioning and maintenance.	No unmitigated interaction between the project and marine mammals, sea turtles, and marine birds is expected to occur. *Indirect, reversible.* *Direction – Adverse* *Magnitude – Negligible* *Geographic extent – Local* *Duration – Operation and maintenance phase* *Frequency – Permanent* *Reversibility – Reversible* *Context – Disturbed*	Not Significant – Adverse
Maintenance of the marine pipeline and effluent outfall diffuser	If required maintenance activities entail the presence and operation of project vessels and equipment, seabed disturbance: Change in risk of injury or mortality and/or Change in habitat quality and use	If required maintenance activities entail the presence and operation of project vessels and equipment, seabed disturbance implement mitigation measures identified above for marine pipeline trenching and installation, installation of effluent outfall diffuser, and associated marine construction activities, including barge anchoring (as applicable)	No unmitigated interaction between the project and marine mammals, sea turtles, and marine birds is expected to occur. *Direct, reversible.* *Direction – Adverse* *Magnitude – Low* *Geographic extent – Local* *Duration – Operation and maintenance phase* *Frequency – Occasional* *Reversibility – Reversible* *Context – Disturbed*	Not Significant – Adverse

The presence and operation of project vessels and equipment (including associated emissions and discharges), seabed disturbance, and marine blasting (if required) during the construction phase (and potentially also during the operation and maintenance phase, depending on the nature of maintenance requirements), as well as treated effluent discharge during the operation and maintenance phase, have potential to adversely affect marine mammals, sea turtles, and marine birds by causing a change in risk of injury or mortality and/or a change in habitat quality and use. The environmental effects assessment in **Section 8.13.3.3** describes these interactions and proposes mitigation measures to reduce anticipated potential adverse environmental effects.

In summary, with implementation of the mitigation measures proposed in **Section 8.13.3.3**, significant adverse residual environmental effects on marine mammals, sea turtles, and marine birds are not anticipated and the residual environmental effects of the project on marine mammals, sea turtles, and marine birds during all phases of the project are rated not significant. The completion of a project-specific EEM program in the vicinity of the treated effluent outfall diffuser as a follow-up measure (refer to **Section 8.13.3.1**, **Section 8.12**, and **Appendix H**) will confirm this prediction.

8.13.5 Follow-up and Monitoring

NPNS will conduct an EEM program in the vicinity of the effluent outfall diffuser, such as that developed by EcoMetrix (2018; **Appendix G**), in compliance with the PPER. The follow up and monitoring program descried in **Appendix H** will also be completed.

In addition, NPNS has had a Toxicity Prevention and Remediation Plan in place for many years that has been reviewed by ECCC to provide a structured approach for addressing treated effluent toxicity problems, should they occur.

8.14 Socio-Economic Environment

The potential environmental effects of the project on the socio-economic environment are assessed in this section. It provides an overview of the existing environment as it pertains to land, water and the socio-economic environment, an assessment of potential environmental effects as a result of the project, a characterization of the significance of potential environmental effects, and identification of follow up and monitoring for the project.

8.14.1 Scope of VEC

The social and economic ('socio-economic') environment was identified as a VEC in consideration of the potential interactions with local communities, how land and water is used in the vicinity of the project, and the potential interaction between the project and the economic well-being of these communities. These potential interactions are of concern to regulatory agencies, non-governmental organizations, and the general public because they can have a direct influence on the everyday lives of those living and working in the vicinity of a project. The socio-economic environment VEC includes land and water uses such as community resources and recreation, and economic industries, infrastructure. Socio-economic features are shown on **Figure 8.14-1**.

8.14.1.1 Boundaries

Spatial boundaries for the assessment of environmental effects on the socio-economic environment include the following:

- The **project footprint area (PFA)** is defined as the physical footprint of the project including the location of the new replacement ETF on the NPNS mill property, the overland portion of the effluent pipeline, and the marine portion of the effluent pipeline and the marine outfall. The PFA is defined in **Section 5.1.1**.
- The **local assessment area (LAA)** is the maximum area within which environmental effects from the project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence. The LAA can be thought of as the "zone of influence" of the project. For the socio-economic environment, the LAA is represented by the communities whose regular activities intersect with the PFA: Pictou Landing First Nation, local residents, and local industries located in the Municipality of Pictou County or the towns of New Glasgow, Stellarton, Pictou, Westville, and Trenton).

Temporal boundaries for the assessment of environmental effects on the environment include periods of construction, operation and maintenance, and decommissioning. Construction is estimated to be approximately 21 months, beginning second quarter of 2019, commencing as soon as the EA review has been completed and the applicable permits, approvals or other forms of authorization have been obtained. Operation and maintenance will commence immediately following the construction phase and will continue to operate efficiently and safely for several decades and likely much longer with a well-maintained system. For the purpose of this EA Registration, it has been assumed that the operation and maintenance phase will begin in the fourth quarter of 2020. Decommissioning of the project would occur at the end of mill life following the completion of operations. Once the ETF or pipeline is nearing the end of a useful service life, a decommissioning plan will be developed and will be submitted for a separate review requiring NSE approval.

8.14.1.2 Significance Criteria

A significant adverse residual environmental effect on the socio-economic environment is one where project-related activities directly interfere with the use of the land or water such that their intended use is no longer possible. This would include interference with land uses, recreational uses, employment and economic impacts in the community, region, or province. A significant positive residual environmental effect of the project on the socio-economic environment is one that results in project-related sustained increased level of employment and economic activity in the community, region, or province, or enhances land and water uses.

8.14.2 Interdependency with Other VECs

The VECs identified for the project include plants and wildlife on land and in the water - all of which directly or indirectly support coastal fisheries, aquaculture, tourism and recreation in the region and in the Northumberland Strait. Cultural heritage and other direct interactions with residents' health are also VECs. Each of these VECs is discussed in their respective section.

The socio-economic environment relies on the results of the following VEC effects assessments in order to identify impacts (**Table 8.14-1**).

Table 8.14-1: Interdependency of Socio-Economic Environment with other VECs

Interdependence	VEC	Document Section
Health of communities	Human Health	Section 9
Accidents, malfunctions	Accidents, Malfunctions, and Unplanned Events	Section 10
Noise during operation or construction	Acoustic Environment	Section 8.2
Odour, air quality	Atmospheric Environment	Section 8.1
Heritage resources	Marine Archaeological Resources Terrestrial Heritage Resources	Section 8.16 Section 8.17
Drinking Water	Surface Water Groundwater	Section 8.4 Section 8.5
Fishing in the Strait and Harbours	Marine Fish and Fish Habitat Marine Mammals, Sea Turtles and Marine Birds	Section 8.11 Section 8.12
Fishing in Rivers	Freshwater Fish and Fish Habitat	Section 8.6
Connection to the Water (e.g., coastline, swimming, paddling)	Harbour Physical Environment and Water and Sediment Quality	Section 8.11

Interdependence	VEC	Document Section
Connection to Land (e.g., landscapes, hiking, hunting)	Freshwater Fish and Fish Habitat Wetlands Terrestrial Habitat and Flora (Plant) Priority Species Terrestrial Wildlife/Priority Species Migratory Birds	Section 8.6 to 8.9

8.14.3 Existing Environment

Existing environmental conditions with respect to the socio-economic environment are described in this section.

8.14.3.1 General Setting

Nova Scotia is part of Mi'kma'ki, the land of the Mi'kmaq, long inhabited before European arrival. The Pictou County area is not an exception. The Mi'kmaq farmed, hunted, and fished in the LAA long before European explorers and settlers arrived. Early Mi'kmaw settlement of the LAA is a significant demonstration of the wealth of socio-economic resources that were available historically, and confirmation of what is seen today.

The communities in the LAA are rich in heritage and their members hold significant relationship to the land, waters, and seasons. Additional heritage context is provided in **Section 8.17**, Terrestrial, Heritage Resources and **Section 8.15**, Indigenous Peoples Use of the Land and Resources.

8.14.3.2 Land Use

The PFA is located within the Municipality of Pictou County which does not have a Municipal Planning Strategy (MPS) or By-laws to direct land use within the County, with the exception of a subdivision By-law and a single issue MPS to regulate wind energy development.

The PFA is also partially within the boundary of the Town of Pictou. The Town of Pictou's Land Use Zoning By-law identifies Light Industrial, Highway Commercial, Institutional, and Residential uses in the LAA (Town of Pictou Land Use By-law, Schedule A-2, 2016).

Physical Land Use In the Vicinity of the Proposed Replacement ETF (NPNS Property)

The replacement ETF will be constructed on an area of unused land within the NPNS property boundary. Land use surrounding the proposed replacement ETF includes industrial (existing pulp mill and former Canso Chemicals properties), rural residential, forested, and agricultural lands. The nearest residential property is approximately 700 m southeast of the replacement ETF. The Abercrombie volunteer fire department is approximately 980 m south of the proposed ETF site.

Physical Land Use In the Vicinity of the Land-Based Portion of the Effluent Pipeline Route

The proposed effluent transmission pipeline will be placed in the shoulder of Highway 106 to minimize disturbance of adjacent land uses. Existing land uses are generally compatible with a pipeline.

Existing land uses in the LAA from the Causeway and Division Road (approximately 800 m north of the Pictou Roundabout) are a mix of light industry, mixed commercial, institutional, multi-unit residential, and undeveloped land. Future development lands are identified by the Town of Pictou at Brown's Point, and surrounding the Pictou Roundabout (Town of Pictou, Western Pictou County Economic Profile 2017).

Existing land uses in the LAA from Division Road to Three Brooks Road at Caribou are largely undeveloped forest and wetlands as well as some agricultural land use between Division Road and Central Caribou Road. Residences are in vicinity to the transmission pipeline at the crossings of Central Caribou Road and Three Brooks Road.

8.14.3.3 Municipal and Regional Infrastructure

Municipal and regional infrastructure surrounds and intersects the LAA including rail, local and regional roads, and public utilities. In addition, the Northumberland Ferries marine terminal is within the LAA. Important nearby municipal and regional infrastructure includes:

- The Cape Breton and Central Nova Scotia Railway –Stellarton to Abercrombie Spur provides a rail link onto the NPNS property. The replacement ETF has been configured so that this rail spur is not within the PFA;
- The PFA intersects the edge of the Pictou and Caribou Wellfield source water area:
    - These two wellfields provide potable water to the Town of Pictou from 13 wells (8 wells in the Pictou Wellfield and 5 wells in the Caribou Wellfield) (Town of Pictou 2017). Additional information on the potential interaction with groundwater resources is provided in **Section 8.5**;
- Underground municipal utility locations are anticipated in the vicinity of the Pictou Roundabout and will be identified during detail design as noted in **Section 5.3**;
- Highway 106 (Designated part of the Trans-Canada Highway) a two lane undivided highway, with one lane in each direction for most of the PFA; and
- Additional transportation infrastructure, including the surrounding road network which either intersect the PFA as overpasses and underpasses, or may be used for transportation of construction materials.

Prince Edward Island – Nova Scotia Ferry (Northumberland Ferries Limited)

The pipeline enters the marine environment at the shoreline of Caribou Harbour adjacent to the Northumberland Ferries marine terminal, operated by Northumberland Ferries Limited. The ferry provides passage between Prince Edward Island and Nova Scotia on two vessels: the *MV Confederation* and the *MV Holiday Island*. The ferries operate between Caribou, Nova Scotia and Wood Islands, Prince Edward Island from May 1st to mid-December, while the Northumberland Strait is free of ice (Northumberland Ferries Limited 2018).

8.14.3.4 River and Marine Based Uses

A marine pipeline and diffuser (marine outfall) is proposed to be constructed which would discharge treated effluent into the Northumberland Strait outside of Caribou Harbour. The lobster fishery has for many years been the largest fishery in the area by landing value (DFO 2008 and DFO 2017). However, the assessment of socio-economic effects will not place the importance of this fishery above others. An 'ecosystem approach' for impact assessment that looks at the health and resilience of the Strait as a whole was put forward and confirmed during discussions with all stakeholders, fishermen, and Pictou Landing First Nation.

Freshwater Fisheries

The LAA includes water uses in the vicinity of the NPNS property and along the pipeline: interaction with these areas could occur during construction or operation and maintenance phases in the case of malfunction or pipe breakage. The fresh waters that surround Abercombie Point (West, Middle, and East Rivers). Pictou Harbour and another bounding water to Abercombie Point, is brackish. These waters are active traditional, subsistence, and recreational fishing areas. They are fishing ground for American eel, smelt and gaspereau and, in the past (currently closed), blue mussel and soft shell clam. Recreational fishing of Atlantic salmon, striped bass, brown trout, and brook trout may occur as well. Pictou Harbour also sees lobster, mackerel and tuna.

The PFA will intersect a number of watercourses with several watercourses identified as potentially supporting fish habitat and are located along the transmission pipeline route. Anticipated species in these smaller watercourses likely include brook trout, American eel, and Atlantic salmon. Further description of the environment is provided in **Section 8.6**, Freshwater Fish and Fish Habitat.

Marine Fisheries

The Northumberland Strait, including Caribou Harbour, supports life and well-being for many individuals and coastal communities. The LAA is utilized by many individuals pursuing subsistence, ceremonial, commercial, and recreational fishing. Conversations with stakeholders (fishing industry representatives), Indigenous fishermen, and other available records (e.g., DFO) have identified many active fisheries intersecting the LAA. These include: lobster, herring, rock crab, oyster, scallop, quahogs, eels, mackerel, smelt, and oysters.

Considerable focus has been given to the potential interaction of the project with the marine environment through **Section 8.11**, and **Section 8.12**.

8.14.3.5 Recreation and Landscapes

The PFA is celebrated and valued for its varied and scenic landscapes. These landscapes are accessed for recreational purposes both on land and on water. Through comments received during this project (**Section 6**), community members report valuing access to the lands and water for recreation and social value, be that for swimming, for use by various types of boat, or for their walking trails and coastlines.

The Jitney Trail (part of the Trans Canada Trail network) passes under Highway 106 near the north end of the Pictou Causeway. Hunting a variety of species, as well as harvesting edible plants such as berries, is common in the county.

Munroes Island and Caribou Island form the headlands which bound the opening to Caribou Harbour. Much of these headlands are protected as Provincial Parks and Nature Reserves, including: Caribou-Munroes Island Provincial Park and Campground, MacKenzie Beach Provincial Park, Waterside Beach Provincial Park, and the Caribou Rivers Nature Reserve (see **Figure 8.14-1**).

Managed areas within 5 km of the PFA as identified by AC CDC (2018) are illustrated on **Figure 8.8-1** in **Section 8.8** and include Haliburton Provincial Park, Harris Provincial Park, MacKenzie Beach Provincial Park, Caribou-Munroes Island Provincial Park, Boat Harbour, and Rail Corridors (Oxford Subdivision and Pictou and Scotia Spur)**;** a Well Watershed along the pipeline route (discussed in **Section 8.5)**, Fishers Grant Indian Reserve 24 (discussed in **Section 8.15),** and McCulloch House Provincial Heritage Site (discussed in **Section 8.17)**.

8.14.3.6 Employment and Economy

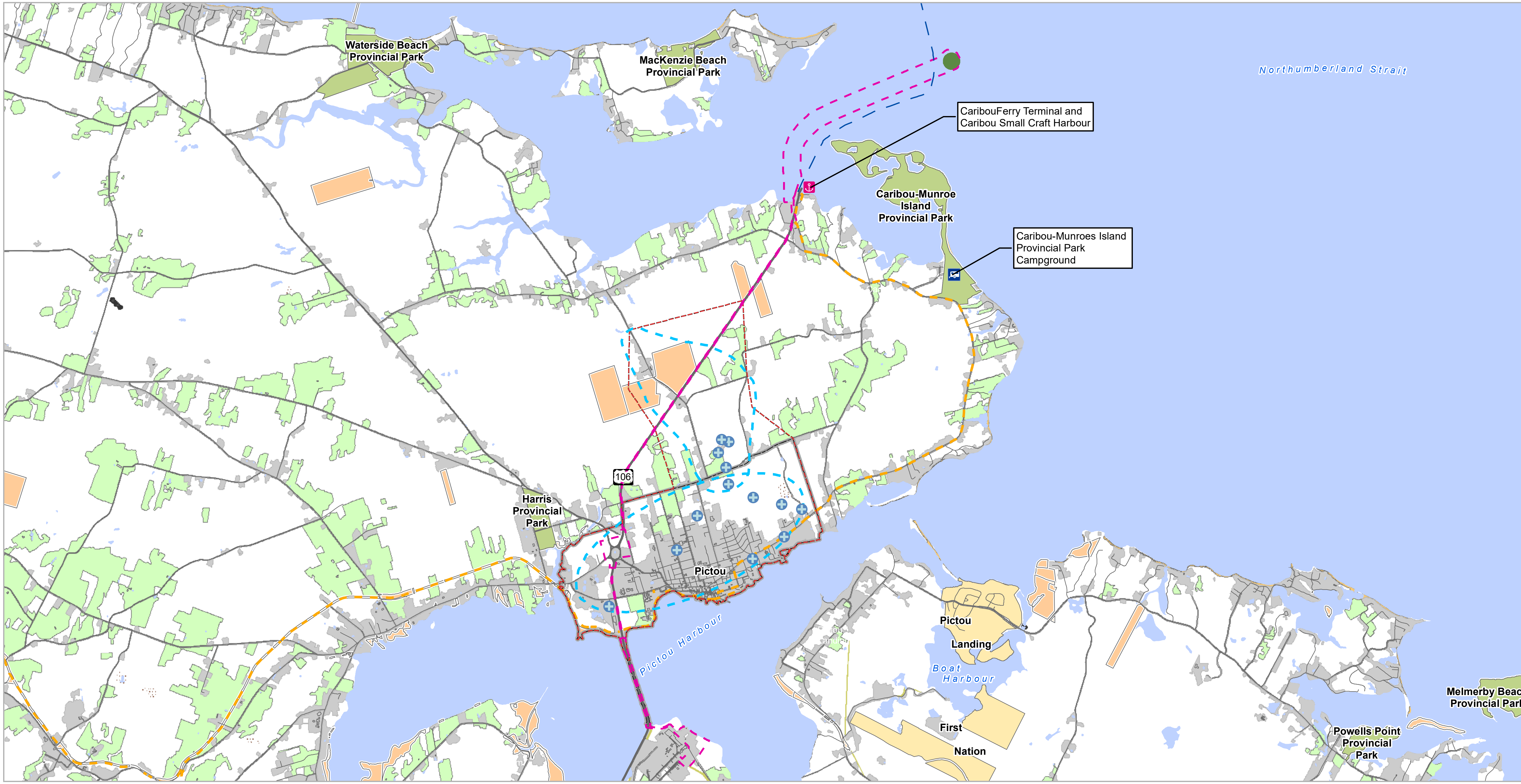
A total of 43,748 people make their home in Pictou County, a 4.2% decrease from 2011 (Statistics Canada 2016). There is a 12.5% unemployment rate, higher than the provincial average of 10% (Statistics Canada 2016). The three largest employment classifications by North American Industry Classification System are retail trade (18%), health care and social assistance (14%), and manufacturing (10%) (Statistics Canada 2016). Agriculture, forestry, fishing and hunting combined provide 4% of jobs for the County (Statistics Canada, 2016).

Several sizable employers in the area of the LAA are consistent with the Statistics Canada profile information include Empire Company (i.e., Sobeys, Crombie REIT), Michelin Tires Canada, NPNS, Nova Scotia Health Authority, Nova Scotia Power Corporation, MacGregor's Industrial Group, MacKay Meters, Advocate Printing & Publishing, Northumberland Ferries Limited, Aecon Fabco, and others.

Based on employment in the LAA, the project activities have most potential to interact with commercial marine activities, manufacturing (including NPNS), and tourism.

Commercial Marine – Harbours, Ferries, and Other Infrastructure

Northumberland Ferries carries approximately 475,000 passengers, 160,000 passenger vehicles and 18,000 commercial trucks annually, providing seasonal employment for more than 200 employees. It contributes an estimated $27 million to the Prince Edward Island provincial economy each year (Prince Edward Island 2017). Additionally, there are further marinas, docks, harbours, and other infrastructure within the LAA.



Northern Pulp Nova Scotia Corporation

Replacement Effluent Treatment Facility Environmental Assessment

Overview of Socio-Economic Environment
Figure 8.14-1

Approximate Project Footprint Area*	First Nation Reserve Lands	Pictou and Caribou Wellfields	Pictou Source Water Protection Committee Delineated Boundary
Approximate Outfall Location	Provincial Park	Town Boundary	Agriculture
Town of Pictou Wells	NS Crown Land May 2018	Trans-Canada Trail Network	Developed

Roads
Watercourse
Railline
Roads
NS-PEI Ferry Route

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NRCan, DFO,
Pictou / Caribou Source Water Protection Plan (Town of Pictou)

MAP CREATED BY: SCM
MAP CHECKED BY: AB
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 0.5 1 2 km

*Precise Project Footprint to be determined following completion of detailed design

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Date: 2019-01-30

Caribou Ferry Small Craft Harbour is located immediately east of the Northumberland Ferries marine terminal and can accommodate up to 65 homeport and transient vessels. A seasonal passenger ferry service to Pictou Island also uses Caribou Small Craft Harbour between May and November, carrying up to 36 passengers (Pictou Island Charters Limited 2018).

Commercial Marine – Fisheries

The Northumberland Strait commercial fishing areas are part of the larger Gulf of Saint Lawrence Region. This area has significant commercial fishing activities, as listed below. Species landed at the harbour include herring, lobster, rock crab, and scallop (NG News 2014). The total value of landings in the Nova Scotia Gulf Region was $99.8 million in 2016 (DFO 2017). The top three landings by value were lobster (approximately 55%), crab (approximately 39%), and herring (3%) (DFO 2017). DFO estimates that approximately 7,000 people participate in the commercial lobster harvest in the overall Gulf Region (DFO 2008).

Commercial fishing that occurs in the LAA includes:
- Aquaculture (American Oyster);
- Herring (Fishing Area 16F);
- Lobster (Fishing Area 26A);
- Mackerel (Fishing Area 16);
- Capelin and Squid (Fishing Area 16);
- Groundfish (Fishing Area 4T8);
- Rock Crab (Fishing Area 26A);
- Scallop (Fishing Area 24); and
- Snow Crab (Fishing Area 12).

Manufacturing (NPNS)

Several manufacturing based employers are in the area. Given the nature of the project, interaction with other employers in the manufacturing industry is not anticipated beyond the function of NPNS itself.

NPNS directly employs over 330 residents of Northern Nova Scotia; in addition, NPNS provides indirect and induced employment to Pictou County and the province of Nova Scotia in general. NPNS' operations maintain and create well over 2,000 jobs across the province in the forestry sector.

Through its direct and spinoff activities, the mill creates about $100 million in labour income in Nova Scotia. NPNS is uniquely connected with many partners in the forest industry, for example, by both producing materials for and purchasing materials from sawmills across the province. Together with its supply chain companies, NPNS produces a total annual value output of $535 million. NPNS exports over $200 million worth of goods annually, which constitutes a significant portion of the province's total forestry exports. NPNS is the single largest exporter out of the Port of Halifax. NPNS exported over $170 million to China in 2016, making wood pulp and NPNS exports in particular over 1/3 of the province's exports to China.

Tourism

Tourism along the Northumberland Strait (including but not limited to the shoreline within Pictou County) generates an estimated $215 million dollars in total revenue, or approximately 8.3% of the total provincial tourism revenue (Tourism Nova Scotia 2017). As further illustration, accommodation and food services provides 7% of the County's employment.

Tourism relies on a strong socio-economic environment including active recreation, aesthetic landscapes, and the maintenance of strong transportation routes to bring tourists into the area. It was described by members of the community at public meetings for the project (**Section 6**), that tourism in the LAA relies on the scenic and historic value of the area.

8.14.4 Impact Evaluation/Effects Assessment

8.14.4.1 Potential Environmental Effects

A number of activities related to the construction and operation and maintenance of the project have the potential to interact with the socio-economic environment, as follows. Note that direct impacts to biophysical environment, or effects that would result from accidents or malfunctions, are discussed in their respective sections as identified in **Section 8.14.2**.

Construction Phase

Without mitigation, construction of the project may interact with the socio-economic environment in the following ways:

- Temporary delays to Nova Scotia – Prince Edward Island ferry due to marine construction;
- Temporary delay or access disruption to marine areas (commercial or recreational) due to marine construction;
- Traffic delays could occur on Highway 106 during construction;
- Traffic delays (vehicular and ferry) discouraging tourists from entering the area or using the ferry;
- Local road network could deteriorate from additional vehicular use due to traffic detouring;
- Temporary nuisance (noise, dust) could be perceived by local residents during construction;
- Temporary property access disruption to properties adjacent to construction may occur, particularly in vicinity to residents along Highway 106 at Caribou Harbour; and
- Temporary access disruption to section of Trans Canada Trail or other recreational uses on land during construction of the effluent pipeline.

The above impacts negatively affect the local economy in the short term by interfering with resources needed for goods production, or transportation of those goods (e.g., Interference with commercial fisheries harvesting season, traffic delays reducing tourism).

Operation and Maintenance Phase

Without mitigation, the operation and maintenance of the project may interact with the socio-economic environment in the following ways:

- The project impacts could negatively affect the local communities by interfering with resources harvested for cultural, commercial, and recreational uses (e.g., if project introduces odour, or negatively affects fisheries); and
- The project impacts could negatively affect the local economy by interfering with resources needed for goods production, or transportation of those goods.

8.14.4.2 Mitigation

Mitigation to reduce or avoid environmental effects to the socio-economic environment includes the following approaches. Standard and general mitigation practices (e.g., noise and dust control during construction) are identified in **Section 5.7**.

Construction Phase

Standard construction best practices (**Section 5.7**) for communication, equipment operation, and construction staging will mitigate the potential impacts identified above. Roads which are travelled regularly by construction vehicles will be repared. Mitigations for the Jitney Trail (Trans Canada Trail) will be similar to those for general construction. Temporary interruption to trail connectivity is anticipated. A trail detour route will be identified in consultation with the Town of Pictou, and advance signage will be placed to notify trail users and direct them to alternate routes. Trail user safety will be maintained throughout construction. The Jitney Trail will be reinstated to its original condition.

Standard communication plans with surrounding community will be completed throughout construction to provide advance notice of lane restrictions (where applicable). Communication with residences along Highway 106 particulrly in vicinity to Caribou Harbour will inform residents of construction schedule and construction staging particularly when in vicinity of invididual properties.

Given that the replacement ETF will be constructed on an existing industrial site and the terrestrial portion of the pipeline will be constructed in existing disturbed areas along the Highway 106 corridor, construction of the project will interact with the socio-economic environment principally during construction of the marine portion of the treated effluent pipeline.

Note that the marine-based construction standards are identified in **Section 5.7.2**, and will be subject to additional permitting which will identify additional marine-specific mitigation measures. Permitting from TC under the Navigation Protection Program will identify approaches to minimize impacts to marine users and identify necessary signage and notification for marine users (as noted in **Section 3**). Permitting from DFO will include discussions to identify how to best mitigate disruption to fisheries harvesting seasons with consideration for all types of harvesters (as noted in **Section 3**).

Operation and Maintenance Phase
The daily operation and regular maintenance of the project is not anticipated to impact the socio-economic environment.

For land-based consideration such as local residents, industries, and recreation no interaction is anticipated. Odour was an item of concern identified in community and during stakeholder engagement. Odour reduction as a priority was incorporated in the ETF design; the atmospheric environment VEC (**Section 8.1**) reviews the potential interaction of the project. No further mitigation measures are required. Similarly, through mitigation of the other project VECs (identified in **Section 8.14.2**), no further interaction is anticipated.

Alteration of the surrounding marine habitat within the PFA due to the presence of the pipeline and outfall may impact specific commercial fisheries reflective of the area and local existing conditions. Mitigation measures to offset the alteration in habitat will be developed with DFO if required and are also anticipated to mitigate impacts to all marine users.

Recreation/Cultural Landscapes: Visual and Odour
Effluent will not be discernable from background water colour at the surface of the water column at the diffuser site. Further, operation of the outfall will not interact with use of community beaches in the surrounding area. Water quality parameters will reach existing background conditions within 5 m from the diffuser. No impact to community use of recreational areas is anticipated from the operation of the outfall.

Additionally, odour prevention was a basic design criteria used in the development of each stage of the ETF process. Through employing a process that has, for example, continuous sludge removal, subsurface air injectors, and indiredct effluent cooling, odour is controlled during the treatment process. No impact to community is anticipated from odour during the operation of the ETF.

Community Liaison Committee
NPNS has an existing Community Liaison Committee (CLC). The CLC serves as a formal consultation process with certain local stakeholders in compliance with NPNS' Industrial Approval to operate. The CLC serves a very important role in providing advice and facilitating two-way communication. The CLC members represent themselves as members of their community and provide their own personal perspective to the committee. They also provide constructive input on how the company may better address and respond to the community needs and concerns. The CLC meets at a minimum twice annually, in Spring and Fall, as well as convening on an as-needed basis. The CLC includes representatives from Pictou Landing First Nation, the communities of Abercrombie, Pictou Landing Moodie Cove and Pictou, NPNS staff, and NPNS executives.

Commercial Fisheries and Aquaculture Compensation

The potential of the project to impact commercial fisheries and aquaculture could occur from effects on marine fish populations, damage to vessels or gear, or interruption to or loss of access to grounds.

The marine construction area will be relatively small, and construction will be staged to avoid the main navigation channel. In advance of and during construction, communication with the fishing industry will allow for strategic planning and limit risk of impacting movement through Caribou Harbour into the Northumberland Strait. Construction will occur outside of key fishing seasons/times of day as much as possible, reducing risk to vessels or gear.

With the implementation of mitigation measures outlined in **Section 8.11.3.2**, significant adverse residual environmental effects on harbour physical environment, water quality, and sediment quality are not anticipated and the residual environmental effects of the project on the physical environment, water quality, and sediment quality during all phases of the project are rated not significant.

With implementation of the mitigation measures outlined in **Section 8.12.3.2**, significant adverse residual environmental effects on marine fish or their habitat are not anticipated and the residual environmental effects of the project on marine fish and fish habitat during all phases of the project are rated not significant. The installation of the pipeline should not result in serious harm to the commercially relevant species and supporting fish species once benthic species have become re-established within approximately 6 months, representing a temporary alteration. DFO review will consider if the project represents adverse effect to marine fish and fish habitats, and if considered "serious harm" by DFO it will be addressed through the Fisheries Act to develop and apply offsetting measures.

As concluded in **Section 8.12.3.8**, the construction activities will likely result in a temporary net-loss of productivity in marine fish populations, including potential residual effect for the commercial fisheries. The area of disturbance will be small, particularly in comparison to the licensed fishing areas. Impact, if it occurs, would be limited to a small number of individual fishers who may be able to compensate for that loss by adjusting their fishing patterns. The impact to income is not expected to be significant. Commercial aquaculture activities do not take place in immediate vicinity of the PFA and are not anticipated to be impacted.

During operations, concerns have been raised by the commercial fishing industry of detrimental impact to target fish populations, habitat, and water quality. It is the conclusion of the environmental assessment that the operation of the project does not pose significant risk to these VECs. The project design utilizes a three-port diffuser, and water quality parameters are expected to meet ambient conditions within 5.0 m of each opening. A robust Follow-up and Monitoring program described **Section 8.12.5** is proposed for the project. The follow up and monitoring program includes subleathal toxicity testing on lobster and herring, surveys to understand existing species populations in the area, and detail testing for locally specific water and sediment quality (**Appendix H**). The follow up program will be able to confirm existing scientific understanding and predictive modeling undertaken as part of this EARD.

Given the above, there is limited likelihood of permanent or significant alteration to commercial fisheries and aquaculture. Potential may be present in the short term stemming from standard construction disruption. In recognition of the concerns raised, and in confidence of the scientific studies that will be and have been undertaken, NPNS will endeavor to develop a Communications and Compensation Plan for Commercial Fisheries and Aquaculture, in coordination with NSE, DFO, and potentially impacted stakeholders. Communications will be established prior to construction and will be maintained as warranted over the life of the project.

8.14.4.3 Characterization of Residual Environmental Effects

The completion of the project will allow for the continued operation of NPNS mill, which since its construction in 1967 has been a significant contributor to the local communities, providing employment, providing considerable taxation revenue for government, and contributing significantly to the local, regional, and provincial economies.

Construction Phase

Section 5.5 Labour Requirements describes the significant level of effort the third party contractors will provide. In addition to this direct employment, the construction of the project will result in indirect and induced employment for companies and individuals providing goods and services to the project, as well as increased economic spin-off from the construction workforce staying in the area and the local procurement of goods and services.

Construction effects on land and water use will be limited to the construction duration and to the project footprint as defined by the PFA (see **Section 5.1**). The PFA is limited to lands compatible with the activity, by being constructed on lands generally previously disturbed from other infrastructure projects. Short-term interruptions in traffic during construction may occur, but the potential for delays will be minimized through working with stakeholders to inform construction staging. The project will provide advance signage and appropriate traffic control methods to maintain traffic flow.

Short-term and periodic delays to marine users in Caribou Harbour and along the marine portion of the PFA may occur during the installation of the marine pipeline and outfall. Given the width of the entrance to Caribou Harbour and the anticipated work zone, delays are only anticipated during some stages of marine pipeline construction. Delays will be further mitigated by timing construction activities to avoid disruption to fishing activities, and in coordination with Northumberland Ferries Limited as much as possible. Advance notice and safety protocols will be developed for mariners in coordination with TC.

There is limited likelihood of significant alteration to commercial fisheries and aquaculture. Potential may be present in the short term stemming from standard construction disruption. In recognition of the concerns raised, and in confidence of the scientific studies that will be and have been undertaken, NPNS will endeavor to develop a Communications and Compensation Plan for Commercial Fisheries and Aquaculture, in coordination with NSE, DFO, and potentially impacted stakeholders. Communications will be established prior to construction and will be maintained as warranted over the life of the project.

Given the mitigation measures described above, the residual environmental effects of the project on the socio-economic environment during construction will be temporary and not significant in nature. These include the potential for:

- Potential localized impact to commercial fisheries in the area due to construction interaction with target species;
- Short-term interruption to Jitney Trail use while construction occurs in that vicinity;
- Potential for periodic, short-term but planned delays to marine traffic including the NS-PEI Ferry and commercial fisheries leaving the marinas east of Northumberland Ferries marine terminal during construction stage where the pipeline route is anticipated to cross navigational channel;
- Potential short term traffic delays; and
- Potential for short-term nuisance (e.g., noise, dust) to local residents from construction activities, particularly in the vicinity of Caribou where residences are along Highway 106.

Operation and Maintenance Phase

Significant environmental effects to land and water use are not anticipated during the operation and maintenance of the replacement ETF, pipeline, and marine outfall. The replacement ETF will be located on the NPNS mill site as part of the everyday operations of the mill. The terrestrial portion of the pipeline will be buried in the shoulder of Highway 106 for the most part, and the short segments that will be visible (e.g., along the causeway) are not expected to cause adverse aesthetic effects. The marine outfall pipe and diffuser will not be visible from the land.

Periodic maintenance of the marine outfall will not interfere substantially with fishing or navigation due to the likely low frequency of such events.

Based on effluent modeling, the plume will not be discernable from background water colour once it reaches the surface of the water column at the diffuser site. Water quality parameters, including colour, are described in Section 8.11 and reach ambient conditions within 5 m of the diffuser. Negative effects on commercial fisheries is not anticipated during the operations stage of the project. However, as described above, NPNS will endeavor to develop a Communications and Compensation Plan for Commercial Fisheries and Aquaculture, in coordination with NSE, DFO, and potentially impacted stakeholders.

As a result of the design and mitigation measures proposed, residual environmental effects are not expected to the socio-economic environment during operation and maintenance. The existing Community Liaison Committee will continue to provide two-way communication between NPNS and the surrounding communities. During operation and maintenance, anyone with concerns about the project and its interactions with the environment may contact NSE's Area office in Granton.

8.14.5 Summary

The residual environmental effects of the project on the socio-economic environment are summarized in **Table 8.14-2** below. A listing of VECs interdependent to the socio-economic environment and the related Document Sections is provided in **Section 8.14.2**.

Table 8.14-2: Summary of Residual Environmental Effects to the Socio-economic Environment

Activities	Potential Effects	Mitigative Factors and Measures	Residual Effects	Significance of Residual Effects
Construction of ETF	Nuisance to surrounding residents (Noise, Dust) Construction equipment and materials delivery causing localized traffic delays	On NPNS property (setback from residents) Dust suppression and noise management will be managed through implementation of the project EPP and standard best practices. Contractor to provide advance notice to local residences of construction commencement and to provide advance notice of interruptions to property access.	Negligible with standard mitigation applied. Temporary, Reversible effects Direct and indirect interaction Magnitude - Low Duration – daily until construction complete of ETF Frequency – daily for duration of construction Geographic extent – local to construction area Context – existing buffers from adjacent properties	Not Significant - Adverse
Construction of Effluent Pipeline (land-based portion)	Nuisance to surrounding residents (Noise, Dust) Traffic delays for regional and local traffic.	Dust suppression and noise management will be managed through implementation of the project EPP and standard best practices. Work with stakeholders for construction staging to minimize traffic delays	Negligible with standard mitigation applied. Temporary, Reversible effects Direct and indirect interaction Magnitude - Low Duration – daily until construction complete of ETF Frequency – daily for duration of construction Geographic extent – local to construction area Context – existing buffers from adjacent properties	Not Significant - Adverse
Construction of Effluent Pipeline and Diffuser (marine portion)	Delays to marine users from construction activities (commercial and recreational) Marine user safety Decrease in fish harvest due to construction	Advance notice and marine signage will be managed through implementation of the project EPP and standard best practices (i.e. signage and scheduling). On-water work zone will be minimized to extent possible to reduce marine traffic conflict. On-water work will be scheduled to avoid impacting ferry schedule to the	Negligible with mitigation applied. Direct and indirect, Reversible Magnitude - Low Duration – short-term Frequency – daily daily until construction complete Geographic extent - site-specific Context – existing and proposed buffers, construction staging approach	Not Significant - Adverse

Activities	Potential Effects	Mitigative Factors and Measures	Residual Effects	Significance of Residual Effects
	activities	extent possible. On-water work will be scheduled to minimize impacting fisheries as possible. It is anticipated that there will be short term habitat alteration during construction but the majority of the PFA will return to existing conditions within 6 months. See also **Section 8.12 and Section 8.13** for mitigations to marine species. Communications and Compensation Plan for Commercial Fisheries and Aquaculture, in coordination with NSE, DFO, and potentially impacted stakeholders		
Operation and maintenance of the project	Negatively impact other VECs that Socio-Economic Environment utilizes/requires (i.e. air quality, fish species). Alteration of marine habitat permanently impacts commercial fisheries resources	Mitigated through implementation of the project EPP and standard best practices. Mitigation measures identified for other VECs will mitigate interactions with socio-economic environment. Follow up and monitoring will be completed to monitor the environmental effects of the project and mitigate any impacts. Communications and Compensation Plan for Commercial Fisheries and Aquaculture, in coordination with NSE, DFO, and potentially impacted stakeholders Anyone with concerns about the project and its interactions with the environment may contact NSE's Area office in Granton. Community Liaison Committee will continue to facilitate two-way communication and advice to NPNS.	Negligible with mitigations applied Direct and indirect, Reversable. Magnitude - negligible Duration – long-term Frequency – consistent for duration of project operation Geographic extent - regional Context - regional	Not Significant - Adverse

In consideration of the above, and in light of the proposed mitigation measures, the residual environmental effects of the project on the socio-economic environment during all phases of the project are rated not significant, with a high level of confidence.

8.14.6 Follow-up and Monitoring

During the construction phase, commercial, recreational and social interaction with the project will be limited and temporary in nature. With mitigation identified in place, including fisheries communication and compensation plan, the project impacts on the socio-economic environment during construction are not expected to be substantive. There is no requirement for further follow-up or monitoring for the construction phase.

The operation and maintenance phase will be largely in relation to the operation of the ETF which is located on NPNS property, as well as periodic maintenance of the ETF and pipeline. Therefore there is no anticipated residual environmental effects of the project on the socio-economic environment during operation and maintenance phase.

The existing Community Liaison Committee will continue to serve the very important role in providing advice and facilitating two-way communication between the local community and NPNS.

There is no requirement for further follow-up or monitoring during the operation and maintenance phase specifically to address the socio-economic environment, although follow-up or monitoring conducted for other VECs will assist in further defining and limiting environmental effects on the socio-economic environment.

8.15 Indigenous Peoples Use of Land and Resources

The potential environmental effects of the project on the traditional activities of the Indigenous Peoples of Nova Scotia are assessed in this section. It provides an overview of the existing uses and activities, an evaluation of potential environmental effects as a result of the project, a determination of the significance of potential environmental effects, and identification of follow-up and monitoring for the project (as applicable).

8.15.1 Scope of VEC

The Indigenous Peoples' use of land and resources has been selected as a VEC in recognition of the constitutionally-protected right of Indigenous Peoples to practice their traditional activities, including hunting, fishing, trapping, and gathering in pursuit of a moderate livelihood, as well as to:

- Identify lands and resources historically used for traditional purposes by Indigenous persons (including water uses); and
- Assess the potential environmental effects of the Project as required under the Nova Scotia *Environmental Assessment Regulation*.

This VEC includes potential environmental effects of the project on traditional land and water uses, as well as mitigation measures taken and recommended. Further, Indigenous persons have knowledge of land and resources that can meaningfully contribute to the wise planning of this project.

8.15.1.1 Boundaries

Spatial boundaries for the assessment of Indigenous Peoples' use of land and resources include the following:

- The **project footprint area (PFA)** is defined as the maximum extent of the physical area of disturbance associated with the project. The PFA will include all temporary and permanent areas of ground and marine disturbance. The PFA is defined in **Section 5.1.1**.
- The **local assessment area (LAA)** is the maximum area within which environmental effects from the Project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence. The Mi'kmaq Ecological Knowledge Study (MEKS) initiated for the project is utilizing a LAA extending approximately 5 km from the PFA. The LAA can be thought of as the "zone of influence" of the project.

Temporal boundaries for the assessment of environmental effects on the environment include periods of construction, operation and maintenance, and decommissioning. Construction is estimated to be approximately 21 months, beginning second quarter of 2019, commencing as soon as the EA review has been completed and the applicable permits, approvals or other forms of authorization have been obtained. Operation and maintenance will commence immediately following the construction phase and will continue to operate efficiently and safely for several decades and likely much longer with a well-maintained system. For the purpose of this EA Registration, it has been assumed that the operation and maintenance phase will begin in the fourth quarter of 2020. Decommissioning of the project would occur at the end of mill life following the completion of operations. Once the ETF or pipeline is nearing the end of a useful service life, a decommissioning plan will be developed and will be submitted for a separate review requiring NSE approval.

8.15.1.2 Significance Criteria

A significant adverse residual environmental effect on Indigenous Peoples' use of land and resources is one where project-related activities directly interfere with the access to or use of the land, water, or resources that are currently used by Indigenous Peoples such that the intended use is no longer possible on a permanent basis. This would also include interference with cultural, recreational uses, employment and economy impacts in the community, region or province.

8.15.1.3 Interdependency with Other Valued Environmental Components

The VECs identified for the project directly or indirectly support traditional uses of land and water in the LAA, and are discussed in their respective section of this EARD as listed in **Table 8.15-1**.

Table 8.15-1: Interdependence of Indigenous Peoples Traditional Uses with other VECs

Interdependence	VEC	Document Section
Health of communities	Human Health	Section 9
Accidents, malfunctions	Accidents, Malfunctions, and Unplanned Events	Section 10
Drinking Water	Surface Water Groundwater	Section 8.4 Section 8.5
Noise during operation or construction	Acoustic Environment	Section 8.2
Odour, air quality	Atmospheric Environment	Section 8.1
Heritage resources	Marine Archaeological Resources Terrestrial Heritage Resources	Section 8.16 Section 8.17
Socio-Economic	Socio-Economic Environment	Section 8.14
Fishing in the Strait and Harbours	Marine Fish and Fish Habitat Marine Mammals, Sea Turtles and Marine Birds	Section 8.11 Section 8.12
Fishing in Rivers	Freshwater Fish and Fish Habitat	Section 8.6
Connection to the Water (e.g., coastline, swimming, paddling)	Harbour Physical Environment, Water Quality and Sediment Quality	Section 8.11
Connection to Land (e.g., landscapes, hiking, hunting)	Freshwater Fish and Fish Habitat Wetlands Terrestrial Habitat and Flora (Plant) Priority Species Terrestrial Wildlife/Priority Species Migratory Birds	Section 8.6 to 8.9

8.15.2 Existing Environment

8.15.2.1 Context

The Mi'kmaq are the indigenous rights holders of Nova Scotia and continue to be the predominant Aboriginal peoples within the province (OAA 2011). When the Mi'kmaq first encountered Europeans, their territory stretched from the southern portions of the Gaspé Peninsula eastward to most of modern-day New Brunswick, and all of Nova Scotia and Prince Edward Island. The Mi’kmaq assert Aboriginal and treaty rights protected by Section 35(1) of the *Constitution Act*, *1982*. The Supreme Court of Canada has held in several important decisions that the Crown (federal and provincial) has a duty to consult with potentially affected First Nations in respect of decisions made by the Crown that might adversely affect these constitutionally-protected Aboriginal or treaty rights, and accommodate them as necessary for infringements of those rights, including particularly those that might relate to their use of the land and resources for traditional purposes.

Input from the Mi’kmaq of Nova Scotia was sought

- following the Proponents Guide: The Role of Proponents in Crown Consultation with the Mi’kmaq of Nova Scotia, November 2012 issued by the Office of Aboriginal Affairs Nova Scotia; and
- input was sought from the Mi’kmaq by seeking input from communities through the completion of a Mi’kmaq Ecological Knowledge Study (MEKS).

A MEKS has been initiated by Membertou Geomatics Services, following the *Mi’kmaq Ecological Knowledge Study Protocol 2nd Edition*, published by the Assembly of Nova Scotia Mi’kmaq Chiefs. Engagement activities are described in **Section 6.6**. To date, a field visit to the areas of NPNS property including the ETF footprint area and spill basin area has been completed, as well as 52 interviews to collect information with regard to past and present traditional use activities. The majority of interviewees were from the community of Pictou Landing First Nation (PLFN), with some information also provided by Paq’tnkek and Millbrook community members. Interviews took place between March and May 2018. Further interviews, field review, and research will be completed to gather and document the Mi’kmaq’s collective body of ecological knowledge of the whole LAA so that it is considered within the overall environmental effects of the proposed undertaking.

Documented details on how and where traditional activities have been or are taking place may exist, but are normally held confidentially by First Nations and their representative organizations. This knowledge is both valuable and private to the rights holders (land users). A high-level summary of the information gathered to date for the MEKS informs this VEC. Preliminary reporting has been provided to KMKNO, PLFN, and OAA.

8.15.2.2 Historical Context

Peace was made between the Mi’kmaq and British with the burying of the hatchet and gun in Halifax in 1761. In 1773, 179 settlers on the ship the *Hector* arrived to settle the McNutt Grant and eventually establish the Town of Pictou. Pictou Landing owes the place name to the ferry crossing Pictou Harbour to the Town of Pictou. Originally a 1765 grant to John Fisher, the Fisher Grant was laid out in 1785 as the town of Walmsley by the disbanded 82nd Regiment but the town did not materialize. Beginning in 1820, Mi'kmaq petitioned the government for lands for their exclusive use. Fifty acres at Fisher's Grant were acquired in 1864 for the Mi'kmaq of the Pictou area.

The Fisher Grant Reserve was eventually expanded over the years for additional food and fuel supply by acquiring near and adjacent parcels. Today PLFN have Fisher Grant Indian Reserve (I.R.) 24 (142.7 hectares), Fisher Grant I.R. 24G (60 hectares), and Boat Harbour West I.R. 37 (98.2 hectares). PLFN also share with other First Nations the Franklin Manor I.R. 22 and Merigomish Island I.R. 31.

Abercrombie Point, historically known as Fraser's Point or Middle River Point, was the site of an annual meeting for the Mi'kmaq of Nova Scotia, Prince Edward Island, and New Brunswick until the early-mid 1800s when a vessel containing small pox was quarantined in this area. Subsequent meetings were then held at Indian Island in Merigomish (Patterson, 1877).

Today, PLFN is the closest Indigenous community to the PFA. There are approximately 670 members of PLFN (INAC, First Nation Profile, undated). One of PLFN's main industries is fishing, employing approximately 100 people each year with community/core licenses in lobster, rock crab, snow crab, mackerel, herring and tuna (KMKNO, 2018).

8.15.2.3 Use of Land, Water and Resources

It is understood that there is a close relationship between the Northumberland Strait fishery and the Mi'kmaq communities in the region. The fishery and coastal resources have provided a source of employment and income, as well as an important source of food and medicines. Harvesting for subsistence is a common activity in the LAA. In interviews completed for the MEKS, subsistence harvesting was reported as more frequent than commercial and recreational fishing activities combined.

The significance of the environment to the Mi'kmaq is unique. Salmon, bass, trout, mackerel, smelt, lobster, and eel were/are understood to be the most reported fishing activity by the informants. Atlantic salmon, American eel, and striped bass are considered Endangered, Threatened, or species of Special Concern in Canada and the Mi'kmaq still rely on these species for sustenance and cultural ceremonies. Any disturbances to these resources or their habitats could have an impact on Mi'kmaq use.

Historically and currently, the Mi'kmaq utilize the LAA to fish, hunt, trap, and gather. Hunting for deer and rabbit are understood to be common current activities. Berry gathering was reported as the most common plant gathered for food. The land-based portion of the PFA is comprised of the NPNS property, and roadways connecting to Caribou Harbour. These are all developed or disturbed lands, and are not understood to be currently used by the Mi'kmaq for practicing traditional activities.

Traditional recreational use of land and water reported during the MEKS interviews centred on swimming and canoeing in the area of PLFN, such as Boat Harbour and Lighthouse Beach. It is noted that full use of these resources has been either removed or significantly limited due to the operation of the BHETF. Informants had noted that arrow heads have been found in the past along the shore of Moodie Cove and the Lighthouse Beach.

8.15.3 Impact Evaluation/Effects Assessment

8.15.3.1 Potential Environmental Effects

In general, construction and operation and maintenance of the project may affect or alter the ability of First Nations to use lands and resources surrounding the PFA and adjacent areas within the LAA to carry out their traditional activities, if they are being carried out there.

The project is intended to provide a new ETF replacing the existing BHETF. In this light, the very nature of the project provides a positive environmental effect to Indigenous Peoples (particularly the members of PLFN) who may be able to enjoy the use of Boat Harbour and its resources at some time in the future. The remediation of Boat Harbour is a separate project from the replacement of the effluent treatment facility.

Construction Phase

Without mitigation, construction of the project may interact with the use of land and resources by the Mi’kmaq in the following ways:

- The project construction could negatively affect the Mi’kmaq use of land and water in the short-term by interfering with access to resources needed for hunting, trapping, fishing, harvesting, cultural or recreational activities, or from effects to those resources themselves.

Operation and Maintenance Phase

Without mitigation, the operation and maintenance of the project may interact with how the Mi’kmaq use the land and water-based resources in the following ways:

- The project operation could negatively affect the Mi’kmaq use of water in the long-term by interfering with resources needed for fishing, harvesting, cultural or recreational activities.

8.15.3.2 Mitigation

A MEKS was initiated by Membertou Geomatics Services for the LAA relating to the original Pictou outfall that included the location of the new replacement ETF on NPNS property. The alternate route for the pipeline necessitated expanding the MEKS study to include the new proposed pipeline route. Field review of the PFA and interviews to confirm activities and uses in the revised LAA will be required. Field review will be completed during appropriate season, following MEKS protocol (anticipated spring 2019). The land based portion of the PFA is not anticipated to interact with Mi’kmaq uses as it is located on lands under active infrastructure or industrial uses. Marine-based impacts may interact with Mi’kmaq activities, as further expanded upon below. Completion of the expanded MEKS will confirm activities and interactions identified based on existing information and the effects assessments completed for marine VECs.

Construction Phase

The construction of the land-based portion of the PFA is not anticipated to interact with Mi'kmaq uses, and as such specific mitigation to address Indigenous Peoples' use of land and resources during construction is not required. During MEKS review of the PFA on NPNS property, the presence of significant plants or medicines was not identified, and given its active use as an industrial site since the 1970s, the NPNS property is not likely currently used for practicing traditional activities. Likewise, construction of the pipeline in the road shoulder of Highway 106 is not likely to interact with Indigenous Peoples' use of land and resources, since few (if any) resources would likely be collected in the road shoulder. If review of the remainder of the PFA identifies plants or medicines, the design team will work with Indigenous Peoples to identify an appropriate mitigation or offsetting plan such as facilitating their harvesting in advance of construction.

Standard and general mitigation practices (e.g., noise and dust control during construction) are identified in **Section 5.7**. **Section 8.14.3** presents a table of interdependent VECs which may provide additional mitigation measures that might further mitigate effects on Indigenous Peoples' use of land and resources.

The land-based pipeline portion of the PFA is located within transportation corridors and NPNS property and therefore is not anticipated to interact with hunting or gathering activities.

During construction of the marine portion of the pipeline, construction activities may interfere with localized access due to construction vessels and movement of construction materials. Timing of construction will be staged to minimize disruption to marine traffic. Marine construction activities may also disturb the species which are fished or gathered by Indigenous Peoples. Impact to marine species and their habitat are addressed under **Sections 8-12 and Section 8-13**. Staging will also seek to avoid key fishing seasons, based on ongoing communications with PLFN.

Operation and Maintenance Phase

The active operations occurring during the operation and maintenance phase will be largely in relation to the operation of the ETF which is located within the NPNS property and therefore traditional activities are currently restricted there. In addition, periodic maintenance of the ETF and pipeline will need to be conducted. No significant adverse effects are anticipated and therefore no mitigation is proposed.

Recreation/Cultural Landscapes: Visual and Odour

The replacement ETF and outfall represent improvements relative to the existing BHETF in interaction with the recreation/cultural landscapes. Effluent will not be discernable from background water colour at the surface of the water column at the diffuser site. No impact to community use of recreational areas is anticipated from the operation of the outfall.

Additionally, odour prevention was a basic design criteria used in the development of each stage of the ETF process. Through employing a process that has, for example, continuous sludge removal, subsurface air injectors, and indiredect effluent cooling, odour is controlled during the treatment process. No impact to community is anticipated from odour during the operation of the ETF.

Commercial Fisheries Compensation

Commercial fishing is a significant employer for PLFN. PLFN holds commercial license and a communication and compensation plan will be developed as described in **Section 8.14.4** Socio Economic Environment.

Aboriginal Rights

Consultation and negotiation will be undertaken by the Crown and the Mi'kmaq of Nova Scotia as part of the Made-in-Nova Scotia Process, including any rights-based issues negotiations and ongoing conversations.

Community Liaison Committee

NPNS has an existing Community Liaison Committee (CLC). The CLC serves as a formal consultation process with local stakeholders in compliance with NPNS' Industrial Approval to operate. The CLC serves a very important role in providing advice and facilitating two-way communication. The CLC members represent themselves as members of their community and provide their own personal perspective to the committee. They also provide constructive input on how the company may better address and respond to the community needs and concerns. The CLC meets at a minimum twice annually, in spring and fall, as well as convening on an as-needed basis. The CLC includes representatives from PLFN, the communities of Abercrombie, Pictou Landing, Moodie Cove and Pictou, NPNS staff, and NPNS executives.

8.15.3.3 Characterization of Residual Environmental Effects

The project is intended to provide a new ETF replacing the existing BHETF. In this light, the very nature of the project provides a positive environmental effect to Indigenous Peoples (particularly the members of PLFN) who may be able to enjoy the use of Boat Harbour and its resources at some time in the future.

Documented details on how and where traditional activities have been or are taking place are normally regarded as confidential by First Nations and their representative organizations. This knowledge is both valuable and private to the rights holders. Information presented within this section has been collected from reliable secondary sources, and information provided through engagement activities and the undertaking of the MEKS to date. It is acknowledged that the conclusion of this VEC is contingent upon the final expanded MEKS.

The construction of the land-based portion of the PFA is not anticipated to interact with Indigenous uses, given that the NPNS property has been actively used as an industrial site since the 1970s, and as such, the NPNS property is not likely currently used for practicing traditional activities. Likewise, construction of the pipeline in the road shoulder of Highway 106 is not likely to interact with Indigenous Peoples' use of land and resources, since few (if any) resources would likely be collected in the road shoulder. However, during construction of the marine portion of the pipeline, construction activities may interfere with localized access by Indigenous Peoples wishing to harvest resources where construction is taking place due to the presence of construction vessels and movement of construction materials. Marine construction activities may also disturb the species which are fished or gathered by Indigenous Peoples. Timing of construction will be staged to minimize disruption to marine traffic and key fishing seasons. Compensation for demonstrated loss of access to or use of resources by Indigenous Peoples during construction will be considered as necessary.

During operation and maintenance, there are no features of the active operations occurring during the operation and maintenance phase in relation to the physical presence or operation of the ETF, pipeline, or existing NPNS mill that would be expected to result in significant adverse environmental effects to Indigenous Peoples' use of land and resources. Treated effluent discharges will be controlled and will be maintained in compliance with the Pulp and Paper Regulations and the conditions of NPNS' industrial approval such that significant adverse environmental effects to the marine environment or the resources it contains would be expected to occur. Based on engineering modeling, there will be no visual impact from the operation of the outfall. Effluent will not be discernable from background water colour at the surface of the water column at the diffuser site. In addition, periodic maintenance of the ETF and pipeline will need to be conducted, but substantive interactions with Indigenous Peoples' use of land and resources are not expected given the likely limited scope, frequency, and duration of such activities.

A review of the residual effects of the environmental assessment on interdependent VECs as identified in **Section 8.15.2** indicates that there are no adverse significant effects anticipated once mitigation measures are followed. Follow up and monitoring programs have been recommended accordingly to confirm these assessments.

Deer hunting and salmon fishing were the most commonly reported activities during interviews completed for the MEKS to date, followed by trout, smelt, mackerel and bass fishing, as well as rabbit hunting and blueberry gathering. Hunting cannot occur within the PFA due to legislation on the discharge of a firearm in vicinity to public highways or residences and/or access restrictions on NPNS property, and therefore will not be impacted by construction or operation and maintenance activities.

During all project phases, the commercial fishing industry, which includes PLFN's community commercial license, will be engaged with the follow-up and monitoring program identified in the marine environment through their ongoing relationship with DFO in reporting observations, and landings.

The existing CLC will continue to provide two-way communication between NPNS and the surrounding communities. The potential will also exist for compensation or accommodation for commercial fishers and impact to treaty Rights in such cases where an adverse effect is demonstrated to have occurred due to project activities.

With mitigation measures in place, residual environmental effects of the project on Indigenous Peoples' use of land and resources during construction or operation and maintenance are not expected to be substantive.

8.15.4 Summary

The residual environmental effects of the project on Indigenous Peoples' use of land and resources are summarized in **Table 8.15-2** below. A listing of interdependent VECs and where to find their impact assessment and mitigation in this document is provided in **Section 8.15.2**.

Table 8.15-2: Summary of Residual Environmental Effects on Indigenous Peoples' Use of Land and Resources

Activities	Potential Environmental Effects	Mitigative Factors and Measures	Residual Environmental Effect	Significance of Residual Environmental Effect
Construction of ETF	On NPNS property. No effect anticipated.	None required. (No effect anticipated).	None.	None.
Construction of Effluent Pipeline (land-based portion)	Within highway corridor and NPNS property. No effect anticipated.	None required. (No effect anticipated)	None.	None.
Construction of Effluent Pipeline and Diffuser (marine portion)	The project construction could negatively affect the Indigenous Peoples' use of land and resources in the short-term by interfering with resources needed for hunting, harvesting, cultural or recreational activities.	Consultation and negotiation will be undertaken by the Crown and the Mi'kmaq of Nova Scotia as part of the Made-in-Nova Scotia Process, including any rights-based issues negotiations. Communications and Compensation Plan for Commercial Fisheries and Aquaculture, in coordination with NSE, DFO, and potentially impacted stakeholders *Further environmental protections described in respective VECs.*	Negligible with mitigation applied. Indirect, Reversible *Magnitude - Low* *Duration – short-term* *Frequency – daily until construction complete* *Geographic extent - site-specific* *Context – existing and proposed buffers, construction staging approach*	Not Significant -Adverse
Operation and maintenance of the project	The project operation and maintenance could negatively affect the Indigenous Peoples' use of land and resources in the short-term by interfering with resources needed for hunting, harvesting,	Consultation and negotiation will be undertaken by the Crown and the Mi'kmaq of Nova Scotia as part of the Made-in-Nova Scotia Process, including any rights-based issues negotiations. Community Liaison Committee will continue to facilitate two-way communication and advice to NPNS.	Negligible with mitigations applied Direct and indirect, reversible. *Magnitude - negligible* *Duration – long-term* *Frequency – consistent for duration of project operation* *Geographic extent -*	Not Significant -Adverse

Activities	Potential Environmental Effects	Mitigative Factors and Measures	Residual Environmental Effect	Significance of Residual Environmental Effect
	cultural or recreational activities.	Communications and Compensation Plan for Commercial Fisheries and Aquaculture, in coordination with NSE, DFO, and potentially impacted stakeholders. *Further environmental protections described in respective VECs.*	*regional* *Context - regional*	

In consideration of the above, the nature of the project, the environmental setting, and planned mitigation, the residual environmental effects of the project on Indigenous Peoples' use of land and resources during all phases of the project are rated not significant, with a moderate level of confidence. This conclusion is contingent upon confirmation through the expanded MEKS. Further, nothing outside the scope of possible mitigation measures are anticipated to be identified in the MEKS. Completion of the MEKS will improve the level of confidence in this prediction.

8.15.5 Follow-up and Monitoring

Completion of the MEKS prior to construction will be carried out as a follow-up measure to verify the effects predictions. The ongoing consultation between the Province and PLFN will also be a means such that any unexpected outcomes from the project can be effectively identified and addressed. NPNS will endeavor to develop a Communications and Compensation Plan for Commercial Fisheries and Aquaculture, in coordination with NSE, DFO, and potentially impacted stakeholders. No further follow-up or monitoring is recommended. No further follow-up or monitoring is proposed specifically to address project interaction on Indigenous Peoples' use of land and resources, although follow-up or monitoring conducted for other VECs (particularly for fish and fish habitat, and human health) may assist in further defining and limiting environmental effects on Indigenous Peoples.

8.16 Marine Archaeological Resources

The potential environmental effects of the project on marine archaeological resources are assessed in this section.

8.16.1 Scope of VEC

Marine archaeological resources are selected as a VEC due to their importance, value and potential interest to Indigenous communities, the general scientific, cultural and public communities, and provincial and federal regulatory agencies in ensuring effective management of these resources. Marine archaeological resources are non-renewable and susceptible to alteration, damage or destruction by any project components that have seabed disturbing activities.

For the purposes of this assessment, marine archaeological resources are sites or objects that are in lands covered with water, including being fully or partially submerged or lying below or partially below the ordinary high-water mark of a body of water. These resources can broadly include any physical remnants that indicate past human use of and interaction with the physical environment. These resources also generally include wrecks (i.e., vehicle, vessel, or aircraft), submerged historical sites such as inundated heritage buildings or structures, cemeteries, monuments, and areas of significance to Indigenous communities or other groups.

Regulatory and Policy Context

All historical, archaeological, palaeontological and ecological resources (both known and unknown) in Nova Scotia are protected and fall under the jurisdiction of the *Special Places Protection Act* which is administered by the Nova Scotia Department of Communities, Culture and Heritage (NSCCH). This protection extends to lands covered with water.

Assessing for marine archaeological resources in Nova Scotia requires an archaeological resource impact assessment (ARIA) conducted in accordance with a Heritage Research Permit issued under the *Special Places Protection Act*. Marine archaeological resources may not be disturbed except under strictly controlled conditions imposed by the terms of a permit issued by the Province. As part of the marine survey works, an ARIA for marine archaeological resources is planned to be conducted prior to construction of the project.

8.16.1.1 Boundaries

The spatial boundaries for the assessment of the environmental effects of the project on marine archaeological resources include the following:

- **Marine project footprint area (PFA):** The PFA is the area of anticipated physical disturbance associated with the project. The Marine PFA (i.e., generally the PFA for the marine portion of the pipeline) consists of a corridor approximately 15 m wide and 4.1 km long that begins at the ordinary high-water mark and extends seaward into the Northumberland Strait until the pipeline terminates at the effluent outfall diffuser (**Figure 5.2-2**). This 15 m wide corridor contains the proposed 3 m wide excavated trench within which the pipe will be installed and also accounts for the temporary placement of excavated marine sediments, the laying of 15 m wide granular rock mattresses, and the potential placement of armour stone along the portions of the pipeline route. The estimated total area of the Marine PFA in the Northumberland Strait is 6.15 ha.

- **Local assessment area (LAA):** The LAA is the maximum area within which VEC-specific environmental effects from project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence (i.e., the potential zone of influence of project-related environmental effects on marine archaeological resources). Given the relatively localized nature of potential effects on marine archaeological resources from physical activities (e.g., trenching and temporary placement of excavated marine sediments), the LAA for this VEC is considered to be equivalent to the Marine PFA (i.e., Marine PFA/LAA).

Temporal boundaries for the assessment of environmental effects on the environment include periods of construction, operation and maintenance, and decommissioning. Construction is estimated to be approximately 21 months, beginning second quarter of 2019, commencing as soon as the EA review has been completed and the applicable permits, approvals or other forms of authorization have been obtained. Operation and maintenance will commence immediately following the construction phase and will continue to operate efficiently and safely for several decades and likely much longer with a well-maintained system. For the purpose of this EA Registration, it has been assumed that the operation and maintenance phase will begin in the fourth quarter of 2020. Decommissioning of the project would occur at the end of mill life following the completion of operations. Once the ETF or pipeline is nearing the end of a useful service life, a decommissioning plan will be developed and will be submitted for a separate review requiring NSE approval.

8.16.1.2 Significance Criteria

A significant adverse residual environmental effect on marine archaeological resources is one where project-related activities cause permanent uncontrolled alteration, disturbance to, or destruction of all or part of a marine resource that is considered by the NSCCH, other stakeholders, or Indigenous groups to be of major archaeological importance (due to factors such as rarity, undisturbed condition, spiritual importance, or research importance), and this alteration, disturbance or destruction cannot be mitigated or compensated.

8.16.2 Existing Environment

The following sections describe the existing conditions of marine archaeological resources within the Marine PFA/LAA.

The assessment of effects on marine archaeological resources is based on background research and analysis of relevant geophysical and remote sensing data. This type of assessment is conducted through an ARIA under a Category C Heritage Research Permit issued under the Special Places Protection Act. An ARIA of the marine environment has not yet been completed for this project but will be completed prior to construction. For the purposes of this assessment, a preliminary desktop assessment was conducted with the objective to assess the marine archaeological resource potential within the Marine PFA/LAA. A preliminary desktop assessment is considered by the Study Team to be sufficient to assess project-related effects on marine archaeological resources, given the well-accepted approaches to mitigation for a range of potential resources.

Marine Archaeological Setting

The Marine PFA/LAA is within the Northumberland Strait, jutting in a general northeast direction from the community of Caribou running between Caribou Island to the northwest and Munroes Island to the southeast. The Mi'kmaq peoples would have been the first people attracted to the Caribou area, particularly given its location as a protected bay. This location was also rich in food resources and allowed easy access to the coast and interior portions of the province.

The past two decades of archaeological and geological research shows that large swaths of the Atlantic coastline in North America and Europe was exposed and inundated during various times since deglaciation (ca. 12,000 years ago). Marine archaeological and paleoenvironmental research in the coastal areas of the European North Atlantic has identified numerous landscapes of archaeological interest (Flemming et al. 2017). While less work has focused on the North American side of the Atlantic, there are studies that identify the potential for Indigenous underwater archaeological sites in certain areas of the Atlantic coastline in Canada (Lacroix et al. 2014; Shaw et al. 2009).

Known terrestrial sites on the current coastlines of Nova Scotia and New Brunswick (Jacques Whitford 2001) show that coastal habitation has occurred in these areas for thousands of years. More recent work demonstrates that people lived on the Atlantic coastline much earlier than previously realized, and there is a gap in the archaeological record in Atlantic Canada which correlates to the periods of time that now inundated areas were above water (Bell and Renouf 2011). The challenge in locating preserved submerged landscapes along the Atlantic coastline is that evidence of these landforms (e.g. shorelines, river channels) was obliterated by high energy waves as the sea level rose between 12,000 and 6,000 years ago (Shaw et al. 2009). However, in special circumstances, submerged landforms are preserved in areas such as the Bedford Basin and the Bras d'Or Lakes in Nova Scotia (Shaw et al. 2009).

Previous research on the post-glacial landscape of the Atlantic shows a large glacial paleochannel that runs between Newfoundland and Nova Scotia (Shaw et al. 2006). Large river valleys have been the loci of many prehistoric archaeological sites worldwide, and large submerged river channels on the coast of British Columbia have presented submerged archaeological finds (Fedje and Josenhans 2000). By 11,000 years ago, next to this large river channel, additional land emerged along the coast of Nova Scotia, plus additional lands to the north and south adjacent to the river channel. At 9,000 years ago, Nova Scotia and Prince Edward Island were one landmass and remained so until 6,000 years ago. This land bridge between the two provinces, now submerged under the Northumberland Strait, would have been available for human occupation for 5,000 years (Keenleyside 1999) (**Figure 8.16-1**). Areas closer to the continental shelf, such as Sable Island, are less likely to retain preserved landscapes. However, more protected areas, such as estuaries, low-gradient beaches, or rocky islands which may protect basins from erosive wave action, are more likely to preserve archaeological materials (Lacroix et al. 2014). Given that the proposed Marine PFA/LAA goes through an area that encloses several protected basins and previously exposed land areas, the potential for submerged landscapes is high.

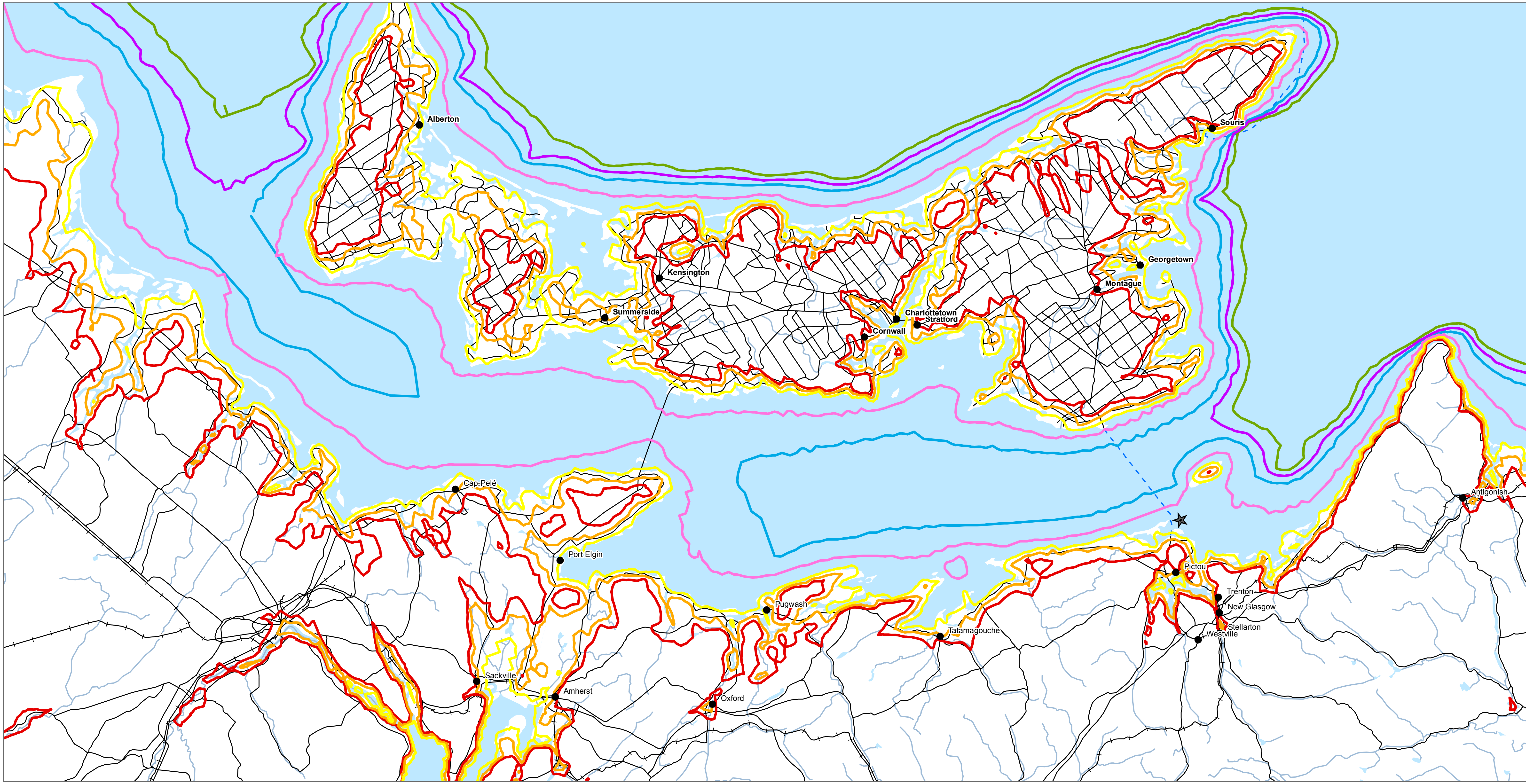
Caribou is reportedly named after a herd of caribou seen on the east point of Caribou Island by early settlers (Nova Scotia Archives 2018). French explorer Nicholas Denys explored what is now known as Caribou Harbour in the 1660s. A small group of French settlers were the first Europeans to have lived in the area, followed by early Scottish immigrants. The area of Caribou grew steadily through to the early 1800s when a sawmill was erected at the head of the harbour by John Harris in November of 1803 (Nova Scotia Archives 2018). The sawmill would have likely increased expansion and assisted with shipbuilding, which became significant to the area to facilitate timber merchants, coastal trade, shipping local surplus produce, and fishing (Cameron 1990). With the large amount of shipping traffic plying the waters to Caribou, a lighthouse at the east end of Caribou Island was constructed in 1868 to protect vessels from the shallow shoals extending off the point. In 1939, Northumberland Ferries Ltd. was organized and began operating a ferry service between Caribou Harbour and Prince Edward Island.

A review of relevant historical literature (Blakeley and Stevens 1963; Cameron 1990; Zinck 1975; Zinck 1977) and the Maritime Museum of the Atlantic's On the Rocks (2018) shipwreck database indicates there are at least 10 known wrecked vessels in the vicinity of the Marine PFA/LAA. No exact locational data exist for these wrecks; however, **Table 8.16-1** lists the wrecks and their approximate location.

Table 8.16-1: Wrecks in the Vicinity of the Marine PFA/LAA

Vessel Name	Type	Date of Wreck	Event	Location of Wreck
Belle	Schooner	July 1, 1875	Foundered	Pictou Island, between Caribou Island
Cape Breton	Dredge	November 7, 1887	Foundered	Caribou Island
Ellen	Schooner	November 20, 1875	Stranded	Caribou Harbour entrance
Emelle	Unknown	April 11, 1885	Wrecked	Caribou Island
Helen	Schooner	October 18, 1854	Ran ashore	Caribou Island
Maggie	Schooner	November 17, 1883	Stranded	Off Caribou
Mary Hart	Schooner	October 24, 1875	Stranded	Caribou Island Shoal
Ocean	Barque	September 1, 1875	Stranded	Caribou Island
Nancy	Schooner	October 19, 1879	Stranded	Caribou Island
Union	Unknown	July 20, 1910	Stranded	Caribou Head

Source: Blakeley and Stevens (1963); Cameron (1990); Maritime Museum of the Atlantic (2018); Zinck (1975); Zinck (1977).



Northern Pulp Nova Scotia Corporation

Replacement Effluent Treatment Facility
Environmental Assessment

Paleoshorelines In and Around the Northumberland Strait

Figure 8.16-1

NORTHERN PULP
NOVA SCOTIA CORPORATION
A PAPER EXCELLENCE COMPANY

DILLON CONSULTING

MAP CREATED BY: HW
MAP CHECKED BY: SS
MAP PROJECTION: NAD 1983 UTM Zone 20N

PROJECT: 17-6461

Date: 1/4/2019

Given the number of known wrecks within close proximity to the Marine PFA/LAA, the potential for shipwrecks is high.

8.16.3 Impact Evaluation/Effects Assessment

The potential environmental effects of the project on marine archaeological resources are assessed in this section.

8.16.3.1 Potential Environmental Effects

As a result of a preliminary desktop assessment, including a review of relevant historical and scientific literature, the Marine PFA/LAA retains potential for marine archaeological resources. An ARIA for marine archaeological resources is still pending, to be conducted in accordance with a Heritage Research Permit issued under the Special Places Protection Act.

Construction and operation and maintenance activities associated with the project could interact with marine archaeological resources through seabed disturbance and sediment deposition. These interactions could potentially result in altering marine archaeological resources, if such sites are present within the Marine PFA/LAA. The value of these marine resources is not quantified in terms of individual objects, but rather in the information that is obtained between the individual objects and features, their spatial distribution and their depositional context. Any alteration to these inter-relationships during project construction or operation and maintenance phases can result in the permanent loss of information that is fundamental to understanding marine archaeological sites and their formation.

In consideration of these potential interactions, the assessment of project-related environmental effects on marine archaeological resources is focused on 'alteration' as a potential environmental effect. For the purposes of this assessment, alteration is considered any kind of damage, disturbance, deposition or erosion of seabed sediments or destruction that affects the number or integrity of any marine archaeological resources.

- **Construction phase**: Due to alteration, there is potential for adverse project-related effects to both recorded and unrecorded marine archaeological resources in the Marine PFA/LAA. Activities associated with project construction will cause seabed disturbance that could affect marine archaeological resources. Activities such as pipeline trench excavation, sediment deposition, pipeline and outflow installation and construction barge anchoring can directly or indirectly cause alteration of a marine resource. These disturbances could result in the loss of the marine archaeological resource or alter its scientific, cultural or public significance. A marine ARIA is still required to confirm whether marine archaeological resources are present within the LAA.
- **Operation and maintenance phase**: There are no predicted project-related effects to marine archaeological resources due to the physical presence of the marine pipeline and diffuser during the operation and maintenance phase of the project. A receiving water study conducted for the effluent discharge for the project (Stantec 2018) determined that a three-port diffuser configuration and the effluent plume buoyancy in the hydrodynamic environment resulted in effluent dilution ratios so high

that the plume is not likely to result in potential adverse effects to the benthic environment. Therefore, no alteration on marine archaeological resources are anticipated due to the physical presence of the marine pipeline and diffuser during the operation and maintenance phase of the project.

However, due to alteration, there is potential for adverse project-related effects to both recorded and unrecorded marine archaeological resources in the Marine PFA/LAA as part of periodic maintenance activities for the marine outfall during the operation and maintenance phase of the project. Maintenance activities, such as construction barge anchoring, will cause seabed disturbance which can directly or indirectly cause an alteration of a marine resource. These disturbances could result in the loss of the marine archaeological resource or alter its scientific, cultural, or public significance.

8.16.3.2 Mitigation

Mitigation measures are implemented to reduce potential adverse effects on marine archaeological resources during the construction and operation and maintenance phases of the project. Mitigation measures follow relevant regulatory approvals, project-specific ARIA reports and Indigenous consultation, and will be implemented prior to any seabed disturbance activities.

Project-specific planning and final design will examine the location and nature of identified marine archaeological resources within the Marine PFA/LAA to avoid any potential adverse effects. The following mitigation measures are recommended to reduce alteration to marine archaeological resources:

- **Complete Archaeological Resource Impact Assessment**: To further determine if the coastal landscapes of the Marine PFA/LAA may have potential for preserved submerged archaeological resources, a marine-specific ARIA will be completed. The ARIA will be completed under a Category C Heritage Research Permit issued by the NSCCH and consist of thorough desktop assessment and background research. Available multi-beam, side-scan sonar and remotely operated vehicle (ROV) data will be analyzed for marine archaeological resources upon the completion of the marine survey work. For submerged landscapes specifically, potential preserved features such as paleochannels and shorelines, along with any additional data such as sub-bottom seismic profiling to determine if sediment has been scoured or deposited in these areas will be assessed. If sediment coring or historic dredging has been completed in the area, the data (if available) will be reviewed to see if potential paleoshorelines and/or paleosols are present. The ARIA will provide recommendations for site-specific mitigation measures for any identified marine archaeological resources in conflict with any seabed disturbance activities.
- **Avoidance**: For marine archaeological resources that may be affected by project-related activities, the preferred mitigative measure is avoidance of these resources through project redesign, if feasible. Planned avoidance for areas of high marine archaeological potential (e.g., submerged landforms, paleoshorelines, and shipwrecks) would also be preferred.
- **Monitoring**: If site avoidance is not feasible or the identification of a marine archaeological resource cannot be confirmed during the ARIA, then archaeological monitoring can be carried out during the

construction and maintenance phases. Archaeological monitoring consists of visual inspection during seabed disturbance activities so that marine archaeological resources can be appropriately identified or managed if encountered. If archaeological monitoring is required, a separate Heritage Research Permit issued under the Special Places Protection Act will be required.

- **Systematic Data Recovery**: If avoidance of a marine archaeological resource is not feasible, then these resources may be mitigated through systematic data recovery (SDR). SDR methods for marine sites are complex and can only be developed through extensive consultation with the NSCCH and Indigenous communities.
- **Implement Project-Specific Environmental Protection Plan**: A project-specific Environmental Protection Plan (EPP) with marine archaeological resource protections will be prepared. The EPP will directly address contingencies and emergency response procedures in the unlikely event that unrecorded marine archaeological resources are encountered during project-related activities. The EPP will provide relevant project staff with descriptive information on cultural materials and archaeological deposits that may be encountered in the marine environment of the Marine PFA/LAA, a protocol to identify these materials, communicate the find(s) to appropriate parties, and to help avoid unmitigated alteration to marine archaeological resources.

8.16.3.3 Characterization of Residual Environmental Effects

The Nova Scotia government requires mitigation of all potential effects to historical, archaeological, palaeontological and ecological resources within the Marine PFA/LAA prior to construction. Marine archaeological resource investigations (ARIA) and mitigation measures will be completed prior to any seabed disturbing activities. Based on the determination that potential effects to marine archaeological resources will be mitigated in accordance with Provincial legislation, including approaches described above, it is determined that no residual effects on marine archaeological resources are anticipated as a result of the project.

8.16.4 Summary

The residual environmental effects of the project on marine archaeological resources are summarized in **Table 8.16-2** below.

Table 8.16-2: Summary of Residual Environmental Effects to Marine Archaeological Resources

Project Activities	Potential Effects	Mitigation	Residual Effects	Significance of Residual Effects
Construction				
Pipeline trenching and installation, installation of effluent outfall diffuser, and associated marine construction activities, including barge anchoring	Alteration of marine archaeological resources	• Complete ARIA • Avoid identified or potential marine archaeological resources within the Marine PFA/LAA • Archaeological monitoring of any seabed disturbing activities within proximity to unconfirmed or potential marine archaeological resources • If avoidance is not possible, SDR of marine archaeological resources in conflict • Make operators aware of identified or potential marine archaeological resources within the Marine PFA/LAA and implement project-specific EPP	No unmitigated interaction between the project and marine archaeological resources is expected to occur. *Direction - Adverse* *Magnitude – Low* *Geographic extent – Local* *Duration – Construction phase* *Frequency - Daily* *Reversibility – Irreversible* *Context – Disturbed*	Not Significant – Adverse
Operation and Maintenance				
Presence and operation of the marine pipeline and effluent outfall diffuser	Alteration of marine archaeological resources	N/A	N/A	No residual effects predicted
Maintenance of the marine pipeline and effluent outfall diffuser	Alteration of marine archaeological resources (if required maintenance activities entail seabed disturbance)	• If required maintenance activities entail seabed disturbance, implement mitigation measures identified above for pipeline trenching and installation, installation of effluent outfall diffuser, and associated marine construction activities, including barge anchoring (as applicable)	No unmitigated interaction between the project and marine archaeological resources is expected to occur. *Direction - Adverse* *Magnitude – Low* *Geographic extent – Local* *Duration – Permanent* *Frequency – N/A* *Reversibility – Irreversible* *Context - Disturbed*	Not Significant – Adverse

Project-related seabed disturbance activities during the construction and operation and maintenance phases have the potential to adversely affect marine archaeological resources by altering the resource. A potential effects assessment outlined in **Section 8.16.3.1** describes these interactions and proposes mitigation measures to eliminate and control anticipated potential adverse effects.

A preliminary desktop assessment determined that the Marine PFA/LAA has high potential for marine archaeological resources, mainly submerged landscapes and potential shipwrecks. An ARIA for marine archaeological resources within the LAA will be conducted prior to construction. If marine archaeological resources are identified within the LAA, potential effects will be mitigated prior to construction through avoidance or SDR as appropriate, so that historical and archaeological data regarding these resources is preserved.

In summary, with the implementation of mitigation measures, significant adverse residual environmental effects on marine archaeological resources are not anticipated. As such, with proposed mitigation, the residual environmental effects of the project on marine archaeological resources during all phases of the project are rated not significant, with a moderate level of confidence. The completion of the ARIA as a follow-up measure will improve the level of confidence in this prediction. In the unlikely event that previously unrecorded marine archaeological resources are identified during project-related activities, the EPP as described in Section 8.16.3.2 will be followed.

8.17 Terrestrial Heritage Resources

This section addresses the potential environmental effects of the project on heritage resources as they are defined in Nova Scotia's *Special Places Protection Act*. The focus of this VEC is on heritage resources potentially located on land (i.e., terrestrial heritage resources). Heritage resources that could potentially be present in the marine environment are assessed in **Section 8.16**, marine archaeological resources.

8.17.1 Scope of VEC

Heritage resources include archaeological resources (e.g., artifacts), palaeontological resources (e.g., fossils), and built heritage resources (e.g., historic buildings or sites) in accordance with the interpretation of the *Special Places Protection Act*. Marine archaeological resources are addressed in **Section 8.16**.

Terrestrial heritage resources have been selected as a VEC due to the overall importance of land-based heritage resources to the people of Nova Scotia and in recognition of the provincial bodies who are responsible for their protection and preservation. Additionally, Indigenous peoples have an important interest in the preservation and management of archaeological resources related to their history and culture. Furthermore, the project is within relatively close proximity to tributaries of the Pictou River System, which like all major watercourses carries an elevated potential for harbouring archaeological resources.

Heritage resources, both human-made and naturally occurring, are those resources related to the past that remain to inform present and future societies of that past. Heritage resources are highly delicate features of the environment and their integrity is susceptible to ground-disturbing activities. Any project activity that includes surface or sub-surface ground disturbance has the potential for interaction with heritage resources, where they are present. Accordingly, ground disturbance and earth moving activities represent the component of the project with the greatest potential for interaction with terrestrial heritage resources that might be contained in surface soils or rock.

Heritage resources in Nova Scotia are protected under the Nova Scotia *Special Places Protection Act* as administered and enforced by the Culture and Heritage Division of the Nova Scotia Department of Communities, Culture and Heritage. The *Special Places Protection Act* protects important archaeological, historical, and palaeontological resources both on land and underwater.

8.17.1.1 Boundaries

Spatial boundaries for the assessment of environmental effects on the terrestrial heritage resources VEC include the following:

- The **project footprint area (PFA)** is the area of anticipated physical disturbance of the project and includes the physical footprint of the replacement ETF and the land-based portion of the effluent pipeline and related systems; an area comprising 62.75 ha.

- The **local assessment area (LAA)** is the maximum area within which VEC-specific environmental effects from project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence (i.e., the potential zone of influence of project-related environmental effects on terrestrial heritage resources). For terrestrial heritage resources, the local assessment area is not expected to extend beyond the project footprint area, as an environmental effect would be related to ground disturbance/earthworks (to occur only within the project footprint area).

Temporal boundaries for the assessment of environmental effects on the environment include periods of construction, operation and maintenance, and decommissioning. Construction is estimated to be approximately 21 months, beginning second quarter of 2019, commencing as soon as the EA review has been completed and the applicable permits, approvals or other forms of authorization have been obtained. Operation and maintenance will commence immediately following the construction phase and will continue to operate efficiently and safely for several decades and likely much longer with a well-maintained system. For the purpose of this EA Registration, it has been assumed that the operation and maintenance phase will begin in the fourth quarter of 2020. Decommissioning of the project would occur at the end of mill life following the completion of operations. Once the ETF or pipeline is nearing the end of a useful service life, a decommissioning plan will be developed and will be submitted for a separate review requiring NSE approval.

8.17.1.2 Significance Criteria

A significant adverse residual environmental effect on terrestrial heritage resources is one where project-related activities result in the permanent disturbance or unauthorized accidental destruction of an archaeological, palaeontological, or built heritage resource, site, or object that is considered by the provincial heritage regulators to be of major importance and that cannot be mitigated.

8.17.2 Existing Environment

8.17.2.1 Archaeological Resources

In order to assess the potential for adverse residual environmental effects on archaeological and historical resources, Cultural Resource Management (CRM) Group, a consulting archaeology firm from Bedford, Nova Scotia, was retained to undertake an archaeological resource impact assessment (ARIA). The ARIA consists of background research to identify known sites and preliminary field investigation (site reconnaissance and walkover) to identify features of the landscape which could indicate past uses and to confirm locations of known sites.

The background study included a review of relevant historic documentation incorporating land grant records, legal survey and historic maps, local and regional histories and consultation with knowledgeable parties. Topographic maps and aerial photographs, both current and historic, were also used to provide information on the general area of Pictou County in order to evaluate the local assessment area. This data facilitated the identification of environmental and topographic features that would have influenced human settlement and resource exploitation patterns. The historical and cultural information was integrated with the environmental and topographic data to identify potential areas of archaeological sensitivity.

CRM Group also contacted the Kwilmu'lw Maw-klusuaqn Negotiation Office's Archaeological Research Division (KMKNO's ARD) to see if they have any information pertaining to traditional or historical Mi'kmaw use of the local assessment area.

As a result of the preliminary desktop assessment (including model/mapping database check for high potential resource areas) and the ARIA conducted for the project (CRM Group 2017; 2018; 2019), most of the PFA exhibits a generally low potential to harbour archaeological resources; however, there is elevated potential for heritage resources to be located within the PFA at Abercrombie Point on NPNS property, given the presence of a registered archaeological site there. Field reconnaissance of the PFA between the edge of NPNS property and the Northumberland Ferries marine terminal confirmed that due to extensive historic disturbance, there was low potential for heritage resources to be encountered. However, a 150 m long historic stone wall was found to be present to the west of the pipeline footprint area, near Caribou Harbour, and while the current alignment of the pipeline footprint area avoids this stone wall, if the pipeline alignment were to be moved elsewhere for whatever reason, the stone wall should still be avoided if possible.

An ARIA conducted on the initial project design (focussed on the NPNS property and ETF layout) revealed archaeological resources and a registered archaeological site at Abercrombie Point on NPNS property, in immediate proximity to the initially planned location of the proposed spill basin site. A 200 m archaeological “buffer” has been established around this site where ground disturbance should be avoided. The spill basin was subsequently redesigned for the current layout to avoid adverse impacts to those resources.

8.17.2.2 Historic Indigenous Land Use

The land within the study area was once part of the greater Mi’kmaq territory known as Agg Piktuk in Mi’kmaw language, meaning ‘The Explosive Place’. Numerous lakes and watercourses spread throughout the general area would have been important transportation and trade corridors providing a resource base for the Mi’kmaq and their ancestors prior to the arrival of European settlers. Pictou Harbour is called Puknipkejk in Mi’kmaw language, which translates to “narrow harbor”. East River is called Amasipukwejk in Mi’kmaw language, which means “long river”. The three rivers at Pictou would have served as important transportation routes, facilitating travel inland from the Northumberland Strait at Pictou Harbour, and a significant source of salmon and other fish species.

Early contact with the Mi’kmaq in the area indicates a strong indigenous presence prior to European contact. An early map of the area depicts the location of a Native village site near the mouth of the East River (Patterson 1877: 27). An area situated further up the river was identified as a burying place

(Dawson 2012:117) and, at the time of English settlement, was marked by a large iron cross standing approximately 10 feet high on the eastern coast of East River, referred to as Indian Cross Point. Furthermore, farming activities along the three rivers has unearthed evidence of pre-Contact habitation throughout the area.

In Nova Scotia, information regarding archaeological sites is stored in the Maritime Archaeological Resource Inventory (MARI), a provincial archaeological site database, which in Nova Scotia is maintained by the Nova Scotia Museum. This database contains information on archaeological sites registered with the province within the Borden system. The Borden system in Canada is based on a block of latitude and longitude measuring approximately 13 kilometres east-west and 18.5 kilometres north-south; each block is referenced by a four letter designator. Sites within a block are numbered sequentially as they are recorded. The LAA is located within the BjCq Borden Block. Examples of archaeological sites recorded in the LAA include a post-contact Indigenous burial site, shell middens, general activity sites (e.g., tool making sites), as well as sites where stone axes, stone projectile points, and knives were found.

Based on the environmental setting (i.e., its proximity to a significant water source), previously identified archaeological sites within and near the LAA and Native land use, the PFA in the area of Abercrombie Point is ascribed an elevated potential for encountering pre-Contact and/or early historic Native archaeological resources.

8.17.2.3 Palaeontological Resources

The PFA is underlain by late carboniferous bedrock of the Pictou Group and to a minor extent, the Malagash Formation, which could potentially contain fossils (personal communication, Anna Cross, Culture and Heritage Division of the Nova Scotia Department of Communities, Culture and Heritage, 2018).

8.17.2.4 Built Heritage

A review of the Canadian Registry of Historic Places indicates that there are no built heritage sites within the PFA (Canadian Register of Historic Places 2019). The closest site is the McCulloch House located approximately 650 m east of the pipeline footprint area on Halliburton Road in Pictou. Given the highly developed nature of the proposed PFA, it is unlikely that built heritage resources would be encountered.

8.17.3 Impact Evaluation/Effects Assessment

8.17.3.1 Potential Environmental Effects

Key interactions between the project and terrestrial heritage resources with the potential to result in both direct and indirect adverse effects to heritage resources are limited to construction activities (and to a lesser extend during decommissioning) such as clearing, grubbing, and excavation may result in disturbance or destruction of terrestrial heritage resources. No interaction is anticipated between the project and terrestrial heritage resources during the operation and maintenance phase, as no further ground disturbance is anticipated during that phase. Effects to terrestrial heritage resources during the decommissioning phase would be similar to those during construction, given the same potential interactions as a result of ground disturbing activities.

Should the unanticipated discovery of heritage resources occur during the construction, operation and maintenance, or decommissioning phases of the project, it would be considered and addressed as an accidental event, as discussed in **Section 10**.

8.17.3.2 Mitigation

Key mitigation measures to avoid or minimize the potential for the environmental effects to terrestrial heritage resources include:

- Planned avoidance of areas of elevated potential for encountering heritage resources to the extent practical;
- As recommended by CRM Group and to be confirmed by the Culture and Heritage Division of the Nova Scotia Department of Communities, Culture and Heritage, intrusive investigations such as shovel testing (as applicable) will be conducted at 5 m intervals in the PFA where there is an elevated potential for archaeological resources;
- Areas of moderate archaeological potential within any further delineated impact zones will be subjected to a program of shovel testing and shovel testing at 10 m intervals should be conducted within 50 and 100 m of the current shoreline;
- Avoid the area of the stone boundary wall identified west of Caribou;
- Conduct archaeological monitoring during construction;
- If the layout of land-based project elements changes from what is proposed, additional archaeological assessments will be carried out to evaluate archaeological potential; and
- A project-specific Environmental Protection Plan (EPP) with defined contingency and emergency response procedures will be developed and implemented.

8.17.3.3 Characterization of Residual Environmental Effects

Any ground breaking or earth moving activity has the potential to uncover previously undiscovered heritage resources. Archaeological resources (i.e., artifacts) tend to be found in surficial soils when discovered, whereas palaeontological resources (i.e., fossils) tend to be found in bedrock. The discovery of these resources can provide valuable information about human activity or use in the distant past (in the case of artifacts), or the presence of wildlife and vegetation in earlier eras (in the case of fossils). With respect to the project, it is possible that previously undiscovered heritage resources in the form of artifacts could be found in the surficial soils of the PFA (including topsoil and overburden) during construction of the project.

Interactions with paleontological resources are not anticipated, since excavation will be limited to the overburden and roadbed fill and not likely to affect exposed bedrock on ground surface or bedrock potentially encountered during excavation activities. Similarly, interactions with built heritage resources are not anticipated as no historic places or listed built heritage resources have been identified in the PFA. Given the nature of construction and the route of the terrestrial portion of the pipeline, it is unlikely that fossils or built heritage resources will be encountered. As such, palaeontological or built heritage resources are not discussed further.

With respect to archaeological resources, based on the early results of the ARIA conducted for the Project, the Abercrombie Point area is generally ascribed an elevated potential for encountering pre-Contact and/or early historic Native archaeological resources, the ARIA conducted for the ETF footprint area indicated that it has a generally low potential for harbouring archaeological resources. Further, subject to confirmation, the pipeline footprint area also has a generally low potential for harbouring archaeological resources because most of the construction of the pipeline will be conducted in the road shoulder.

The ARIA identified that there is a registered archaeological site at Abercrombie Point on the NPNS property, adjacent to Pictou Harbour—a 200 m archaeological “buffer” has been established in this area where disturbance of ground will be avoided during construction and the spill basin has been relocated to avoid disturbance in this area. Additionally, the ARIA identified a 150 m long historic stone wall to the west of the pipeline footprint area near the Northumberland Ferries marine terminal, and although this wall is not present in the PFA, construction activity in this area should be avoided if the pipeline alignment needs to change. The ARIA made a number of recommendations to further avoid adverse environmental effects to archaeological resources, including avoiding disturbance to the stone wall and registered archaeological site during construction activities, as well as conducting shovel testing in areas identified as having elevated archaeological potential prior to construction.

The operation and maintenance of the replacement ETF and pipeline, including their presence and periodic maintenance activities, is not anticipated to interact with terrestrial heritage resources since there will be no further ground disturbance or earth moving activities arising during this phase that could affect such resources.

Eventual decommissioning of the project would have a similar potential to encounter archaeological resources as during the construction phase, but if the same avoidance and mitigation are exercised during decommissioning as were implemented during construction, substantive environmental effects with archaeological resources during decommissioning would be unlikely to occur.

Based on these observations, and with the implementation of planned mitigation, substantive interactions between the project and archaeological resources are unlikely to occur.

8.17.4 Summary

Table 8.17-1 provides a summary of the residual environmental effects of the project on terrestrial heritage resources, including a summary of the potential effects, associated mitigation measures, residual effect, and significance of residual effects.

Table 8.17-1: Summary of Residual Environmental Effects on Terrestrial Heritage Resources

Phase and Activities	Potential Effects	Mitigative Factors and Measures	Residual Effects	Significance of Residual Effects
Construction				
Site preparation vegetation clearing, grubbing and excavation	Accidental disruption/ destruction of archaeological resources	Planned avoidance of potential heritage resources by utilizing Highway 106 right-of-way and establishing a buffer zone around the registered archaeological site at Abercrombie Point Employing shallow construction methods that do not extend to bedrock where possible Unavoidable areas of elevated archaeological potential in the project footprint area will be subject to intrusive investigation (shovel testing) to remove and preserve any artifacts that might be present there Archaeological monitoring will be conducted during construction	Negligible with standard mitigation applied. Direct and Indirect, Irreversible Magnitude - Low Duration – one to two years Frequency - daily Geographic extent – Low (limited to project footprint area) Context – footprint within areas previously undisturbed	Not Significant -Adverse

Based on the preliminary results of the ARIA conducted for the project, the project footprint area is generally thought to have low archaeological potential, with the exception of a few areas to be avoided and others having a higher archaeological potential that have been recommended to be subjected to shovel testing prior to construction. No interactions with palaeontological or built heritage resources are anticipated. As a result, the potential for terrestrial heritage resources to be present within the PFA is considered low; therefore, substantive interactions between the project and terrestrial heritage resources are unlikely to occur.

In light of these observations, and with the implementation of the mitigation and environmental protection measures, it is not anticipated that there will be any substantial unmitigated interaction between the project and terrestrial heritage resources during any phase of the project. Therefore, in consideration of the above, the residual environmental effects of the project on terrestrial heritage resources during all phases of the project are rated not significant, with a moderate level of confidence.

Implementing the recommendations of the ARIA, including archaeological monitoring during construction, will improve the level of confidence of this prediction.

8.17.4.1 Follow-up and Monitoring

Given the elevated potential for archaeological resources in the Abercrombie Point area of the NPNS property, it is recommended that any ground impacts (excavation, grading or grubbing) in that area be monitored by an archaeologist during construction activities.

8.18 Effects of the Environment on the Project

The potential effects of the environment that could occur on the project are assessed in this section.

8.18.1 Scope

Effects of the environment on the project are those effects related to risks of natural hazards and influences of the natural environment on the project. Potential effects of the environment on any project are a function of project or infrastructure design in the context of its receiving environment, and ultimately how the project is affected by the natural environment. These effects may arise from physical conditions, land forms, and site characteristics or other attributes of the environment which may act on the project such that the project components, schedule, and/or costs could be substantively and adversely changed.

Based on the nature of the undertaking, the following environmental attributes have been identified as having potential to interact with the project and requiring further consideration in this assessment:

- *Extreme weather events, including wind, precipitation, storm surge, electrical storms, tornadoes and hurricanes;*
- *Seismic activity;*
- *Forest fires resulting from causes other than the project; and*
- *Climate change.*

8.18.2 Boundaries

As effects of the environment on the project relates to potential influences of the forces of nature on the project integrity and conduct, the assessment area for effects of the environment on the project is limited to the PFA.

Spatial boundaries for the assessment of environmental effects on the project include the following:

- The **project footprint area (PFA)** is defined as the maximum extent of the physical area of disturbance associated with the project. The PFA will include all temporary and permanent areas of ground and marine disturbance. The PFA is defined in **Section 5.1.1**.

Temporal boundaries for the assessment of environmental effects on the environment include periods of construction, operation and maintenance, and decommissioning. Construction is estimated to be approximately 21 months, beginning second quarter of 2019, commencing as soon as the EA review has been completed and the applicable permits, approvals or other forms of authorization have been obtained. Operation and maintenance will commence immediately following the construction phase and will continue to operate efficiently and safely for several decades and likely much longer with a well-maintained system. For the purpose of this EA Registration, it has been assumed that the operation and maintenance phase will begin in the fourth quarter of 2020. Decommissioning of the project would occur at the end of mill life following the completion of operations. Once the ETF or pipeline is nearing the end of a useful service life, a decommissioning plan will be developed and will be submitted for a separate review requiring NSE approval.

8.18.3 Significance Criteria

A significant adverse effect of the environment on the project is defined as one where:

- Damage to the project infrastructure results in a substantial increase in risks to the health and/or safety of the public, or substantial risks of a business interruption;
- Damage to the project infrastructure results in repairs that could not be technically or economically implemented;
- A long-term interruption in service occurs (e.g., an interruption in NPNS production activities such that targets cannot be met); or
- A substantial change of the project schedule is experienced (e.g., a delay resulting in the construction period being extended by one or more seasons).

8.18.4 Existing Conditions

Existing environmental conditions are summarized below based on existing available datasets.

8.18.4.1 Existing Climate and Severe Weather

Climate is defined as the statistical averages of precipitation, temperature, humidity, sunshine, wind velocity, and other phenomena such as fog, frost and hail storms for a particular region and time period, generally taken over a 30 year period (NASA 2017). Recent climatological conditions, with particular consideration to weather variability and weather extremes is important for determining potential effects during the construction phase of the project.

Current climate conditions are generally described by the most recent 30 year period for which ECCC has developed statistical summaries. These summaries are typically referred to as “climate normals”. The closest weather station to the project with available climate normals (including temperature and precipitation, amongst other variables) is the Lyons Brook weather station, located in Lyons Brook, NS, approximately 6 km west of the ETF and 15 km southwest of the marine outfall location. The current climate normals data are available for the period of 1981 to 2010, and data were summarized in **Table 8.1-3** in **Section 8.1**. This period has been chosen as the most applicable period for summarizing current climate conditions for the project (GOC 2018).

The Köppen climate classification system is one of the most widely used climate classification systems, and is based on seasonal precipitation and temperature patterns. This system classifies the PFA as humid continental, with rainy and snowy cold winters and warm humid summers. Typical and extreme temperature ranges can inform material selection, and construction methodologies and scheduling; this information is summarized in **Table 8.18-1**.

Table 8.18-1: Extreme Temperatures on Record (Lyons Brook Station, ECCC)

Highest Temperature on Record	36.0°C in August 2001
Coldest recorded temperature	-39.4°C in February 1961
Monthly mean temperatures	range from -6.2°C in January to 19.3°C in July
Monthly maximum mean temperatures range	24.8°C in July to -1.5°C in January
Monthly minimum mean temperatures	-11.0°C in January to 13.8°C in July

Monthly mean wind speeds measured at the Halifax Stanfield International Airport weather station range from 13.2 to 18.5 km/h, with an annual mean wind speed of 16.5 km/h. From May to September, the dominant wind direction is from the south, with winds predominantly blowing from the west, northwest and north from October through April (GOC 2018). Maximum hourly wind speeds, averaged from 1981 to 2010 for each month, range from 64 km/h to 93 km/h, while maximum wind gusts for the same period range from 91 km/h to 132 km/h. Occurrences of extreme winds are relatively uncommon at the reference weather station. From 1981 to 2010, there has been an average of 13.3 days per year with winds greater than or equal to 52 km/h and 2.9 days per year with winds greater than or equal to 63 km/h (GOC 2018).

Table 8.18-2: Extreme Precipitation on Record (Lyons Brook Station, ECCC)

Average historical yearly precipitation	1,232.2 mm 953.3 mm was rain and 279.0 mm was snowfall (as water equivalent)
Extreme daily precipitation	43.0 mm (May 1994) to 92.5 mm (November 2002).
Days per year with rainfall greater than 25 mm	7.6 days per year on average
Days per year with snowfall greater than 25 cm	1.4 days per year on average

Severe Weather Events

Extreme precipitation and high wind events can occur in Nova Scotia throughout the year but tend to be more common and severe during the late fall and winter. Extreme precipitation records are summarized in **Table 8.18-2**. Fall and winter storms generally bring high winds and a combination of snow and rain, especially in low lying areas near the Northumberland Strait.

In the 2000s, many areas of Nova Scotia had more extreme rainfall events than any other decade on record. As recently as October 2016, record breaking extreme storm events have occurred, affecting much of Nova Scotia, where many regions of the province received over 150 mm of rain during a 24-hour period; these events threatened public safety and transportation systems (GOC 2018b).

A storm surge refers to an abnormal rise in seawater level during a storm, measured as the height of the water above the normal predicted astronomical tide (NOAA 2018). Storm surges typically result from the meteorological effects on the ocean such as wind setup, a function of the fetch and the wind duration, and low pressure, which heightens the predicted tide level (often referred to as storm tide). The amplitude of the storm surge at any given location is dependent on the orientation of the coast line with the storm track, including its size, intensity, speed, and the local ocean bathymetry (NOAA 2018). Extreme storm surges will typically occur during high wind events, and often coincide with high and/or spring tides. Since the height of breaking waves in part is determined by water depth, storm surges coinciding with high and/or spring tides allow larger waves to break closer to shore, which can compound flooding impacts.

Electrical storms, or thunderstorms, are less frequent in Nova Scotia than in the rest of the Maritime region, occurring on average 5 to 10 times a year (NAV Canada 2001). Statistically, less than one of these storms (per year) is extreme enough to produce hail. Thunderstorms can produce extremes of rain, wind, hail and lightning; however, most of these storms are relatively short-lived (GOC 2018). According to Environment and Climate Change Canada's lightening activity statistics, the average number of days with lightening for New Glasgow is 11.8. This is lower than any other recorded site in the Maritime Provinces other than Sydney, NS (8.9 days) (ECCC 2016d).

Tornadoes are also rare in Nova Scotia, but can occur. Since 1980, two tornadoes have been identified (confirmed or probable), according to ECCC. Wind speeds in tornadoes have been categorized on a scale, developed by T. Fujita, from F0 to F5 with 0 being the weakest and 5 the strongest. Both tornadoes were identified as being less than F2 on the Fujita Scale, and were located over 100 km from the PFA. Nova Scotia is not considered part of Canada's Tornado zone, a region that stretches from the British Columbia-Alberta border to the western portion of New Brunswick.

The Atlantic hurricane season runs from June 1 to November 30, although the risk of hurricanes in Nova Scotia is highest during the months of September and October (NOAA 2018b).

8.18.4.2 Seismicity

Seismic activity is dictated by the local geology of an area and the movement of tectonic plates comprising the Earth's crust. Natural Resources Canada monitors seismic activity throughout Canada and identifies areas of known seismic activity (often referred to as 'Seismic Zones' by seismologists), in order to document, record, and prepare for seismic events that may occur. The project area is located outside (>100 km from zone boundary) of any defined Seismic Zone. Historical seismic data recorded near the project area has not identified an earthquake exceeding a magnitude 3 event (Natural Resources Canada 2017). Earthquakes in Nova Scotia generally cluster in the southwestern region (Shelburne and Yarmouth counties) in the Northern Appalachians Seismic Zone, and northeastern regions (Cape Breton and Victoria counties) in the Laurentian Slope Seismic Zone.

Although earthquakes can occur in all regions of Canada, certain areas have a higher probability of experiencing damaging ground motions caused by earthquakes. This probability is used in the National Building Code to help design and construct buildings that are as earthquake proof as possible. The damage potential of an earthquake is determined by how the ground moves and how the buildings within the affected region are constructed. Expected ground motion can be calculated on the basis of probability, and the expected ground motions are referred to as seismic hazard. The seismic hazard map for Nova Scotia presented below in **Figure 8.18-1**, below, indicates the relative seismic hazard across Nova Scotia. The map is a simplification of the National Building Code of Canada seismic hazard map and shows the ground motions that might damage one- to two-storey buildings. The probability of strong shaking (strong enough to cause significant damage in a fraction of these buildings) is more than 30 times greater in the regions of highest hazard (at least a 30 per cent chance of significant damage within towns of these regions every 50 years) than in the regions of lowest hazard (less than 1 per cent chance in 50 years). In the region of moderate hazard, there is a 5 to 15 per cent chance that significant damage will occur every 50 years. Pictou County and Nova Scotia, more generally, are in an area of low seismic hazard potential.

In summary, a review of historical earthquake records and regional tectonics indicates that the project area is situated in a region of low seismicity.

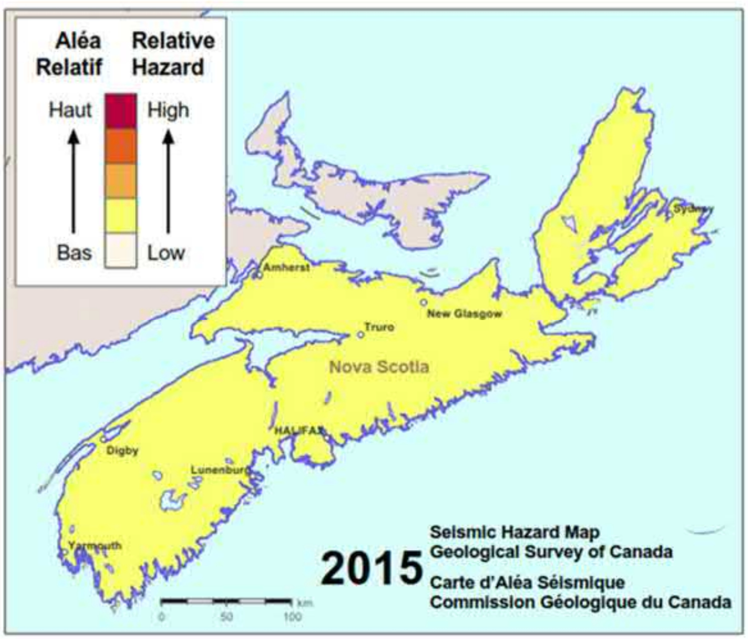


Figure 8.18-1: 2015 Nova Scotia Seismic Hazard Map (Natural Resources Canada 2017)

8.18.4.3 Forest Fires

The Fire Weather Index is a component of the Canadian Forest Fire Weather Index System. The index provides a numeric rating of fire intensity, and is the general index of fire danger throughout the forested areas of Canada (Natural Resources Canada 2018).

The mean Fire Weather Index in Pictou County, Nova Scotia for July, when risk of forest fire is typically greatest, is rated from 0-5, as shown in **Figure 8.18-2**, below, which is the lowest rating on the scale of possible fire risk. This risk is based on fire weather normals data, representing the average value of a fire weather code or index over the 30-year period from 1981 to 2010 (Natural Resources Canada 2018).

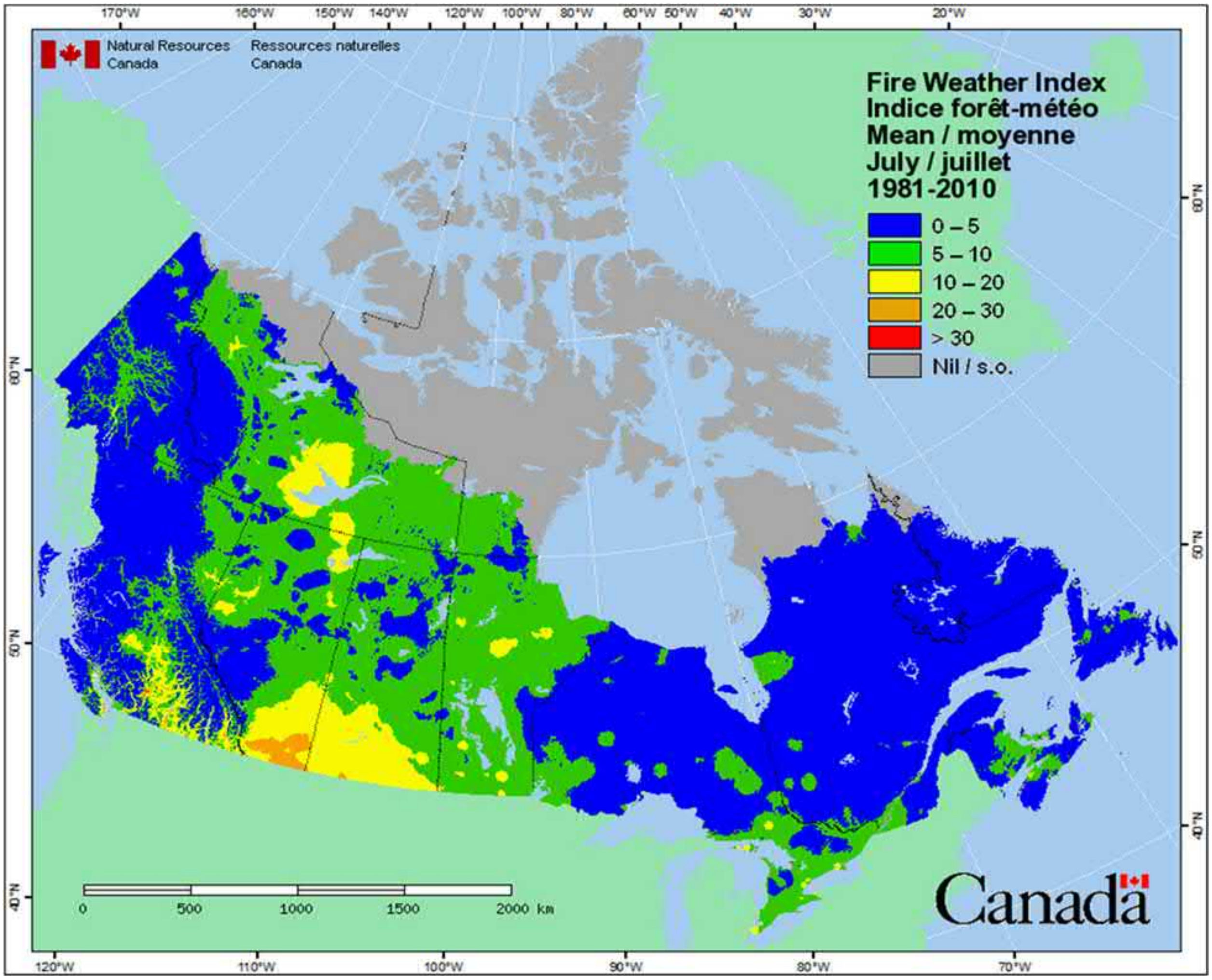


Figure 8.18-2: Natural Resources Canada Fire Weather Index for July (1981-2010) Effects Assessment

8.18.4.4 Climate Change

Climate change is an acknowledged change in climate that has been documented over two or more 30 year periods. According to the Intergovernmental Panel on Climate Change (IPCC), climate change may be due to natural internal processes or external forces, or to persistent anthropogenic changes in the composition of the atmosphere or in land use (IPCC 2014).

The establishment of local climate conditions is limited to the spatial coverage of weather stations across central Nova Scotia, the number of parameters monitored at each station, and the temporal coverage of data collection at each station. Further the prediction of effects of climate change relate to the inherent uncertainty of global climate models in predicting future changes in climate parameters, and the application of global-scale prediction algorithms to a relatively localized scale through "downscaling". Global climate models can provide relatively useful information for predicting and preparing for global and macro-level changes in climate, but their ability to pinpoint location-specific changes to climate on a localized level is limited.

According to Climate Change Nova Scotia, it is anticipated that climate change will result in the following conditions across the province (GNS 2014):

- Warmer average temperatures;
- Drier forests resulting in more frequent forest fires;
- Higher sea levels;
- Increased frequency and intensity of storm surges;
- A reduction in winter sea ice coverage; and
- More frequent and extreme precipitation events and storm related flooding.

Refer to **Table 8.18-3** for a summary of tri-decadal climate change and sea-level rise scenario data for Pictou and Antigonish Counties from Climate Change Nova Scotia.

Table 8.18-3: Pictou/Antigonish, NS – Climate Change and Sea-Level Rise Scenarios (from Climate Change Nova Scotia, 2014)

Pictou/Antigonish, NS - Climate Change and Sea-Level Rise Scenario Data

Parameter		Historical 1980s	Projected 2020s	Projected 2050s	Projected 2080s
Temperature (°C)	Annual	5.7	6.8	8.0	9.2
	Winter	-5.4	-4.3	-3.0	-1.7
	Spring	3.5	4.4	5.5	6.6
	Summer	16.8	17.8	19.0	20.1
	Autumn	8.1	9.2	10.3	11.5
Precipitation (mm)	Annual	1383.3	1415.8	1423.6	1462.5
	Winter	363.6	377.8	385.1	404.0
	Spring	324.3	334.3	339.5	352.0
	Summer	291.5	296.6	294.1	294.7
	Autumn	403.9	407.1	404.4	411.3
Heating Degree Days		4556.0	4226.0	3869.7	3525.0
Cooling Degree Days		104.4	153.1	223.0	307.7
Hot Days (Tmax > 30)		3.1	6.3	11.6	18.6
Very Hot Days (Tmax > 35)		0.0	0.1	0.5	1.1
Cold Days (Tmax < -10)		6.9	5.9	4.5	3.2
Very Cold Days (Tmax < -20)		0.0	0.0	0.0	0.0
Growing Degree Days > 5		1652.7	1852.4	2094.2	2357.5
Growing Degree Days > 10		824.9	966.8	1141.0	1331.1
Growing Season Length (days)		161.0	173.1	190.9	208.6
Corn Heat Units (CHU)		2342.1	2632.3	2972.6	3333.5
Corn Season Length (days)		131.6	143.7	155.6	169.5
Freeze Free Season (days)		188.7	214.1	235.6	253.4
Days With Rain		108.2	120.7	124.2	127.1
Days With Snow		35.0	51.7	45.2	38.8
Freeze-Thaw Cycles - Annual		105.7	99.1	87.3	77.4
Winter		37.3	37.6	40.1	40.8
Spring		41.5	39.6	32.1	25.5
Summer		1.1	0.8	0.3	0.1
Autumn		25.8	21.1	14.8	11.0
Water Surplus (mm)		968.3	886.8	877.4	881.5
Water Deficit (mm)		28.0	31.4	39.0	46.6
Δ Intensity Short Period Rainfall (%)		0	5	9	16

Sea Level Rise

Extreme Total Sea Level (metres CD) – Pictou/Antigonish						
Return Period	Residual	Level 2000	Level 2025	Level 2055	Level 2085	Level 2100
Total Sea Level Rise (m)			0.15 ± 0.03	0.42 ± 0.15	0.82 ± 0.36	1.05 ± 0.48
Extreme TSL - 10 Yr Ret Period	1.12 ± 0.10	3.17 ± 0.10	3.32 ± 0.13	3.59 ± 0.25	3.99 ± 0.46	4.22 ± 0.58
Extreme TSL - 25 Yr Ret Period	1.27 ± 0.10	3.32 ± 0.10	3.47 ± 0.13	3.74 ± 0.25	4.14 ± 0.46	4.37 ± 0.58
Extreme TSL - 50 Yr Ret Period	1.38 ± 0.10	3.43 ± 0.10	3.58 ± 0.13	3.85 ± 0.25	4.25 ± 0.46	4.48 ± 0.58
Extreme TSL - 100 Yr Ret Period	1.49 ± 0.10	3.54 ± 0.10	3.69 ± 0.13	3.96 ± 0.25	4.36 ± 0.46	4.59 ± 0.58

Chart Datum (CD) – CGVD28 (lidar) relationship: 0.92

Source: W. Richards Climate Consulting, August 2011

8.18.5 Potential Effects

8.18.5.1 Effects of Climate and Severe Weather on the Project

Extreme snowfall can affect winter construction and operation by causing a delay in delivery of materials, and resulting in additional effort for snow clearing and removal. This additional effort, however, would not substantially change the project schedule. Extreme snowfall contributing to unusual flooding during snowmelt and extreme rainfall events could also potentially lead to inland flooding and erosion. Heavy rain, snowfall and/or freezing rain events could also cause an interruption of services such as communications or on-site electrical power, specifically at the ETF.

During electrical storms, a lightning strike could result in danger to personnel and damage to infrastructure (e.g., ETF clarifiers and buildings). Power outages due to lightning strikes could also potentially occur. Some effects, such as damage to infrastructure, can also result in consequential effects on the environment. These types of environmental effects are addressed as Accidents, Malfunctions, and Unplanned Events in **Section 10**.

Each of these effects must be considered in terms of how they may adversely affect components of the project if they are not planned, engineered, and designed to account for such effects. The environmental attributes described have the potential to affect the project in several ways, including but not limited to:

- A reduction in visibility and an inability to manoeuver construction and operational equipment;
- Changes to the ability of workers to access the work site (e.g., erosion and road wash outs);
- Damage to construction equipment and infrastructure, including the pipeline and outfall from erosion;
- Increased structural loading from snow and ice build-up; and/or
- Reduce the ductility of construction materials used in project components (e.g., ETF facilities and pipe materials), and increase susceptibility to brittle fracture.

8.18.5.2 Effects of Seismic Activity on the Project

Seismicity is not considered to have the potential to substantively damage project infrastructure or components during all phases of the project, due to the very low probability (identified as low risk area) of occurrence at the project location, planned design mitigation and the application of the National Building Code of Canada and other applicable guidelines.

Given the low seismic potential of Nova Scotia, the likelihood of a seismic event in the immediate vicinity of the project that could cause major damage or interrupt activities during any phase of the Project is low.

8.18.5.3 Effects of Forest Fires on the Project

Forest fires are not considered to have the potential to adversely affect project infrastructure or components during all phases of the project due to construction materials (i.e. concrete, metal, steel and HDPE) that are not typically affected by fire.

8.18.5.4 Effects of Climate Change on the Project

The relatively long project period, consisting of construction, operation and maintenance, and eventually decommissioning of the project, is considered as a period over which the effects of future climate change can and should be considered. It is also important to consider recent climate trends (1981-2010 averages and extremes) and assess the likelihood and effect of severe and extreme weather events on the project so that they may be accounted for in the design, construction, and operational planning aspects of the project. The most relevant climate changes that could potentially have effects on the project include:

- Increased frequency and magnitude of heavy precipitation events;
- Increased frequency of extreme storms accompanied by heavy and/or freezing precipitation, thunderstorms, and strong winds;
- Increased incidence of flooding and erosion;
- Permanent inundation;
- Reduction in winter sea ice coverage resulting in winter waves developing more often accompanied by increased erosion rates;
- Increased incidence of storm surges, resulting in coastal erosion and episodic flooding; and/or
- Increase in forest fires due to drier forests.

Storm surges in the PFA are predicted to be more destructive with an increase in sea levels, as well as reduction in local sea ice. Damage to infrastructure and property from erosion and flooding caused by surges will likely increase in the future without the implementation of mitigation measures. The effluent pipeline section along the Pictou Causeway will be particularly susceptible to these forces, for example, through soil erosion and a loss of soil cover over the pipeline.

8.18.6 Mitigation

Mitigation strategies for minimizing the likelihood of a significant adverse effect of the environment on the project are inherent in: the planning process being conducted, the application of engineering design codes and standards, construction practices, and monitoring. To address these environmental effects, proactive design, planning, and maintenance are required in consideration of the potential normal and extreme conditions that might be encountered throughout the life of the project.

Extreme rainfall events occur when 50 mm or more rain falls over a 24-hour period. ECCC issues a rainfall warning when this is forecast to occur.

Meteorologist's with ECCC's Canadian Hurricane Centre will issue hurricane watch if an approaching hurricane is considered a threat to coastal and inland areas, and a hurricane warning will be issued to potentially affected areas if winds are above or anticipated to be above 118 km/h, or if dangerously high waves are expected to occur.

Mitigating Effects of Climate and Extreme Weather on the Project

- The materials specified for the project will be in compliance with the applicable standards and codes and will maintain structural integrity at the anticipated minimum and ambient temperatures near the PFA to prevent damage to project infrastructure that could pose a substantial health and safety risk, could delay the project schedule and milestones, or could not be technically or economically repaired;
- Disruption of project activities and delays to the project schedule will be avoided by scheduling tasks that require precise and/or timely movements (e.g., implementation of erosion and sediment control structures) for periods when the weather conditions are favourable. A disruption allowance will be considered in project and operational scheduling;
- Extreme precipitation events are an expected work condition and the project schedule allows for weather conditions typical for the central Nova Scotia region. The project should be designed with storm allowances for containment of largest design storm event (eg., 1-in-100-year 24-hour flood event). These allowances are sufficiently conservative to account for extreme weather events and to take into account any increase in the frequency and/or severity of significant storm events that might arise from climate change over the life of the project. As such, site water management features will be in place early in the construction phase to manage any potential increased site run-off from precipitation events that could occur;
- Erosion as a result of extreme precipitation, sea level rise and a reduction in sea ice, as well as potential flooding is not anticipated to have a substantive adverse effect on the project due to standard mitigation measures that will be implemented (e.g., collection and management of site water, use of erosion and sedimentation control structures, construction methods that stabilize erodible soils as early as possible after ground has been disturbed). Following construction, roadways will use suitable gravel bases and sub-bases to prevent erosion, and exposed areas will be vegetated where possible to prevent surface erosion. The pipeline will also be buried at a sufficient depth to minimize effects from erosion and flooding (appropriate soil cover);
- Any building structures will be designed such that they will be able to withstand extremes of temperature, wind, rain, snow, and ice events through the life of the project. Structures will be designed to withstand these weather-related factors and loads, in consideration of future climate changes, and to be in compliance with applicable codes and standards. Materials selected for the effluent pipeline (i.e., HDPE) and the method of construction in the marine environment (i.e., sub-sea burial and possible use of armour stone protection) are intended to provide resistance to potential effects of changing climate and severe weather; and
- The NPNS mill is capable of maintaining power in the event of a power outage as it generates its own power and, as such, is normally able to maintain operations throughout a power outage.

As described above, environmental stressors potentially associated with climate change and severe weather would be more than adequately addressed by engineering design to comply with building codes and standards that incorporate factors of safety to account for these changes, and careful materials selection for project-related infrastructure. The National Building Code of Canada provides for factors of safety to account for possible extreme weather (including allowances for future increased frequency and/or severity of these storms that could arise from climate change), and will form the basis of the design and construction of the project-related infrastructure.

Mitigating Effects of Seismic Activity on the Project

The project and related infrastructure will be designed to the applicable standard in consideration of the maximum credible earthquake magnitude for the region. The National Building Code of Canada provides for sufficient factors of safety to account for seismic activity in Canada, and will form the basis of the design and construction of site infrastructure. The intent of these and other design standards is to maintain the integrity of the facilities based on the level of risk (i.e., low risk) for an earthquake in the area of a magnitude up to the maximum credible earthquake. Therefore, seismicity is not considered to have the potential to substantively damage project infrastructure or components during all phases of the project, due to planned design mitigation and the application of the National Building Code of Canada and other applicable guidelines.

While it is possible for earthquakes to occur in Nova Scotia, the project area is geographically situated over 100 km from the nearest defined Seismic Zone, and is considered to be in an area of low seismic potential. Although past occurrence of seismic activity in an area is not necessarily an indicator that a significant seismic event could not occur in the future, the likelihood of a major seismic event in the immediate vicinity of the project that could cause major project damage or interrupt activities during any phase of the project is low. Design of the project to protect the facility during the operations and maintenance phase will follow the National Building Code requirements for seismology.

Mitigating Effects of Forest Fires on the Project

The project and related infrastructure, including the ETF will be constructed primarily of concrete, metal, steel and HDPE, which are not typically affected by fire, and there will be a large sparsely vegetated buffer between the ETF and nearby forested areas. The National Fire Code of Canada (2015 version) will be adopted as the standard for the safe operation of buildings and facilities associated with the project.

The pipeline will be installed and located below ground surface and the majority of materials handled (e.g., topsoil, grubbings, gravel and other granular materials) are not flammable. Petroleum products and other highly flammable substances will be stored in secure areas of the plant, and are not planned to be stored along the pipeline route.

Through integrated and coordinated emergency response capabilities at the mill, local and provincial levels, project personnel will mobilize away from the PFA if forest fires are affecting the local area, and will only return under clear and safe conditions, as determined by emergency response agencies in the province.

The Nova Scotia Wildfire Control Centre (often referred to as “fire control”) provides a coordinated, province-wide program for fire preparedness and suppression throughout the entire fire season. The program is in place to identify and control fires, minimizing the potential magnitude and extent of any forest fire, and their potential consequential effects on the project.

Mill, local and provincial emergency response crews will provide for rapid detection and response to any identified fire threat. This includes fires that could start within the perimeter of the project area, as well as fires approaching from outside the area (i.e., forest fires). Large open cleared area at the ETF and along much of the pipeline route (i.e., a partially cleared NSTIR ROW) provides a safety and fire buffer, further decreasing the likelihood of a forest or brush fire causing substantive damage to the project.

With respect to the effects of forest fires on the project, the structures comprising the ETF will be constructed primarily of concrete, metal, steel and HDPE, which are not typically affected by fire, and there will be large sparsely vegetated buffer between the ETF and nearby forested areas. The pipeline will be installed and located below ground surface and the majority of materials handled (e.g., topsoil, grubbings, gravel and other granular materials) are not flammable. Petroleum products and other highly flammable substances will be stored in secure areas of the plant, and are not planned to be stored along the pipeline route during construction.

8.18.7 Characterization of Residual Effects

The potential effects of the environment on all project phases will be considered in the planning and design of the project and in the scheduling of project activities to limit delays, prevent damage to infrastructure and the environment, and to maximize the safety of staff. The key environmental stressors that may affect the project include climate and severe weather. As described above, environmental stressors potentially associated with climate change and severe weather would be more than adequately addressed by engineering design to comply with building codes and standards that incorporate factors of safety to account for these changes, and careful materials selection (i.e. HDPE for pipe) for project-related infrastructure. The National Building Code of Canada provides for factors of safety to account for possible extreme weather (including allowances for future increased frequency and/or severity of these storms that could arise from climate change), and will form the basis of the design and construction of the project-related infrastructure.

Erosion as a result of extreme precipitation, sea level rise and a reduction in sea ice, as well as potential flooding is not anticipated to have a substantive adverse effect on the project due to standard mitigation measures, as described above. Following construction, roadways will use suitable gravel bases and sub-bases to prevent erosion, and exposed areas will be vegetated where possible to prevent surface erosion. The pipeline will also be buried at a sufficient depth to minimize effects from erosion and flooding (appropriate soil cover).

Potential effects from forest fires are unlikely given their low probability of occurrence, the types of materials (e.g., concrete, metal, steel and HDPE) and components comprising the project, which are not typically affected by fire, and the presence of large sparsely vegetated buffers between the project components and nearby forested areas. The pipeline will be installed and located below ground surface and the majority of materials handled (e.g., topsoil, grubbings, gravel and other granular materials) are not flammable. Petroleum products and other highly flammable substances will be stored in secure areas of the plant, and are not planned to be stored along the pipeline route. Integrated and coordinated emergency response capabilities at the mill, local and provincial levels are also available in the area if forest fires are affecting the local area.

Compliance with design and building codes and standards are expected to account for the effects of climate change, weather extremes, seismicity, and forest fire threats through built-in factors of safety to prevent undue damage to infrastructure from such events. Although it is possible, even likely, for the PFA to experience extreme environmental conditions during the project lifecycle, a substantive delay (e.g., a delay for more than one season) is not anticipated.

Further, no substantial damages to project infrastructure are anticipated as a result of natural environmental conditions due to the design and type of activities proposed. Therefore, the effects of the environment are not expected to adversely affect the project in a manner that cannot be planned for or accommodated through design and other mitigation and adaptive management strategies. As a result, the effects of the environment on the project are expected to be not significant.

8.18.8 Summary

As a matter of generally accepted engineering practice, responsible and viable engineering designs tend to consistently overestimate and account for possible forces of the environment, and thus inherently incorporate several factors of safety to ensure that a project is designed to be safe and reliable throughout its lifetime.

For the project, long-term environmental management and project longevity are inherent considerations in the best management practices of the design and associated project risk management. Equipment and materials that are able to withstand changes in the climate, severe weather and other influences will be used. Environmental stressors, such as those that could arise as a result of climate change, severe weather, or other factors (e.g., seismic events, fires), would more than adequately be addressed by good engineering design, materials selection, best practices, and engineering foresight. As will be demonstrated, while there is potential for natural forces to affect the project, it is not likely to have a substantive effect due to planned mitigation and design. The effects of the environment on the project are considered not significant.