# NORTHERN PULP NOVA SCOTIA CORPORATION REPLACEMENT EFFLUENT TREATMENT FACILITY PROJECT FOCUS REPORT – MARINE ENVIRONMENT IMPACT ASSESSMENT

Report prepared for:

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# NORTHERN PULP NOVA SCOTIA CORPORATION REPLACEMENT EFFLUENT TREATMENT FACILITY PROJECT FOCUS REPORT – MARINE ENVIRONMENT IMPACT ASSESSMENT


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# PLAIN LANGUAGE SUMMARY

**Basis of the Environmental Assessment**

- NPNS currently going through an environmental assessment process with the province as it is proposing to build/operate a new effluent treatment facility (ETF)
- the new effluent treatment facility is needed to support future, continued mill operations as the Boat Harbour effluent treatment centre (ETC) is closing
- The new ETF will be located on mill property
- Effluent will be discharged from the ETF through a buried pipeline adjacent to Hwy 106 to Caribou Harbour and then on the ocean bottom to its terminus 3.6 km offshore in the Northumberland Strait
- NPNS submitted its EA documentation to the provincial government for review and comment, including public consideration
- Provincial government, through the Minister of Environment, requested additional information prior to issuing a final decision on whether the proposed project could proceed
- Specific requirements for the additional information provided by a Terms of Reference for a Focus Report that was issued by the provincial Minister of the Environment
- Among other things the Terms of Reference indicated that NPNS needed to reconsider potential effects related to the project on the marine environment, particularly fish and fish habitat that are important to local commercial, recreational and Aboriginal fishers


Northern Pulp Nova Scotia Corporation

Replacement Effluent Treatment Facility
Environmental Assessment - Focus Report

**Proposed Realigned Effluent Pipeline Route**

Figure 2.1-1

NORTHERN PULP
NOVA SCOTIA CORPORATION
A PAPER EXCELLENCE COMPANY

| | |
|---|---|
| Approximate Project Footprint Area* | Wetland |
| Approximate Diffuser Location | Open Water |
| Pictou Landing First Nation | Properties Intersecting Project |
| Property Parcels | |
| Roads | Watercourse |
| Rail | |

DILLON CONSULTING

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

MAP CREATED BY: SCM
MAP CHECKED BY: SLD
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: 2019-09-26

- This report has been prepared to address this aspect of the ToR of the Focus Report
- The report provides:
  - an updated description of the local and regional marine environment that includes the results of new work completed to support the assessment and information pertaining to ongoing and planned work
  - a description of the methods that have been used to re-evaluate the potential effects of the project on the marine environment
  - the results of the re-evaluation of the potential effects of the project on the marine environment
  - recommendations for follow-up monitoring so that the conclusions that have been made can be tested and re-tested to measure the environmental performance of the proposed ETF on an ongoing basis

**Existing Conditions in the Marine Environment in the Vicinity of the Project Site**

- As part of the EA process it is necessary to define the existing conditions in the Project area, in this case in terms of both biophysical conditions (i.e., biology and habitat) and the use of fisheries resources by commercial, recreational and Aboriginal users
- This information is collected so that it is possible to assess how the project could affect those biophysical conditions and resource users
- In the current study, both existing and project-specific survey information have been used to describe the existing marine environment in the area
- Further studies are ongoing and planned and the information from these studies will be made available as the studies are completed
- The biophysical environment has been described from an ecosystem perspective
- Physical aspects of the local environment that have been characterized include:
  - water quality
  - sediment quality
  - habitat types
- Biological aspects of the local environment that have been characterized include information relevant to the various levels of the food chain, and attributes of the organisms at these levels, such as:
  - plankton – zooplankton and phytoplankton
  - aquatic plants – commercially harvested seaweed and valued habitats (i.e. eelgrass beds)

  - benthic invertebrates – macrobenthos (visual to the naked eye) and meiobenthos (visible with magnification).
  - fish – species that are fished for commercial, recreational and Indigenous resource use, Species at Risk, and other species important to the ecology of the marine environment.
- Fisheries resources uses by commercial, recreational and Aboriginal were described based on a regional basis, but further assessment using available resource habitat, distribution and known harvest areas was undertaken to identify the likelihood of interaction of a given species with the Local Assessment Area (LAA). This assessment helped in defining reasonable and representative indicators of the Marine Fish and Fish Habitat VEC.

## Methods to Assess Potential Effects in the Marine Environment in the Vicinity of the Project Site

- the assessment of potential effects in the marine environment in the vicinity of the Project site followed a very standard assessment methodology
- considered the various ways that the project could interact with the marine environment
- to simplify this process the project was broken down into a long list of activities, encompassing all of the project phases (construction, operation, closure or decommissioning)
- evaluated each activity and how it could interact with the marine environment
- interactions could be physical – that is, a physical disruption of the marine environment could be caused by the project activity – or, it could be chemical – that is, the marine environment could be disrupted by an emission related to the project (i.e., the effluent)
- in EA jargon the "marine environment" is referred to as a Valued Ecosystem Component (VEC)
- the "marine environment" is made up of many, many aspects – far too many for the assessment to practically consider potential project effects simply with reference to "marine environment"
- to help make the assessment easier and more meaningful the VEC "marine environment" is broken down into a more workable pieces, or "classes" and each of the classes is further broken down by representative "indicators"
- These indicators are marine species (fish, shellfish, plankton and habitat features) that are found locally, could be affected by the project and in many cases have been identified as having value by stakeholders and Indigenous people
- to summarize therefore the assessment evaluates how the Project, that is represented by its many activities over its entire life cycle, interacts with the marine environment, that is represented by its many indicators

## Marine Environment VEC and Associated Indicators

| Class | Group | Indicator | Rationale |
|---|---|---|---|
| Marine Fin-Fish | Benthic | White Hake | SOCC, Habitat available in the LAA for multiple life stages, recreational fishery |
| | Benthic | Winter Flounder | Habitat potentially available in the RAA for multiple life stages |
| | Benthic | Winter Skate | SOCC, possible habitat available in the RAA |
| | Migratory-Forage | Rainbow Smelt | Commercial and Indigenous Fisheries, harvested in the RAA |
| | Migratory | Atlantic Herring | Commercial and Indigenous Fisheries, harvested in the RAA |
| | Migratory | Atlantic Mackerel | Commercial, recreational and Indigenous Fisheries, harvested in the RAA |
| | Migratory | Atlantic Cod | recreational and Indigenous Fisheries, harvested in the RAA |
| | Migratory | American Eel | SOCC, Commercial (freshwater) and Indigenous fisheries |
| | Migratory | Atlantic Striped Bass | SOCC, recreational and Indigenous fishery |
| | Migratory | Atlantic Salmon | SOCC, recreational and Indigenous fishery, traditional sustenance species for the local First Nations |
| | Migratory | Atlantic Bluefin Tuna | SOCC, Targeted by commercial, recreational and Indigenous fisheries |
| Marine Shellfish | Crustacean | Rock Crab | Rock Crab represents one of the most important species harvested in the LAA by commercial and Indigenous fisheries |
| | Crustacean | American Lobster | Constitutes a large proportion of the commercial and Indigenous fisheries in Caribou Harbour and Pictou Harbour |
| | Shellfish | Sea Scallop | Targeted by commercial, recreational and Indigenous fisheries. Present in the LAA. |
| | | Soft-Shell, Bar, Razor Clams | Targeted by commercial, recreational and Indigenous fisheries |
| | | Blue Mussel | Targeted by recreational and Indigenous fisheries, commercial aquaculture, locally harvested. Important indicator of water quality and species that can be monitored post construction. |
| | | Oyster | Targeted by recreational and Indigenous fisheries |

| Class | Group | Indicator | Rationale |
|---|---|---|---|
| | | Quahaug | Targeted by recreational and Indigenous fisheries |
| Plankton | Phytoplankton | Phytoplankton abundance and diversity | Important indicator of water quality and primary production for local marine environment. Important indicator of water quality and can be consistently monitored post construction. |
| | Zooplankton | Zooplankton abundance and diversity | Important indicator of water quality and lower trophic level production in the local marine environment. Important indicator of water quality and can be consistently monitored post construction. |
| Benthic Invertebrates | Benthic Invertebrates | Benthic Invertebrate Community (BIC) | BIC important to sustaining the forage base for benthic fish species, and important indicators of sediment and water quality. |
| Marine Vegetation | Seaweed | Seaweed | Historic commercial harvest for seaweed in RAA |
| Marine Fish Habitat | Vegetation / Cover | Eel Grass Beds | Eelgrass beds are important habitat for stabilization for sediments and providing cover and protection for many marine species including SOCC (i.e., White Hake). Often associated with finer substrate materials in the LAA. |
| | Substrates / Cover | Cobble / rock | A less common substrate type within the study area which provides important cover, spawning, and nursery habitat to multiple species. |
| | Substrates / Cover | Sand / silt / gravel | The majority by area of the LAA consists of varying proportions of sand with silts and gravel. Represents the most abundant habitat type for marine species in the LAA. |
| | Water Quality | Receiving Environment Water Quality | Water quality within the context of baseline condition for contaminants of potential concern (COPCs) qualitatively and/or quantitatively compared to the predicted concentrations of COPCs in the effluent to identify potential impacts to aquatic biota. |

### Project Phases, Schedule and Potential Interactions with Marine Environment

| Phase | Activity | Duration | Interaction with Marine Environment | Description of Interaction |
|---|---|---|---|---|
| Construction | Establishment of marine based staging area for temporary pipe and project vessel storage | 21 Months (weather dependent) | ✓ | Potential machinery/material spills, habitat disturbance by in-water infrastructure |
| | Final geotechnical investigations, marine seismic, and confirmation of marine pipeline alignment | 3 months | ✓ | Habitat disturbance during geo-technical studies, high intensity sounds |
| | Open-cut trenching and side-casting or disposal of material | 8 to 10 months | ✓ | Habitat disturbance, sedimentation, high intensity sounds |
| | Pipeline installation | | ✓ | |
| | Backfilling and grading | | ✓ | |
| | Land-marine pipeline connection – gravel access causeway construction (intertidal zone) | | ✓ | Habitat overprinting, habitat disturbance, sedimentation, high intensity sounds |
| | Land-marine pipeline connection trench excavation | | ✓ | Habitat disturbance, sedimentation, high intensity sounds |
| | Marine Outfall Construction – underwater welding | | ✓ | Habitat disturbance, sedimentation, |

| Phase | Activity | Duration | Interaction with Marine Environment | Description of Interaction |
|---|---|---|---|---|
| | | | | high intensity sounds |
| | Pipeline Testing and Commissioning | 1 to 3 months | ✓ | Potential habitat disturbance |
| | Environmental Inspections | 21 Months (continuous throughout construction phase) | ✓ | Potential habitat disturbance |
| Operations and Maintenance | Discharge of treated pulp and paper effluent to the marine environment. | Commencing in 2021 for several decades | ✓ | Potential changes to water quality and therefore fish habitat including sedimentation |
| | Ongoing repair and maintenance of the constructed pipeline as necessary (possibly including incremental replacement of individual components) | Commencing in 2021 for several decades | ✓ | Habitat disturbance, sedimentation, high intensity sounds |
| | Regular outfall and diffuser operation, inspection and maintenance – SCUBA diver team inspections and repair as necessary | | ✓ | Habitat disturbance, sedimentation, high intensity sounds |
| Decommissioning | Removal of marine diffuser ports | Decommissioning of the ETF replacement will be conducted following the end | ✓ | Habitat disturbance, sedimentation, high intensity sounds |

| Phase | Activity | Duration | Interaction with Marine Environment | Description of Interaction |
|---|---|---|---|---|
| | Capping of pipeline at terminus | of the useful service life of the project components or at the end of the life of the NPNS facility, whichever comes first. Decommissioning is assumed to have a duration of up to a year for the purposes of this assessment. | ✓ | Habitat disturbance, sedimentation, high intensity sounds |

- when interactions are identified there may be ways in which the interaction can be mitigated (i.e., reduced)
- in some cases, the interaction can be reduced to the extent that no effects are expected
- in other cases, the interaction cannot be fully reduced (mitigated) and therefore some level of effect is expected to occur – these are called residual effects
- when residual effects are identified they evaluated based on a number of attributes that examine whether the effects can be considered significant, or not, including:
    - Magnitude: a quantitative or qualitative measure of a given key indicator representing the potential effect after mitigation relative to the baseline condition.
    - Extent: the geographic area over which an effect will occur.
    - Duration: the period of time over which an effect will occur.
    - Frequency: how often an effect will occur within a given time period.
    - Reversibility: the degree to which the effect can or will be reversed.
    - Likelihood: the probability of the effect occurring.
    - Context / Value: a qualitative measure for environmental impacts identified as being meaningful based on input and feedback received regarding the Project from the public, local community members, government and Aboriginal peoples, as well as the professional of the project team.
- to be as objective as possible, each attribute is assessed using criteria, whereby the Level 1 criterion is indicative of a negligible or limited potential for effect and on the other end of the scale a Level 3 criterion is indicative of a high potential for effect. The Level 2 criterion represents the intermediate condition.
- based on this methodology we conclude a residual effect to be not significant if:
    - It is of low magnitude and/or geographic extent, or;
    - Of short-term duration including residual effects (i.e., the effect itself is of short-term duration), or;
    - Is likely to occur very infrequently (or not at all) with little potential for long-lasting effects.

**The Potential Effects of the Project**

- The current assessment has concluded that there are no significant residual effects associated with the Project on any of the VECs
- In general potential effects that are associated with physical disturbance are small in terms of spatial extent (e.g., limited to the construction area), are of short duration (e.g., are limited to the construction timing window) and are reversible (e.g., once

construction is complete the areas that are affected will be suitable to be re-inhabited by marine flora and fauna)

- In general potential effects that are associated with chemical disturbance are small in magnitude (e.g., the concentrations of chemical parameters in the Northumberland Strait are less than water quality guideline levels for the protection of aquatic life) and are small in terms of spatial extent (e.g., the concentrations of chemical parameters in the Northumberland Strait will be indistinguishable from background levels within metres of the discharge.
- A significant residual effect was not identified through this assessment specific to changes in water quality (including temperature and salinity) as a result of the proposed treated effluent discharge to the Northumberland Strait. This conclusion was made for the following reasons:
  - 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;
  - Through mitigative design, the effluent diffuser will result in rapid mixing of the effluent within the receiving environment such that the zone that temperature and salinity may be greater than the background condition for the Northumberland Strait at the point of discharge (as measured during baseline water quality sampling throughout 2018 and 2019) is generally limited to a distance of a few metres from the point of discharge. Warmer and lower salinity effluent discharged within the receiving environment will reach almost instantaneous mixing.
  - Within this zone, larval fish and crustaceans (i.e. American Lobster (stages I to III)) may be present, however in these free-swimming stages, the duration of their residence in this small zone of influence is likely to be very short, and any exposure will be transient in nature; and,
  - Through mitigative design, the diffuser will deliver effluent to the receiving environment such that the vertical distribution of warmer and lower salinity effluent water will not interact with the benthic environment.
- However, based on the socio-economic importance of American Lobster, Rock Crab and Atlantic Mackerel that may have a higher potential for interaction with the project than some other indicators that were assessed specific to the Marine Fish and Fish Habitat VEC, it is recommended that EA Follow-up Monitoring be undertaken. The purpose of such monitoring should be to identify if predictions with respect to water quality and potential impacts are consistent with the conducted assessment.

**Recommendations for Follow-up Monitoring**

- follow-up monitoring is used to determine the accuracy of the conclusions of the environmental assessment and the effectiveness of the mitigation measures that have been proposed/implemented. A follow-up program is used to:
    - verify predictions of environmental effects identified in the environmental assessment;
    - determine the effectiveness of mitigation measures in order to modify or implement new measures where required;
    - support the implementation of adaptive management measures to address previously unanticipated adverse environmental effects;
    - provide information on environmental effects and mitigation that can be used to improve and/or support future environmental assessments including cumulative environmental effects assessments; and
    - support environmental management systems used to manage the environmental effects of projects[1].
- there are two components to the follow-up monitoring program that will be implemented at the Project site should the Project move forward.
    - Environmental Effects Monitoring – this required by the PPER under the Fisheries Act
    - Follow-up Performance Monitoring Program - that captures a broader range of issues that is not captured by EEM.
- the report describes a program framework, rather than a detailed study plan at this time as program details will be further developed based on further discussions with stakeholders, First Nations and governmental agencies and, where appropriate, responses to the EA submission
- The EEM program includes laboratory and in-field biological assessment for EEM studies consist of:
    - sublethal toxicity testing of effluent to monitor effluent quality; and,
    - biological monitoring studies in the aquatic receiving environment to determine if mill effluent is having an effect on fish, fish habitat or the use of fisheries resources.
- For NPNS, sublethal toxicity testing will be completed on invertebrate and plant (algae) species

- For NPNS, confirmation of the size of the effluent plume once operations have begun will be needed to determine the scope of in-filed biological monitoring
    - Based on the predicted effluent plume size no in-field monitoring will be mandated by the PPER
- the EA Follow-up Monitoring Performance Program includes the following main components:
    - Toxicity Testing of Treated Effluent - Local and regional fisheries resource users have raised concerns over potential effects on larval lobster and herring, both locally important species. Toxicity testing to determine both potential acute and sublethal effects on immature stages of lobster and herring are proposed.
    - Phytoplankton Community Assessment - Seasonal phytoplankton sampling will be conducted and summarized in terms of species composition, distribution and abundance for comparison to baseline conditions.
    - Zooplankton Community Assessment - Seasonal zooplankton sampling will be conducted and summarized in terms of species composition, distribution and abundance for comparison to baseline conditions.
    - Benthic Invertebrate Community - Sampling to determine the recolonization of the disturbed areas will be undertaken along the pipeline corridor, as well as in the vicinity of the discharge.
    - Water Quality Monitoring - Water sampling would be implemented following the commencement of discharge from the new ETF in areas in close proximity to the discharge and at areas further removed from the discharge at surface and at depth on a seasonal basis to test the predictions made by the surface water quality assessment.
    - Fish and Shellfish Tissue Chemistry Investigations – Fish and shellfish will be collected in key areas in the vicinity of the Project site, with tissues analyzed for a suite of chemical parameters for comparison to baseline conditions.

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# 1.0 INTRODUCTION

## 1.1 Background Information

The Northern Pulp Nova Scotia Corporation (NPNS) northern bleached softwood Kraft (NBSK) pulp mill is located at Abercrombie Point, adjacent to Pictou Harbour in Pictou County, Nova Scotia (**Figure 1-1**). A mill has operated continuously at this location, under several different owners, since it was commissioned in 1967.

Mill effluent has been treated at the Effluent Treatment Centre[2] (ETC) at Boat Harbour since the mill was commissioned. The ETC was created in 1965 when dams were built across this natural harbour to form a settling and stabilization pond for effluent from the mill. The ETC is owned by the Province of Nova Scotia and has been operated by NPNS, and its processors, under lease since 1996. Prior to 1996, the ETC was operated by the province.

The *Boat Harbour Act*, which received Royal Assent on May 11, 2015, prohibits the use of the provincially-owned facility for the receipt and treatment of effluent from NPNS after January 31, 2020. As a result, NPNS has proposed to construct a new effluent treatment facility (ETF) that will replace the existing ETC – the so-called Replacement Effluent Treatment Facility Project (the "Project") – so as to continue future mill operations.

The Project proposed by NPNS was registered on February 7, 2019 for environmental assessment (EA) as a Class 1 undertaking pursuant to Part IV of the provincial Environment Act and the Environmental Assessment Regulations. On March 29, 2019, the Minister of Environment released a decision concerning the EA submission. The Minister determined that the EA Registration Document (EARD) was insufficient to make a decision on the Project, and that a Focus Report was required in accordance with clause 13(1)c of the Environmental Assessment Regulations, pursuant to Part IV of the Environment Act. Nova Scotia Environment (NSE) released the Terms of Reference for the Preparation of the Focus Report Regarding the Replacement Effluent Treatment Facility Project Proposed by Northern Pulp Nova Scotia Corporation on April 23, 2019 (see **Appendix A**).

[2] Originally referred to as the Boat Harbour Treatment Facility.

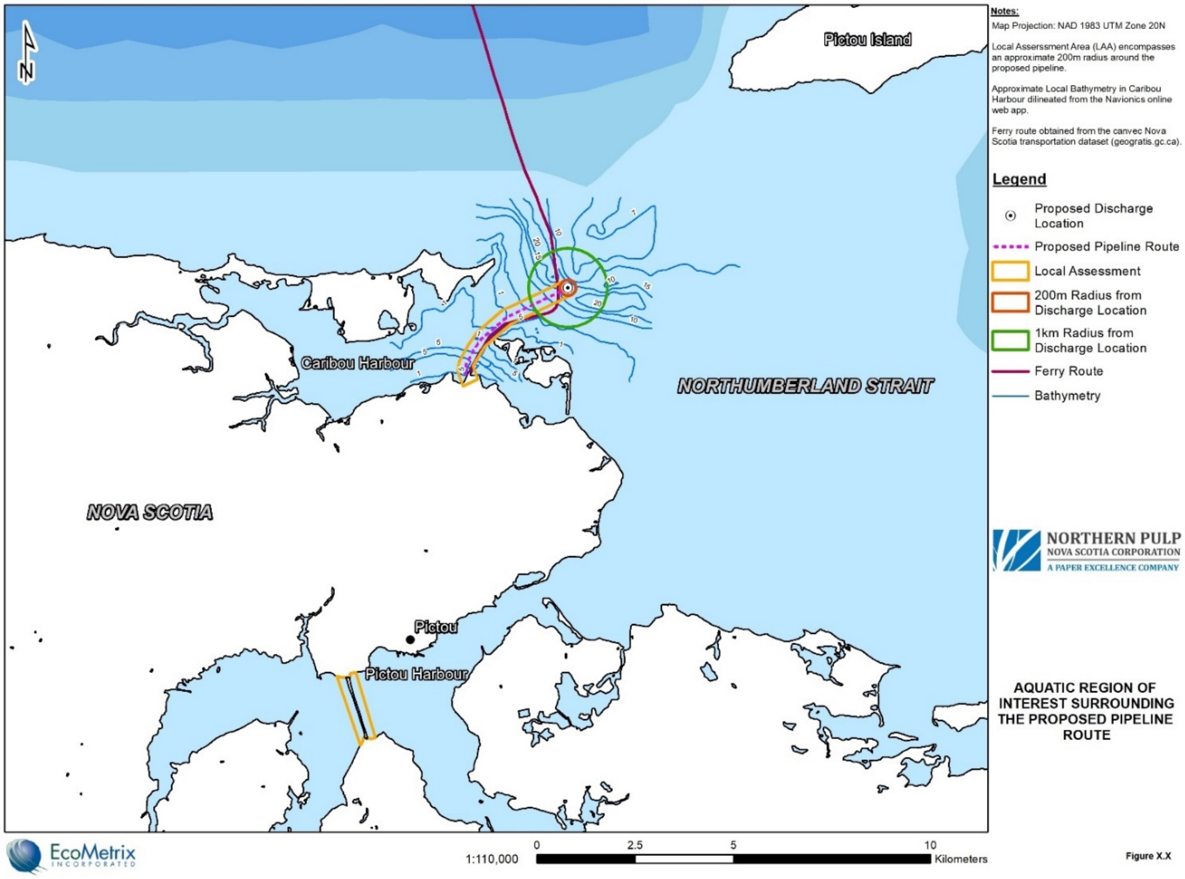


**Figure 1-1: Regional and Local Assessment Areas**

## 1.2 Terms of Reference for the Focus Report

The Terms of Reference (TOR) for the Focus Report identified eleven (11) specific items that NPNS is to address that are broadly defined under the following headings:

1. public, Mi'kmaq and government engagement;
2. project description;
3. facility design, construction, operation and maintenance;
4. marine water and marine sediment;
5. freshwater resources;
6. air quality;
7. fish and fish habitat;
8. flora and fauna;
9. human health;
10. archaeology; and,
11. indigenous people's use of land and resources.

An addendum to the TOR listed several other information requirements that were raised by reviewers of the EARD that are to be addressed with NSE and that are to be included in the Focus Report, where appropriate.

NPNS is required to submit the Focus Report within one year of receipt of the TOR (April 23, 2020). Upon submission of the Focus Report by NPNS, NSE has 14 days to publish a notice advising the public where the Focus Report can be accessed for review and comment. A 30-day public consultation period of the Focus Report follows. At the conclusion of the 30-day public consultation period, NSE has 25 days to review comments, and provide a recommendation to the Minister. The Minister of Environment will have the following decision options, following the review of the Focus Report:

- the undertaking is approved subject to specified terms and conditions and any other approvals required by statute or regulation;
- an Environmental-Assessment Report is required; or
- the undertaking is rejected.

## 1.3 Scope of this Current Report and its Relationship to the Focus Report

EcoMetrix Incorporated (EcoMetrix) was retained by NPNS to provide support in preparation of documentation associated with Section 7.3 of the TOR. Specifically, section 7.3 of the TOR states that the proponent must:

- Conduct additional impact assessment of treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. This must be based upon updated information, additional studies and/or an understanding of expected movement of contaminants. Assessment methodology must first be agreed upon by NSE in consultation with relevant federal departments.

This report details the response to Section 7.3 of the TOR.

## 1.4 Organization of the Report

Following this introductory section, the remainder of the report is organized as follows:

- **Section 2.0** provides a description of the proposed Project, including updated information with respect to material changes to pre-construction, construction, and operation phases. The purpose is to provide a concise summary of the nature and extent of the proposed development. The description is consistent with the most up to date level of conceptual design that is available.

- **Section 3.0** provides an updated description of the existing environment within the study area that includes the marine environment surrounding the confirmed pipeline footprint and around the outfall diffuser within the area that is predicted to be exposed to relative effluent concentrations exceeding 1%.

- **Section 4.0** provides a description of the scope and methodology utilized herein to assess potential Project-related effects, specifically as it related to Item 7.3 of the TOR. This includes an explanation of the spatial and temporal boundaries of the assessment, Valued Ecosystem Components (VECs), Project-environment interactions, mitigation measures, and consideration of residual effects and their significance. This section provides a description of the effects assessment results.

- **Section 5.0** provides a description of the framework upon which compliance, follow-up and effects monitoring will be based for all project phases.

- **Section 6.0** provides a concise summary of the key findings of the effects assessment, including the identification of any residual effects and their significance.

References cited in the preparation of this report are provided in **Section 7.0**.

The following are provided as appendices to this report:

- **Appendix A** – Terms of Reference for the Preparation of the Focus Report Regarding the Replacement Effluent Treatment Facility Project Proposed by Northern Pulp Nova Scotia Corporation
- **Appendix B** – Baseline Water Quality Results
- **Appendix C** – Baseline Sediment Quality Results
- **Appendix D** – Fish Species and Fish Habitat Presence Screening
- **Appendix E** – Effluent Water Quality Assessment Data

# 2.0 DESCRIPTION OF THE REPLACEMENT EFFLUENT TREATMENT FACILITY PROJECT

This undertaking is known as the "Northern Pulp Nova Scotia Replacement Effluent Treatment Facility". The general nature of the Project is the construction of a new Effluent Treatment Facility (ETF), effluent transmission pipeline, marine outfall location, and associated ancillary facilities.

The production of pulp can be achieved through various means (pulping processes), all of which require the addition of water (process water) to accomplish. Though there are some water losses during the production process, a large proportion of the process water is conserved in the system, collected and returned to the environment as a so-called process effluent. In Canada, the Pulp and Paper Effluent Regulations under the *Fisheries Act* govern the discharge of process effluents to the environment. The province of Nova Scotia does not regulate pulp and paper mills on an industry wide basis; rather, it issues approvals for individual industrial discharges on a site-specific basis. Treatment - that is the removal of contaminants - is required for the process effluent to meet federal and provincial discharge quality criteria. Currently, the NPNS process effluent is treated at the ETC at Boat Harbour that is owned by the Government of Nova Scotia and operated by NPNS. The use of this facility by NPNS will be prohibited after January 31, 2020, and consequently, a new ETF is required and must be constructed for NPNS to continue its pulp production operations in the future.

## 2.1 Project Proponent

**Project Proponent:**

Northern Pulp Nova Scotia Corporation
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**Civic Address:**

260 Granton Abercrombie Road Abercrombie, Nova Scotia
B2H 5C6

**NPNS Contact:**

Kathy Cloutier
Director of Communications 902 759 - 7246
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## 2.2 Project Location and Infrastructure

The project footprint area (PFA) in the EARD (Dillon 2019) is defined as the maximum extent of the spatial area of potential disturbance associated with the project (**Figure 1-1**). The PFA will include all temporary and permanent areas of ground and marine disturbance, including:

- The new ETF, situated within the property boundaries of the NPNS mill, west of the NPNS mill main access road and southeast of the existing NPNS facility;
- The pipeline, including land-based and marine footprint;
- Temporary and permanent works for access including any roadway improvements, realignment, materials storage, staging or other terrestrial and marine working areas required to support construction; and,
- The spatial extent of the effluent mixing zone in the receiver, which is expected to be considerably less than 200 m from the point of discharge.

The new ETF will be built adjacent to the mill on NPNS property.  This facility will provide effluent both primary and secondary treatment. Sludge from the primary clarifier, secondary clarifiers, and activated sludge treatment basin will be dewatered and the liquid portions returning to the start of secondary treatment and the remaining sludge going to the biomass boiler as fuel.

The treated effluent will be piped along Highway 106 for approximately 11.4 km. The pipe will be buried for the majority of the route, exposed only to cross the Pictou Causeway. The pipeline will enter the marine environment adjacent to the Northumberland Ferries Limited terminal in Caribou then continue for approximately 3.6 km through Caribou Harbour into the Northumberland Strait ending at the discharge structure (multi-port diffuser). The pipeline will be buried, adjacent to the navigation channel for the ferries. The pipe will be weighted down with concrete collars to counteract buoyancy.

Effluent will be discharged through a multi-port diffuser set perpendicular to the predominate flow direction in the Northumberland Strait. The diffuser will be 50 m long, with three nozzles approximately 1 m tall. The peak discharge is estimated to be 0.984 $m^3$/s, achieving a dilution ratio of 146:1 at 100-m from the discharge point (Stantec 2019c).

With the addition of ETF sludge being burned in the biomass boiler, the boiler fuel will consist of approximately 14:1 biomass fuel to ETF sludge. Biomass fuel is an unrefined mix of coarse chips, bark and wood fiber that are left over from preparing the trees for the pulping process as well as potentially saw dust from nearby sawmills. The use of sludge a fuel will partially displace the use of fossil fuels as fuel.

A detailed description of the Project infrastructure components is provided in Section 5.2 of Dillon (2019) including:

- Alteration to the existing infrastructure – mill connection;
- Effluent treatment facility process infrastructure:
- Coarse screening;
- Feed system (existing effluent lift pumping system);
- Primary clarifier;
- Activated sludge aeration tank (including the MBBR chamber);
- Two secondary clarifiers;
- Sludge management system; and
- Spill collection system.

The ETF is designed to treat the NPNS effluent and remove, among other constituents, solid materials, organic loads, and chlorinated compounds. It should be noted that the project does not include the decommissioning of the existing Boat Harbour effluent treatment system, effluent piping system downstream of the existing standpipe, and ancillary components, which is covered under a separate regulatory process.

Changes to the project from what was previously indicated in the EARD include:

- Placement of the pipeline at the toe of slope of the Pictou Harbour Causeway rather than above grade;
- On-land portions of the pipeline will be placed at the edge of the Highway 106 Right-of-Way, rather than within the margin of the highway shoulder; and,
- The marine portions of the pipeline will be 150 m shorter than what was previously proposed.

The first and last items have been considered within the context of the marine fish and fish habitat impact assessment.

### 2.2.1 Spatial Study Boundary

For the purposes of the marine environment impact assessment, the spatial boundaries for the assessment of environmental effects include:

**Marine regional assessment area (RAA)** – The area inclusive of Pictou Harbour, Caribou Harbour and the south-eastern portion of the Northumberland Strait adjacent to the Marine local assessment area.

M**arine local assessment area (LAA)** - The area surrounding the confirmed pipeline footprint (within 200 m on either side of the linear pipeline footprint) and the effluent diffuser area (within a 200 m radius around the effluent discharge point). This includes the marine environment surrounding the confirmed pipeline footprint and around the outfall diffuser within the area that is predicted to be exposed to relative effluent concentrations exceeding 1%, as determined by effluent discharge modelling (Stantec, 2019).

## 2.3 Project Phases

The phases of the Project include construction (including commissioning), operation and maintenance, and decommissioning (ETF closure). A comprehensive description of the activities associated with each of these phases is provided in Dillon (2019). Activities associated with each phase of the project that will have a direct interaction with the marine environment are listed below for context with respect to the marine environment impact assessment.

**Table 2-1: Summary of Project Phases and Associated Activities**

| **Phase** | **Activity** |
|---|---|
| Construction | Establishment of marine based stating area for temporary pipe and project vessel storage |
| | Final geotechnical investigations |
| | Pipeline portion and diffuser deployment |
| | Open-cut trenching and sidecasting or disposal of material |
| | Pipeline installation |
| | Backfilling and grading |
| | Land-marine pipeline connection – gravel access causeway construction (intertidal zone) |
| | Land-marine pipeline connection trench excavation |
| | Marine Outfall Construction – underwater welding |
| | Discharge of treated pulp and paper effluent to the marine environment. |

| | |
|---|---|
| Operations and Maintenance | Ongoing repair and maintenance of the constructed pipeline as necessary (possibly including incremental replacement of individual components) |
| | Outfall and diffuser operation, inspection and maintenance – SCUBA diver team inspections and repair as necessary |
| Decommissioning | Removal of marine diffuser ports |
| | Capping of pipeline at terminus |

Interactions of these activities with Valued Ecosystem Components (VEC) indicators are discussed in **Section 4.0.**

# 3.0 EXISTING ENVIRONMENT

The existing environmental conditions described herein are based upon historical data collected within the region of the Project, as well as new data collected specifically in support of addressing the requirements of the Focus Report. Existing conditions in the environment are studied as part of the environmental assessment process to provide the basis on which changes that may occur as a result of project-environment interactions are considered. For the purposes of this document, the existing conditions described are specific to the marine aquatic environment and marine resources that are important to commercial, recreational and Indigenous (Aboriginal) (CRA) fisheries within the vicinity of the proposed Project.

## 3.1 Water Quality

### 3.1.1 Background Water Quality

Water quality information within the marine local assessment area (LAA) along the in-water pipeline corridor and the area that corresponds to the modelled effluent mixing zone was collected over two seasons, tide cycles and at multiple depths. Water samples for chemical characterization were collected in October 2018 and May and June 2019. Additional sampling, consistent with the scope of these sampling efforts is planned and data corresponding to these events will be made available as it is completed.

A total of eight samples were collected within Caribou Harbour along the pipeline and 14 within the effluent mixing zone. Samples were analyzed for a wide-variety of parameters, including but not limited to those that could reasonably be expected to be present within a modern Kraft pulp mill effluent, as well as those that have historically been associated with mill effluents and have in the past been raised as a potential concern by the public. A list of the types of parameters or parameter groups analyzed from the water samples collected to date is provided in **Table 3-1**.

**Table 3-1: Groups of Parameters Sampled in Background Water**

| Parameter Group |
|---|
| General Chemistry and Physical Parameters |
| Anions and Nutrients |
| Oxygen Demand |
| AOX |
| Dioxins and Furans |
| Organic Halogens |
| Metals |
| Petroleum Hydrocarbons (PHCs) |
| Phenols |
| Polychlorinated Biphenyls (PCBs) |
| Polycyclic Aromatic Hydrocarbons (PAHs) |
| Glycols |
| Volatile Organic Compounds (VOCs) |
| Semi-volatile Organic Compounds (SVOCs) |
| Fatty Acids |
| Resin Acids |

Samples from along the pipeline corridor and within the diffuser area were pooled into two datasets for the determination of the variability of baseline water quality. A summary of the water quality collected to date within the effluent mixing zone are provided in Appendix B. Results of the individual samples are also provided in **Appendix B.** Data were compared to Canadian Council of Ministers of the Environment (CCME) marine water quality standards for the protection of aquatic life[3] (CCME 2019) and Environmental Protection Agency Priority Marine Screening Level Criteria under the U.S. Water Protection Act for the states of Maine and New Hampshire (MDEP 2012, EPA 2015). **Table 3-2** and **Table 3-3** provide a summary of parameters that exceeded benchmarks in the vicinity of the proposed diffuser and along the proposed pipeline corridor, respectively.

The location of the proposed diffuser is typical of a marine offshore environment with salinity around 29 ppt. Along the pipeline corridor the salinity can be lower and varies based on distance from shore, tidal cycle and seasonal inputs of freshwater. The pH is generally around 7.7 throughout the area whereas turbidity and total suspended solids had median values around 1 NTU throughout the area and between 2 to 4 mg/L depending on location, respectively. Oxygen demand both biological and chemical are generally low throughout the study area as are the concentrations of most metals, various organics, hydrocarbons, PCBs, resin and fatty acids, dioxins and furans and phenols.

Overall, a total of over 300 parameters were part of the analyses, or calculated from the analyses, of background water samples. Of these, the concentrations of a large majority of constituents were below their respective detection limits in all samples. No measured data (i.e., instances where actual concentrations were reported) exceeded their respective

[3] See https://www.ccme.ca/en/resources/canadian_environmental_quality_guidelines/

CCME water quality guideline value. For a limited number of parameters (2,4 dimethylphenol, calculated total PCBs, sulphide as (H2S), total copper, total nickel, total residual chlorine, chloromethane, trichlorofluoromethane and hexachlororcyclopentadiene) the laboratory method detection limits that were achieved were above their available guideline values in at least one sample.

Results from the pipeline corridor were generally similar to the diffuser area with a few exceptions. The median TKN, total mercury, total phenols, Octa CDD, TSS and Langelier Index were greater than 20% higher in samples along the pipeline corridor compared to those at the proposed diffuser location. Conversely, the median concentration at the proposed diffuser location were more than 20% higher than along the pipeline corridor for total nitrogen, turbidity, ion balance, C13-2378 Tetra CDD and C13-2378 Tetra CDF. Similar to near the diffuser, none of the parameters that were noted as higher along the corridor exceeded their respective guidelines (**Table 3-3**).

**Table 3-2: Summary of Water Quality Guideline Exceedances in the vicinity of the Proposed Diffuser**

| Parameter Group | Exceeds CCME | Exceeds EPA | Parameters |
|---|---|---|---|
| General Chemistry & Physical Parameters | - | - | |
| Oxygen Demand | - | - | |
| Anions and Nutrients | - | X | Sulphide (as H2S), Total Residual Chlorine |
| Oil and Grease | - | - | |
| Metals | - | X | Total Copper (Cu), Total Nickel (Ni), |
| Dioxins & Furans | - | - | |
| Organic Halogens | - | - | |
| Glycols | - | - | |
| Polycyclic Aromatic Hydrocarbons | - | - | |
| Volatile Organics | - | DL | Chloromethane, Trichlorofluoromethane (FREON 11) |
| Semi-Volatile Organics | - | DL | Hexachlorocyclopentadiene |
| Petroleum Hydrocarbons with Atl. RBCA V3.1 method | - | - | |
| Petroleum Hydrocarbons with CCME PHC-CWS method | - | - | |
| Polychlorinated Biphenyls | - | DL | Total PCB |
| Fatty Acids | - | - | |
| Resin Acids | - | - | |
| Phenols | - | DL | 2,4 Dimethylphenol |

**Note:**
DL – indicates parameter with RDL greater than EPA benchmark
exceedances of VOCs and SVOCs in all cases indicates that RDL was greater than the EPA benchmark.
exceedances of PCBs in all cases indicates that reported detection limit (RDL) was greater than the EPA benchmark.
exceedances of Phenol parameter specific to a reported detection limit (RDL) greater than the EPA benchmark.

**Table 3-3: Summary of Water Quality Guideline Exceedances along the Proposed Pipeline Corridor**

| General Chemistry & Physical Parameters | Exceeds CCME | Exceeds EPA | Parameters |
|---|---|---|---|
| Oxygen Demand | - | - | |
| Anions and Nutrients | - | X | Sulphide (as H2S) |
| Oil and Grease | - | - | |
| Metals | - | X | Total Copper (Cu), Total Nickel (Ni), |
| Dioxins & Furans | - | - | |
| Organic Halogens | - | - | |
| Glycols | - | - | |
| Polycyclic Aromatic Hydrocarbons | - | - | |
| Volatile Organics | - | DL | Chloromethane, Trichlorofluoromethane (FREON 11) |
| Semi-Volatile Organics | - | - | |
| Petroleum Hydrocarbons with Atl. RBCA V3.1 method | - | - | |
| Petroleum Hydrocarbons with CCME PHC-CWS method | - | - | |
| Polychlorinated Biphenyls | - | DL | Total PCB |
| Fatty Acids | - | - | |
| Resin Acids | - | - | |
| Phenols | - | DL | 2,4 Dimethylphenol |

**Note:**
DL – indicates parameter with RDL greater than EPA benchmark
exceedances of VOCs and SVOCs in all cases indicates that reported detection limit (RDL) was greater than the EPA benchmark.
exceedances of PCBs in all cases indicates that reported detection limit (RDL) was greater than the EPA benchmark.
exceedances of Phenol parameter specific to a reported detection limit (RDL) greater than the EPA benchmark.

### 3.1.2 General Chemistry and Physical Parameters

There were no exceedances of applicable CCME guidelines in the general chemistry and physical parameter group either around the proposed diffuser location or along the proposed pipeline corridor. Parameters within this group for both areas were as expected for a typical marine environment.

### 3.1.3 Oxygen Demand

There were no exceedances of applicable CCME guidelines in the oxygen demand parameter group either around the proposed diffuser location or along the proposed pipeline corridor.

### 3.1.4 Anions and Nutrients

There were not exceedances of applicable CCME guidelines in the anions and nutrients parameter group either around the proposed diffuser location or along the proposed pipeline corridor. Similar to the general category the majority of the parameters were within expected ranges for the environment sampled.

### 3.1.5 Oil and Grease

There were not exceedances of applicable CCME guidelines in the Oil and Grease parameter group either around the proposed diffuser location or along the proposed pipeline corridor.

### 3.1.6 Metals

There were not exceedances of applicable CCME guidelines in the metals parameter group either around the proposed diffuser location or along the proposed pipeline corridor. A large majority of metals were below their respective detection limits in all of the samples analyzed. The exceptions were, sodium, strontium, potassium, magnesium, calcium and boron. All of which were above detection in all instances. Aluminum, barium, cadmium and mercury all had at least one instance of a concentration greater than the detection being reported. Two metals (copper and nickel) were reported in one or more surface water samples, taken along the pipeline route or diffuser location, above the EPA chronic screening level criteria (3.73 µg/L and 8.28 µg/L, respectively). CCME guidelines do not exist for these parameters for marine water.

### 3.1.7 Dioxins and Furans

There were not exceedances of applicable CCME or EPA guidelines in the dioxins and furans parameter group either around the proposed diffuser location or along the proposed pipeline corridor. Similar to metals, the majority of dioxins and furans were below their respective detection limits. Octa CDD and Total Hepta CDD were the only parameters above detection.

### 3.1.8 Organic Halogens

There were not exceedances of applicable CCME guidelines in the organic halogens parameter group either around the proposed diffuser location or along the proposed pipeline corridor. AOX is not an appropriate test for marine water however it is a recognizable parameter tested in pulp and paper effluents. AOX was less that detect in all samples collected.

### 3.1.9 Glycols

There were not exceedances of applicable CCME or EPA guidelines in the glycol parameter group either around the proposed diffuser location or along the proposed pipeline corridor.

### 3.1.10 Polycyclic Aromatic Hydrocarbons (PAHs)

There were no exceedances of applicable CCME or EPA guidelines in the PAH parameter group either around the proposed diffuser location or along the proposed pipeline corridor. All PAHs were less than their respective detection limits in all instances.

### 3.1.11 Volatile Organics

There were not exceedances of applicable CCME guidelines in the volatile organics parameter group either around the proposed diffuser location or along the proposed pipeline corridor. VOCs were less than their respective detection limits in most instances. However, in a few instances, the reported detection limit was greater than the EPA benchmark.

### 3.1.12 Semi-Volatile Organics

There were not exceedances of applicable CCME guidelines in the semi-volatile organics parameter group either around the proposed diffuser location or along the proposed pipeline corridor. However, in a few instances, the reported detection limit was greater than the EPA benchmark.

### 3.1.13 Petroleum Hydrocarbons with Atl. RBCA V3.1 method

There were not exceedances of applicable CCME guidelines in the RBCA analysis method petroleum hydrocarbons parameter group either around the proposed diffuser location or along the proposed pipeline corridor.

### 3.1.14 Petroleum Hydrocarbons with CCME PHC-CWS method

There were not exceedances of applicable CCME guidelines in the CCME analysis method petroleum hydrocarbons parameter group either around the proposed diffuser location or along the proposed pipeline corridor.

### 3.1.15 Polychlorinated Biphenyls (PCBs)

There were not exceedances of applicable CCME guidelines in the PCBs parameter group either around the proposed diffuser location or along the proposed pipeline corridor. The RDL for PCBs was greater than both the CCME and EPA benchmark for a number of samples.

### 3.1.16 Fatty Acids

There were not exceedances of applicable CCME guidelines in the fatty acids parameter group either around the proposed diffuser location or along the proposed pipeline corridor.

All measures of various fatty acids were below their respective detection limits in all samples collected.

### 3.1.17 Resin Acids

There were not exceedances of applicable CCME guidelines in the resin acids parameter group either around the proposed diffuser location or along the proposed pipeline corridor. All measures of various resin acids were below their respective detection limits in all samples collected.

### 3.1.18 Phenols

There were not exceedances of applicable CCME or EPA guidelines in the phenols parameter group either around the proposed diffuser location or along the proposed pipeline corridor. All phenol concentrations were below their respective detection limits in all samples collected to date with the exception of the RDL being greater than the EPA chronic benchmark for (110 µg/L) for 2,4 Dimethylphenol in one instance at the diffuser location.

## 3.2 Marine Sediment Quality

Marine sediment sampling has been undertaken within Caribou Harbour and Pictou Harbour in 2008, 2014, 2015 and 2019 (AMEC 2014, 2015a, 2015b, Stantec 2019a). The study conducted by Stantec in 2019 (April/May) included surface and at depth sampling using grab and coring techniques within the marine environment. Samples were collected along length of the proposed pipeline corridor and in the vicinity of the preferred outfall diffuser location. Samples were collected to depth to support the characterization of materials that may be excavated and potentially permanently sidecast or disposed of during the construction phase. Grain size distribution within 0 to 0.5-m (substrate surface to a vertical depth of 0.5 m) and inclusive of the bioactive zone (i.e. to a maximum depth of 0.20 m in most marine and coastal offshore habitats) as studied by Stantec (2019a) is summarized in **Table 3-4**. Sampling locations and results specific to these locations are provided in **Figure 3-1**, **Figure 3-2**, **Figure 3-3**, **Figure 3-4** and **Appendix C**.

**Northumberland Strait in the Vicinity of the Northumberland Ferries Limited terminal at Caribou**

Sediments in this area may have been influenced with respect to composition based on recent or past dredging and at sea disposal activities (i.e. due to proximity to disposal areas used in 1981, 2007 and 2017). Disposal at Sea (DAS) of dredged material in 2017 occurred less than 2 km to the southwest of the proposed diffuser location.

Upper layer sediments collected near the proposed diffuser location were predominately composed of sand with lesser proportions of gravel present (**Table 3-4**). Samples collected at greater depths (i.e. 0.5 to 3 m) also indicated sand as the dominant material, with slightly increased proportions of silt (Stantec 2019a).

Upper layer sediments collected along the proposed pipeline corridor between the diffuser location and Caribou Harbour were primarily composed of sand and/or silty sand with less gravel. Samples collected at greater depths were characterized by increased proportions of silt. Previous study of substrates at the proposed (DAS) near the mouth of Caribou Harbour, to the southeast of the marine PFA (AMEC 2015a), indicated some occurrence of cobble and rock (generally less than 20% by proportion). Shell hash was also observed in at most the sampling areas within the area studied.

Sediment quality, as assessed by core sampling in 2019 along the proposed pipeline corridor and diffuser location did not indicate any exceedances of TOC, PAHs, Metals or PCBs (Stantec 2019a) (**Figure 3-3**).

**Caribou Harbour**

Sediment samples collected in 2008 indicated that sediment in Caribou Harbour is composed primarily of sand (51.5%), silt (27.9%), clay (16.9%), and gravel (3.6%) (AMEC 2014). The upper layer sediments, as collected by Stantec (2019a), within Caribou Harbour along the pipeline corridor consisted of silty sand or sandy silt. Sampling locations closer to shore had higher proportions of clay.

Sediment quality in Caribou Harbour has been surveyed along the Caribou ferry corridor by AMEC (2015b) from the surface to a depth of 0.15 m. PAHs were not detected at any samples from the Inner Channel and ferry berth areas. Total organic carbon (TOC) and total inorganic carbon (TIC) content in 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). Metal concentrations did not exceed the Canadian Environmental Protection Act Disposal at Sea (CEPA DAS) lower level screening criteria for metals or the Canadian Sediment Quality Guidelines (CSQG) Interim Sediment Quality Guideline (ISQG) or Probable Effect Level (PEL) in the Inner Channel or ferry berth areas (AMEC 2015b).

The previous study conducted by AMEC (2015b) in the vicinity of the DAS did not identify benzene, toluene, ethylbenzene, xylene (BTEX) nor total petroleum hydrocarbons (TPH) above detection limits. Modified TPH values that were detected resembled 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).

Polychlorinated biphenyls (PCB), DDT (Dichlorodiphenyltrichloroethane), DDE (Dichlorodiphenyldichloroethylene), and DDD (Dichlorodiphenyldichloroethane) were not detected in Caribou Harbour as sampled by AMEC (2015b).

Analyses conducted on sediment samples collected in Caribou Harbour along the proposed pipeline corridor and diffuser location in 2019 (Stantec 2019a; **Figure 3-1**) indicated the following:

- Total organic carbon (TOC) concentrations ranged from below detection (<0.5 g/kg) to 23 g/kg;
- PAH concentrations were below CEPA Disposal at Sea sediment screening criteria and CCME Sediment Quality Guidelines – Probable Effects Levels for Marine environments in all samples collected;
- Arsenic concentrations exceeded the CCME Interim Sediment Quality Guideline (ISQG) benchmark of 7.24 mg/kg at several sampling locations and sediment depths ranging from 7.3 mg/kg to 12 mg/kg) (**Figure 3-3**). Exceedances for this parameter were generally localized to the area between the Caribou Harbour Ferry Terminal and Munro's Island and concentrations remained below the CCME Probable Effects Level (PEL). The PEL is defined as the level above which adverse biological effects ae usually or always observed;
- Copper exceeded the CCME ISQG of 18.7 mg/kg in two samples collected within along the proposed pipeline at VC-12-2 (41 mg/kg) and VC-16-3 (19 mg/kg) (**Figure 3-3**), but did not exceed the PEL at any location;
- PCBs remained below detection in most instances and in all cases, concentrations were well below the Marine CSQG PELs; and,
- Two chlorinated dioxin compounds (1,2,3,4,6,7,8-Hepta CDD and 1,2,3,4,6,7,8-Hepta CDF) exceeded the CCME ISQG benchmark (0.85 pg/g both compounds) at VC16-1 which was located just west of Munro's Island (**Table 3-5**). However, neither compound had concentrations exceeding the CCME PEL.

**Pictou Harbour**

Upper layer sediments collected along the proposed pipeline corridor in Pictou Harbour were predominately composed of silt (> 75%) with a smaller proportion of clay (15 to 20%) and sand (< 1 to 2 %). Two of the sampling locations closer to the southern end of the pipeline corridor had grain size distributions which were less dominated by silt and had higher proportions of clay (42% at VC-50C-1) or gravel (35% at VC-51A) (**Table 3-4**). Samples collected at greater depths (i.e. 0.5 to 3 m) also indicated silt as the dominant material, with variable proportions of clay and sand. Gravel was generally present in proportions of less than 10% at depth (Stantec 2019a).

Of 13 sediment samples collected in Pictou Harbour in 1990 (Dalziel et al. 1993), 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.

Analyses conducted on sediment samples collected in Caribou Harbour along the proposed pipeline corridor and diffuser location in 2019 (Stantec 2019) indicated the following:

- Total organic carbon (TOC) ranged from 4.7 g/kg to 69 g/kg;
- Total PAH concentration exceeded the CEPA Disposal at Sea Screening Criteria at VC-50C-1, which was the sample taken near the southern portion of the Pictou Causeway and represented a depth of the upper 0.2 m of substrate at that location;
- 2-Methylnaphthalene (1.8 mg/kg), acenaphthene (0.69 mg/kg), fluorene (0.36 mg/kg), and naphthalene (6.8 mg/kg) each exceeded the CSQG PEL (0.201, 0.0889, 0.144 and 0.391 mg/kg, respectfully) at VC-50C-1 (**Table 3-5**);
- 2-Methylnaphthalene, fluoranthene, fluorene, naphthalene, phenanthrene and pyrene all had concentrations that exceeded their respective CSQG PELs at VC-50C at multiple depth strata (**Table 3-5**);
- Only one sample (0.64 mg/kg at VC-53-3) exceeded the sediment screening criteria for cadmium (0.60 mg/kg) under the CEPA Disposal at Sea Regulations;
- Arsenic concentrations in samples taken at all locations and associated depths along the proposed pipeline corridor exceeded the CSQG Marine PEL (7.24 mg/kg) and ranged from 8.3 mg/kg to 12 mg/kg (**Figure 3-4**);
- Copper marginally exceeded the CSQG Marine PEL (18.7 mg/kg) at a number of locations both near substrate surface (0 to 0.5 m) as well as at greater depths (2 to 3 m). Concentrations ranged from 19 to 21 mg/kg (**Figure 3-4**);
- Lead marginally exceeded the CSQG Marine PEL (30.2 mg/kg) at VC-50C-1 (33 mg/kg) and VC-50C-3 (33 mg/kg), which was the sample taken near the southern portion of the Pictou Causeway and represented depths of 0 to 0.2 m and 1.2 to 2.2 m, respectively.

**Table 3-4: Sediment Grain Size Distribution**

| Area | Location | Sample | Grain Size Proportion (%) | | | | Classification |
|---|---|---|---|---|---|---|---|
| | | | Clay | Silt | Sand | Gravel | |
| Northumberland Strait | Diffuser | S1 | 0.9 | 0.1 | 98 | 1.2 | Sand |
| Northumberland Strait | Diffuser | S2 | 1.7 | 0.8 | 78 | 20 | Sand/Gravel |
| Northumberland Strait | Diffuser | VC-01-SFC | 4.3 | 14 | 81 | 1.2 | Silty Sand |
| Northumberland Strait | Diffuser | VC-02C-1 | 1.6 | 1.8 | 57 | 40 | Sand/Gravel |
| Northumberland Strait | Pipeline | VC-03B-1 | 1.3 | 0.8 | 80 | 18 | Sand/Gravel |
| Northumberland Strait | Pipeline | VC-04A | 1.6 | 2.1 | 91 | 5.5 | Sand |
| Northumberland Strait | Pipeline | VC-04B | 1.3 | 1.1 | 96 | 1.7 | Sand |
| Northumberland Strait | Pipeline | VC-05-1 | 8.3 | 16 | 73 | 2.4 | Silty Sand |
| Northumberland Strait | Pipeline | VC-07A | 1.2 | 0.5 | 95 | 3.8 | Sand |
| Northumberland Strait | Pipeline | VC-10B-1 | 1.3 | 0.4 | 98 | 0.68 | Sand |
| Northumberland Strait | Pipeline | VC-23A-1 | 7 | 10 | 83 | 0.18 | Silty Sand |
| Caribou Harbour | Pipeline | S3 | 16 | 58 | 26 | 0.32 | Sandy Silt |
| Caribou Harbour | Pipeline | S4 | 10 | 54 | 36 | 0.1 | Sandy Silt |
| Caribou Harbour | Pipeline | VC-11A-1 | 8.2 | 7.1 | 84 | 0.43 | Clay/Silty Sand |
| Caribou Harbour | Pipeline | VC-12-1 | 4.4 | 13 | 77 | 6.2 | Silty Sand |
| Caribou Harbour | Pipeline | VC-14-1 | 19 | 67 | 14 | 0.1 | Clay & Sandy Silt |
| Caribou Harbour | Pipeline | VC-15A-1 | 11 | 54 | 34 | 0.43 | Sandy Silt |
| Caribou Harbour | Pipeline | VC-16-1 | 25 | 42 | 28 | 4.9 | Sandy Silt |
| Caribou Harbour | Pipeline | VC-19A-1 | 19 | 34 | 47 | 0.11 | Silt/Sand |
| Caribou Harbour | Pipeline | VC-20A-1 | 17 | 29 | 53 | 0.34 | Silty Sand |
| Caribou Harbour | Pipeline | VC-21A-1 | 23 | 54 | 24 | 0.1 | Clay & Sandy Silt |
| Caribou Harbour | Pipeline | VC-22A-1 | 4.4 | 13 | 82 | 0.24 | Silty Sand |
| Pictou Harbour | Pipeline | VC-50C-1 | 42 | 46 | 10 | 1.7 | Clay/Silt |
| Pictou Harbour | Pipeline | VC-51A | 19 | 27 | 35 | 18 | Silty Sand / Gravel |
| Pictou Harbour | Pipeline | VC-52A-1 | 13 | 79 | 7.5 | 0.1 | Clay & Sandy Silt |
| Pictou Harbour | Pipeline | VC-53A-1 | 16 | 79 | 5 | 0.34 | Clay & Sandy Silt |
| Pictou Harbour | Pipeline | VC-54A-1 | 15 | 76 | 7.3 | 2.3 | Clay & Sandy Silt |

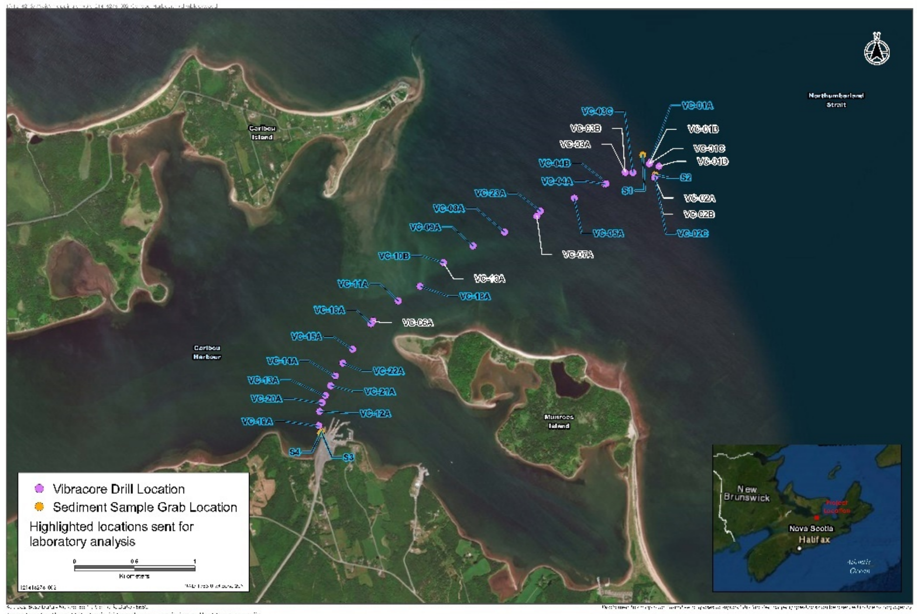


**Figure 3-1: Sediment Sampling Locations in the Northumberland Strait and Caribou Harbour (as presented in Stantec (2019)**


**Figure 3-2: Sediment Sampling Locations in Pictou Harbour (as presented in Stantec (2019)**

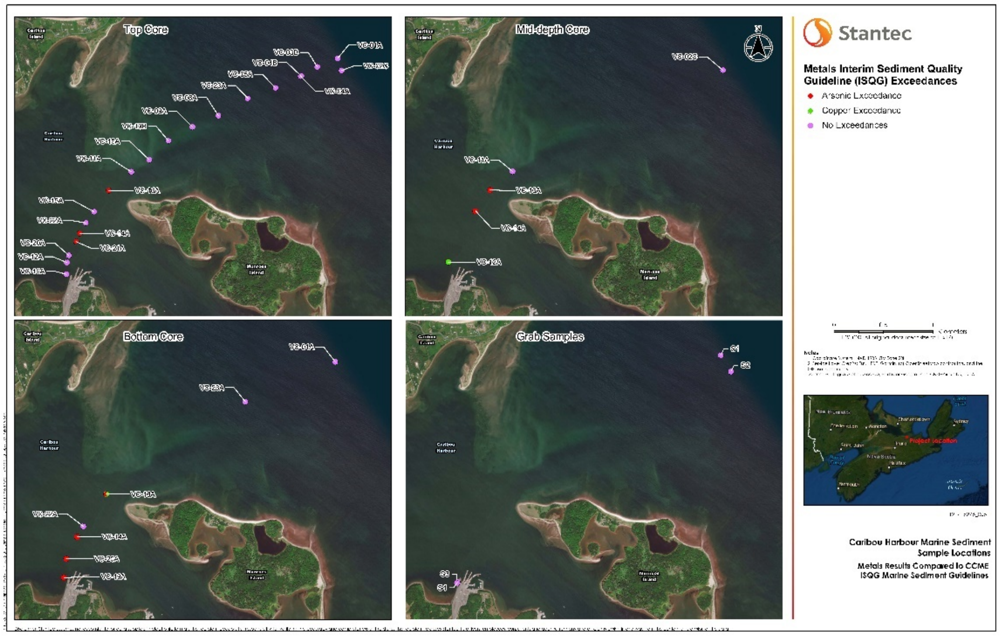


**Figure 3-3: Caribou Harbour Marine Sediment Quality Location and Benchmark Comparison (as presented in Stantec (2019))**


**Figure 3-4: Pictou Harbour Marine Sediment Quality Location and Benchmark Comparison (as presented in Stantec (2019))**

**Table 3-5: Summary of PAH Exceedances in Sediment**

| Parameter | Area | Sample | Sample Value | Benchmark | CCME Benchmark value | Units |
|---|---|---|---|---|---|---|
| 1,2,3,4,6,7,8-Hepta CDD | Caribou | VC-16-1 | 8.55 | CCME ISQG | 0.85 | pg/g |
| 1,2,3,4,6,7,8-Hepta CDF | Caribou | VC-16-1 | 1.63 | CCME ISQG | 0.85 | pg/g |
| 2-Methylnaphthalene | Pictou | VC-50C-1 | 1.8 | CCME PEL | 0.201 | mg/kg |
| 2-Methylnaphthalene | Pictou | VC-50C-2 | 0.082 | CCME ISQG | 0.0202 | mg/kg |
| 2-Methylnaphthalene | Pictou | VC-50C-3 | 0.15 | CCME ISQG | 0.0202 | mg/kg |
| Acenaphthene | Pictou | VC-50C-1 | 0.69 | CCME PEL | 0.089 | mg/kg |
| Fluoranthene | Pictou | VC-50C-1 | 0.13 | CCME ISQG | 0.113 | mg/kg |
| Fluoranthene | Pictou | VC-50C-2 | 0.15 | CCME ISQG | 0.113 | mg/kg |
| Fluoranthene | Pictou | VC-50C-3 | 0.14 | CCME ISQG | 0.113 | mg/kg |
| Fluorene | Pictou | VC-50C-1 | 0.36 | CCME PEL | 0.144 | mg/kg |
| Fluorene | Pictou | VC-50C-3 | 0.03 | CCME ISQG | 0.0212 | mg/kg |
| Naphthalene | Pictou | VC-50C-1 | 6.8 | CCME PEL | 0.391 | mg/kg |
| Naphthalene | Pictou | VC-50C-2 | 0.039 | CCME ISQG | 0.0346 | mg/kg |
| Naphthalene | Pictou | VC-50C-3 | 0.081 | CCME ISQG | 0.0346 | mg/kg |
| Phenanthrene | Pictou | VC-50C-1 | 0.24 | CCME ISQG | 0.0867 | mg/kg |
| Phenanthrene | Pictou | VC-50C-2 | 0.11 | CCME ISQG | 0.0867 | mg/kg |
| Phenanthrene | Pictou | VC-50C-3 | 0.11 | CCME ISQG | 0.0867 | mg/kg |
| Pyrene | Pictou | VC-50C-3 | 0.21 | CCME ISQG | 0.153 | mg/kg |

## 3.3 Marine Benthos

Marine invertebrates are comprised of a diverse group of spineless organisms that live in virtually all marine habitats, from in-shore intertidal zones to the deepest parts of the ocean. Marine invertebrates that are associated with the sea floor (or benthic zone) are termed benthic invertebrates.

Benthic invertebrate species include those that live within sea floor sediments that are referred to as infauna, as well as those that live on top of sea floor sediments that are referred to as epifauna. Benthic invertebrates are further characterized or categorized based on relative size. Macrobenthos can generally be considered to be those species that would be visible to the naked eye (or nearly so) and would include, but not be limited to important commercial species such as lobster, crabs, shellfish (oysters, mussels, scallops) and snails. In contrast, meiobenthos are smaller and some level of magnification may be needed to seem them, let alone identify them on a taxonomic basis. The meiobenthos include very diverse types of organisms representing several animal phyla.

Benthic invertebrate communities have been characterized within the Northumberland Strait on several occasions, though data tend to focus on the macrobenthos portion of the community. This is in part because the macrobenthic species include those that have commercial value – data on these species have been collected from targeted sampling programs, and are reported as incidental catch from non-targeted surveys.

Available information concerning benthic invertebrate community composition and distribution is generally, though not exclusively, drawn from the regional assessment area (RAA) and covers all habitat types within the immediate vicinity of the proposed works (pipeline and discharge system) that is referred to as the local assessment area (LAA). Some survey data are available within the local assessment area (LAA), as well as within the immediate vicinity of the proposed works (pipeline and discharge system).

An LAA-focused field survey to further characterize the benthic invertebrate community in all key habitat types along the proposed pipeline route and in the vicinity of the effluent discharge system will be completed in the fall 2019 to supplement existing information.

The St. Georges Bay Ecosystem Project (https://people.stfx.ca/rsg/gbayesp/welcome.htm) was a co-operative, inter-agency, interdisciplinary research project that served to bring a greater understanding to marine resources in the area, including in the Northumberland Strait. The review of benthic fauna and community studies was prepared by Mitchell describes survey results between the 1960s and 1990s citing several sources (e.g., Scarrat and Lowe, 1972; Caddy et al., 1977; Dunbar et al., 1980). Overall, these studies indicated that the benthic community was numerically dominated by the following taxonomic groups, presented in order of the number of unique species identified:

- polychaete worms (91 unique taxa identified) – a taxonomic Class of marine annelid worms that includes diverse groups of infaunal and epifaunal taxa;
- amphipods (73 unique taxa identified) – a taxonomic Order of malacostracan crustaceans commonly referred to as “scuds” or “sideswimmers” that are typically part of the epifauna community commensurate with their scavenging/grazing foraging behaviour;
- bivalves (26 unique taxa identified) – marine molluscs representing both infaunal and epifaunal taxa, including clams, oysters, cockles, mussels, scallops, and numerous other families, a number of which are of important commercial value in the area;
- gastropods (16 unique taxa identified) - marine molluscs commonly referred to as snails and slugs representing both infaunal and epifaunal taxa;
- decapod crustaceans (6 unique taxa identified) – marine epifauna from the taxonomic order Decapoda including lobster and crabs which are of important commercial value in the area; and,

- echinoderms (6 unique taxa identified) – taxonomic phylum representing both infaunal and epifaunal taxa including well-known animals such as starfish, sea urchins, sand dollars, and sea cucumbers.

AMEC (2007) developed an Ecosystem Overview Report (EOR) in support of Northumberland Strait Ecosystem Initiative, a Government/Stakeholder Working Group was established in the fall of 2005 by the Fisheries and Oceans Canada (DFO). The EOR is a compilation of information gleaned from various sources, such as scientific, statistical, social, and economic study reports, traditional and local information, and a technical consultative process, and includes information regarding benthic invertebrate populations. The information provided in the EOR is summarized as follows:

- The EOR reports on a survey by Hurley Fisheries (1989) in which samples were collected at the same locations as an earlier study in the Strait (Caddy et al., 1977). Overall, the species composition was similar for the two data sets, with few minor exceptions. Hurley Fisheries (1989) also describes the distribution and relative abundance of non-commercial epifauna of the Abegweit Passage area based on scallop drag samples and videotape records. A summary of the key infauna results are shown below (source, AMEC, 2007).

**Table 3-6: Key Infauna Distribution and Relative Abundance**

| Group | Species | Comments/Habitat |
|---|---|---|
| Sand Dollars | *Echarchnius parma* | Highly abundant, often many thousands in drags over sandy areas. Distribution highly clumped and patchy. Similar distribution to 1975. |
| Starfish | *Asterias sp.; Henricia snaguinolenta* | Common throughout stations. Majority of specimens tiny – nursery area? |
| Mussels (horse mussels) | *Modiolus* | Two dense beds off Borden & Cape Tormentine. Cobble and sand bottom. 10 -15 m depth. |
| Slipper limpets | *Crepidula sp.* | On dispersed rocks in sand close to NB coast. |
| Rock Crabs | *Cancer irroratus* | Not associated with bottom type. Common at depths <15m. |
| Clams | *Astarte sp.* | Commonly encountered. |

- Marine Environmental Effects Monitoring Studies (MEEM) in relation to the Northumberland Strait Bridge Crossing Project reported on benthic infauna (JWEL, 1994, 1995, 1996). A summary of the key infauna results are shown below (source, AMEC, 2007).

**Table 3-7: Benthic Infauna Community**

| Taxa | Comments |
|---|---|
| Polychaetes | The most common group; 54 genera and/or species identified. |
| Other Vermiformes | Nematodes were abundant, and present throughout most samples. |
| Crustaceans | 13 species listed including Amphipods, copepods, *Gammarus sp*. |
| Marine Spiders | 3 unspecified Pycnogonid species |
| Molluscs | Common, particularly *Tellina sp.* Also 2 unspecified nudibranch species. |
| Echinoderms | Occasional |

- The EOR shares information regarding the neighbouring Shediac Bay (LeBlanc and Turcotte-Lanteigne, 2006), Bedeque Bay (unreferenced) and Richibouctou Bay (Turcotte-Lanteigne & Ferguson, 2006) Ecosystem Overview and Assessment Reports (EOAR). AMEC (2007) reasoned that the near shore epifauna of these areas would likely be generally representative of what would be commonly found throughout the nearshore regions of the Strait. The most common macro epifauna described for the Shediac Bay watershed are shown below (source, AMEC, 2007).

**Table 3-8: Macro Epifauna Community**

| Common Names | Scientific Names |
|---|---|
| **Molluscs** | |
| Razor Clam | *Ensis directus* |
| Bar clam | *Spisula solidissima* |
| American Oyster | *Crassostrea virginica* |
| Soft Shell Clam | *Mya arenaria* |
| Northern Quahog | *Mercenaria* |
| Blue mussel | *Mytilus edulis* |
| Creeper | *Stophitus undulatus* |
| Gastropods | |
| Moonsnail | *Lunatia sp.* |
| **Crustaceans** | |
| Grass shrimp | *Palaemonetes vulgaris* |
| Sand shrimp | *Crangon septemspinosa* |
| Rock crab | *Caner irroratus* |
| Mud crab | *Neopanopeus sayi* |
| Lobster | *Homarus americanus* |

Each September since 1971, a stratified-random bottom trawl survey has been conducted in the southern Gulf of St. Lawrence that includes the western and eastern ends of the Northumberland Strait (see **Figure 3-5**).

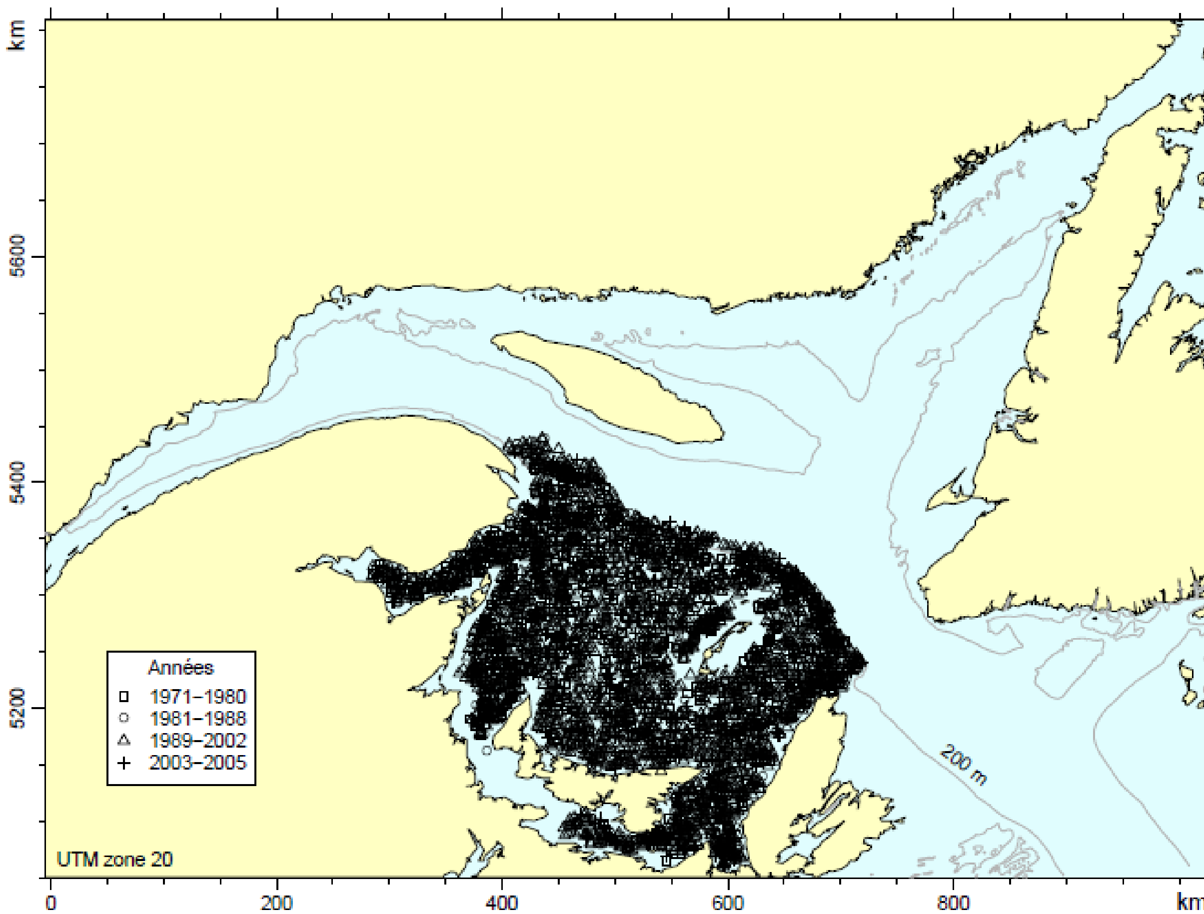


**Figure 3-5: Distribution of sampling locations associated with September survey trawls in the southern Gulf of St. Lawrence (source, Chabot et al., 2007)**

This survey provides an information time series for both marine and diadromous fish, as well as groups of marine invertebrates. Data associated with the trawls are available from Benoit et al. (2003; data to 2002) and Chabot et al. (2007; data to 2005). The table below indicates the presence of benthic invertebrate epifauna collected during the trawls.

**Table 3-9: Invertebrate epifauna collected during September survey trawls in the Northumberland Strait (source, Benoit et al., 2003)**

| Taxa | West End of Strait | East End of Strait |
|---|---|---|
| Unspecified Marine Invertebrates | X | X |
| Decapod Shrimp | - | X |
| Pandalid Shrimp | - | X |
| Atlantic Rock Crab | X | X |
| Toad Crab (*Hyas sp.)* | X | X |
| Lobster | X | X |
| Snails & Slugs - Gasteropoda | X | X |
| Whelks (*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 |
| True mussels - Mytillidae | - | X |
| Echinoderms | X | |
| Starfish | X | X |
| Sun star *Solaster sp.* | X | X |
| Mud star *Ctenodiscus crispatus* | - | X |
| Sea urchins *Strongylocentrotus sp.* | - | X |
| Sand dollars | X | - |
| Sea anemones | - | X |
| Large jellyfish – Scyphozoa | - | X |
| Sponges - Porifera | X | X |
| Algae & kelp - Thallopya | - | X |

Regular benthic invertebrate data have been collected over the last 20-plus years in Pictou Road, just east of the LAA as part of Environmental Effects Monitoring (EEM) studies that Northern Pulp Nova Scotia undertakes to satisfy monitoring requirements under the Pulp and Paper Effluent Regulations (PPER) under the *Fisheries Act*. Generally, data from these surveys would provide information for both infauana and epifauana, though the data would be biased somewhat to the meiofuanal component of the community based on sampling methodology (bottom dredge). Given the proximity of the sampling locations to the LAA it is reasonable to assume that the taxa described by the EEM program are likely to also be found in the LAA in similar habitats. All EEM benthic surveys include sediment characterization (grainsize analysis) and it is possible therefore to associate community structure relative to sea bottom type and related these results to the LAA based on the sediment types identified in the LAA by Stantec (2019a and 2019b).

Substrate types within the LAA as reported by Stantec 2019b ranged from clayey silt to gravel and cobble as illustrated in **Figure 3-6.**

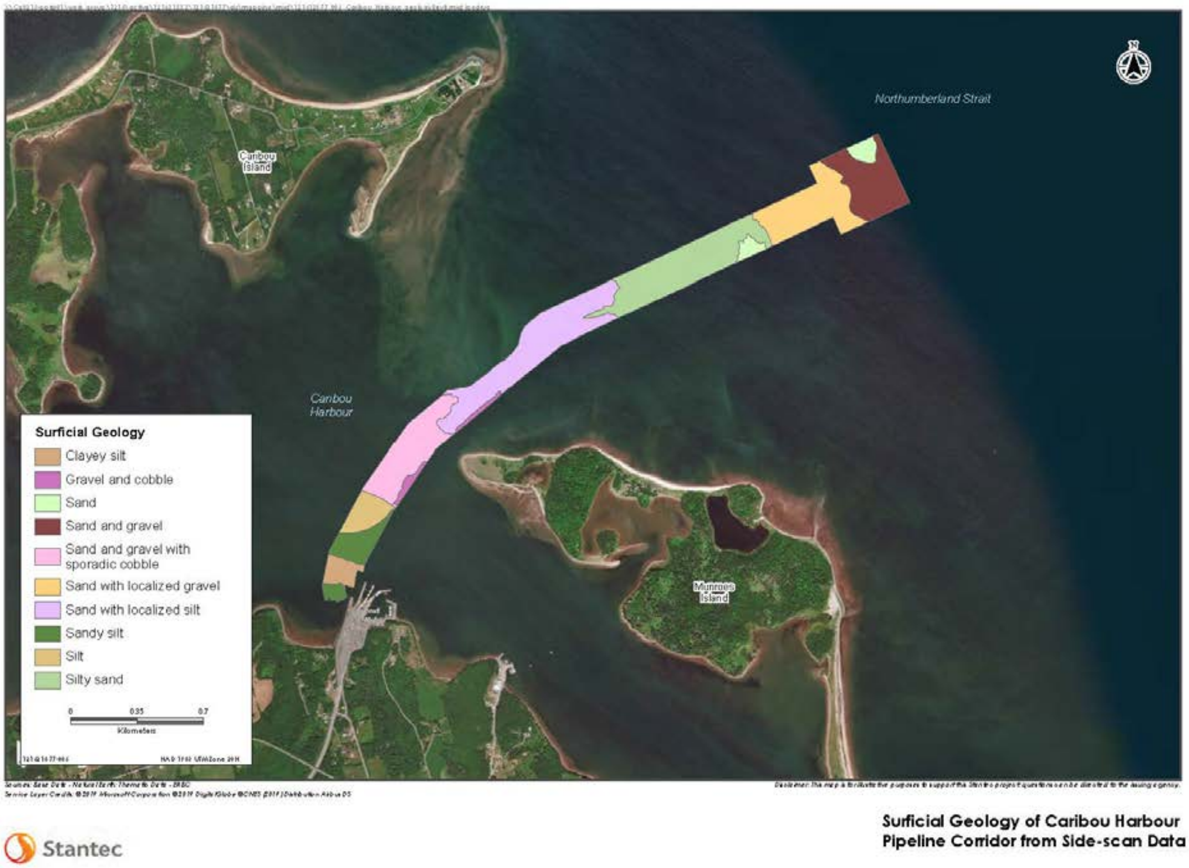


**Figure 3-6: Surficial substrates associated with the pipeline corridor (Stantec 2019b)**

Over EEM Cycles 3, 4, 5 and 7 that span the period 2002 through 2016 a total of 120 benthic stations were sampled in Pictou Road (Beak, 2002; EcoMetrix, 2007; EcoMetrix, 2010; EcoMetrix, 2016). Benthic community structure is described for these data based on assemblages associated with sediment types as follows: silt, silty sand, sand/silt, and sand/gravel/cobble. In all sediment types, more than 90% of the average benthic community was comprised of polychaete worms, snails and clams (**Figure 3-7**). Within the sand and sand/silt habitat mobile polychaetes (taxonomic subclass Errantia) were the most dominant taxonomic group with 37% and 46% of the average community comprising 28 and 10 genera or species, respectively. For the silty sand and sand/gravel samples snails were the dominant group with 9 and 8 genera or species identified, respectively. The second most dominant taxonomic group, on average, in the sand was snails, whereas for silty sand, and silt/sand it was clams and for sand/gravel it was mobile polychaetes. Other taxonomic groups comprised approximately, 7%, 4%, 6% and 1 % of the average benthic community from the sample collected in the sand, silty sand, silt/sand and sand/gravel habitat types. Taxonomic groups comprising more that 1% of the average community in all habitat types and likely to be present within the project footprint include: roundworms, members of the order Foraminifera and seed shrimps (taxonomic Class Ostracoda).

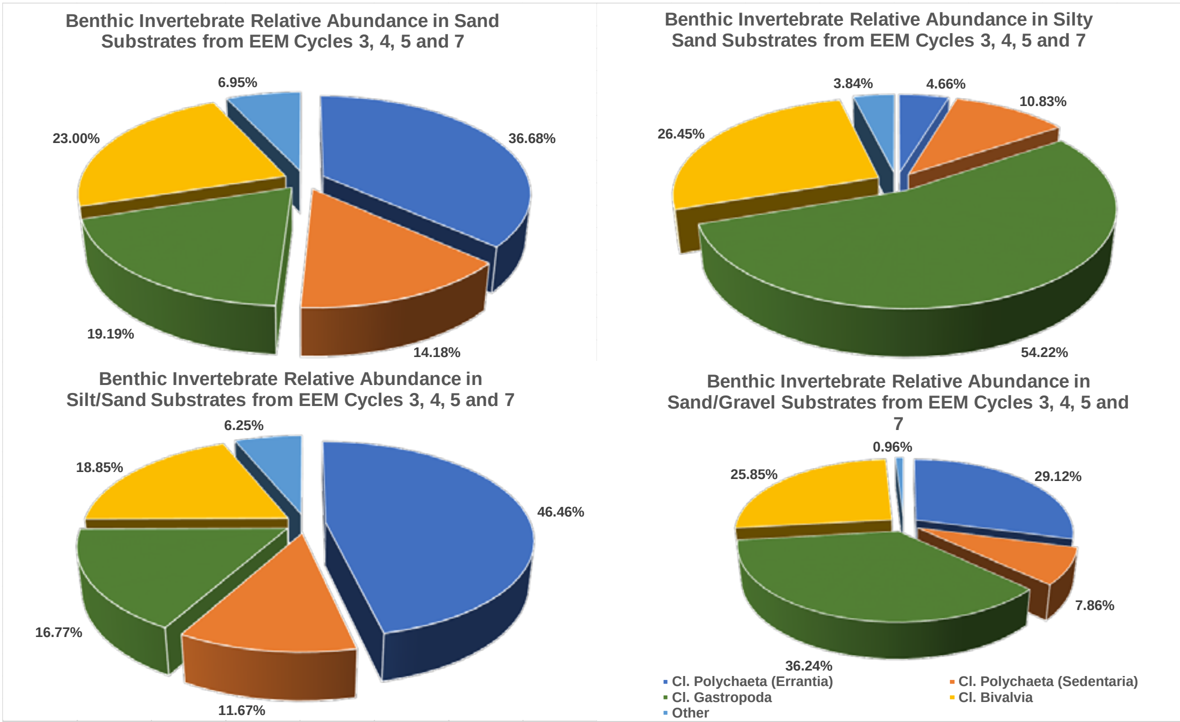


**Figure 3-7: Benthic Invertebrate Relative Abundance in Representative Substrate Types**

AMEC (2015a, 2015b) describes benthic macrofauna and habitat at Caribou in relation to disposal of dredgeate associated with the Caribou Ferry Terminal. Common species observed included Stimpson's whelk, periwinkle, sea scallop, and sand dollar. Other species noted somewhat less commonly 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 2015a).

## 3.4 Plankton

Plankton are organisms which carry out some portion of their life suspended in the water column, free floating with limited mobility and largely dependent on movement of the surrounding water mass for movement. In simple terms, plankton can be separated into two components:

- phytoplankton –chlorophyll containing plants capable of photosynthesis; and
- zooplankton – aquatic animals in the water column which feed on plants, bacteria, detritus or other zooplankton.

The Northumberland Strait is a region of high primary productivity during the summer months, but relatively low productivity in the winter (AMEC 2007). Previous studies conducted in the Northumberland Strait identified that phytoplankton species diversity is relatively high and rich in diatoms (JWEL 1994, AMEC 2007).

Zooplankton is comprised of a number of groups of animals inhabiting the water column. Holoplankton are animals which spend their entire life cycle in the water column environment (e.g. copepods). Meroplankton include plankton that spend some component of their life in the open water environment (e.g., lobster larval stages 2 and 3, some fish larvae). It is noted that zooplankton studies of either group are sparse or lacking specific to Caribou Harbour and/or Pictou Harbour.

Previous studies conducted at nearshore and open water areas of Shediac Bay and related to the Confederation Bridge Project (Citarella 1982 and Hurley Fisheries 1989, respectively) provide some indication of potential zooplankton communities in the study area. Nearshore zooplankton has been described as having a large abundance of copepods (potentially > 80%) (Citarella 1982, Turcotte-Lanteigne and Ferguson 2006).

Open water zooplankton assemblages within area of the Strait outside the RAA have indicated a dominance of coastal, warm water calanoid copepods of medium size with planktonic molluscs and pteropods constituting a smaller portion of the samples.

It should be noted that further investigations of the plankton communities within the direct vicinity of the proposed diffuser location have been initiated as of the summer of 2019 with additional sampling events scheduled for the early and late fall of the same year. These studies will provide a baseline with respect to phytoplankton and zooplankton species presence/absence, diversity and relative abundance.

## 3.5 Distribution of Marine Fish and Fish Habitat in the Study Area

### 3.5.1 Fish Habitat

Previous accounts of general fish habitat within the RAA were provided previously in the EARD (Dillon 2019). The following is derived from side-scan sonar data and underwater video capture methods provided by Stantec (2019b) with respect to available fish habitat within the LAA. The results of this study are also provided in **Figures 3-6, 3-8 and 3-9**

**Northumberland Strait / Caribou Harbour**

Underwater Benthic Habitat Surveys (UBHS) conducted from 3 m from shore near the Ferry Terminal along the proposed pipeline corridor and diffuser area (depth of approximately 20 m maximum).

Water depth remains generally consistent between 2 and 7 m along the majority of pipeline route prior to descending to greater than 10 m closer to the proposed diffuser location. The substrates within this portion of the pipeline transition from finer material (silt, sandy silt, clayey silt) near the ferry terminal to larger particle size substrates (sand, gravel and cobble, sand and gravel with localized cobble) just west of the western tip of Munroe's Island (depths variable from 2 to 6 m). Northeast of Munroe's Island, the substrates transition back to a silty sand (depths from 2 to 7 m). Upon reaching water depths of approximately 8 to 15 m the substrate is dominated by sand with localized gravel (**Figure 3-6, Figure 3-9, Figure 3-10**) (Stantec 2019b).

Within shallow areas of Caribou Harbour eelgrass is the most common macroflora present although in variable densities, reaching high proportional levels of cover in areas associated with finer particle substrates. As water depth increases and substrates transition to sand, there is a reduction in eelgrass presence. These less vegetated areas had less biological diversity and little macroflora. Eelgrass habitats are generally contained inside Caribou Harbour and not out at deeper depths along the pipeline route, nor near the diffuser location (**Figure 3-10**).

The water depth within a 200 m radius of the diffuser location ranges between 16 and 20 m is dominated by sand with localized gravel and sand and gravel overlain with shell hash (**Figure 3-9** and **Figure 3-10**).

Macrofauna observed during video surveys were consistent, with invertebrate species and marine fin-fish species generally rare and not identified in any definable abundance or presence (Stantec 2019b).

**Pictou Harbour**

The UBHS conducted on the east side of the Pictou Causeway within 150 m of the causeway right of way indicated the predominant substrates as silt and mixed substrates (silty sand, shell hash and gravel) (Stantec 2019b). Patches of larger particles (cobble/gravel and rock/boulders) were located at the south and north extremes of the surveyed area. Substrates within the deepest portion of the survey area (7-10 m) were characterized by sandy clay with gravel patches. Depths recorded at chart datum ranged from 1 to 10 m in the area surveyed, with greater depth near the centre of the causeway (**Figure 3-8**) (Stantec 2019b).

Macroflora within the surveyed area in Pictou Harbour near the causeway included brown algae, *Cystoseira* sp., *Chorda filum*, *Fucus vesiculosus*, *Laminaria longicuris* and *Ascophyllum nodosum*. Macroflora cover was generally sparse overall. Macrofauna observed during video surveys were consistent, with invertebrate species and marine fin-fish species characterized as rare and not identified in any definable abundance or presence (Stantec 2019b).

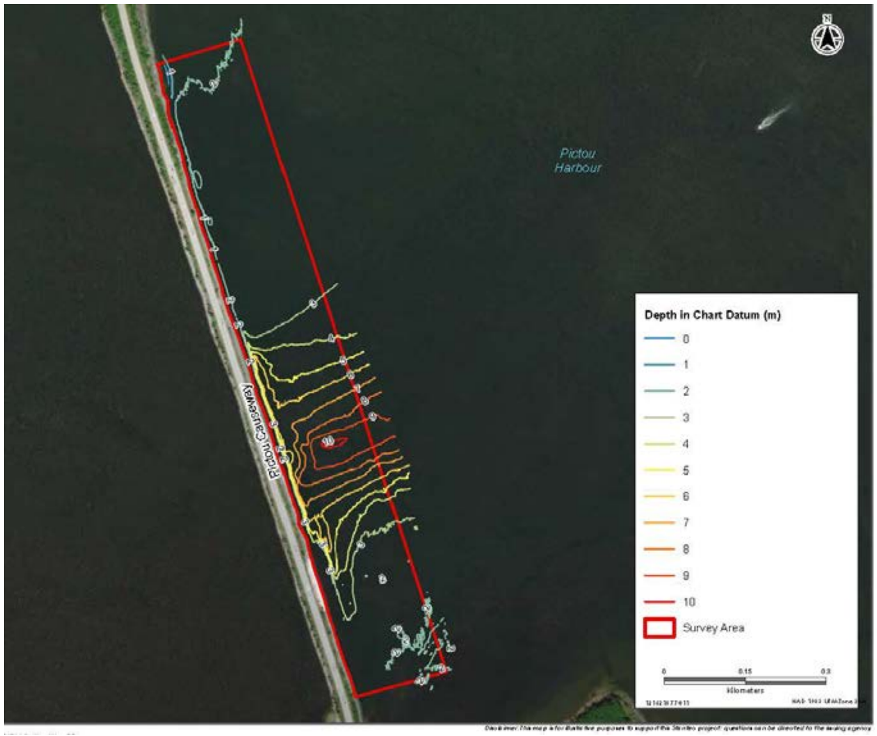


**Figure 3-8: Bathymetry near Pictou Causeway (Stantec 2019b)**

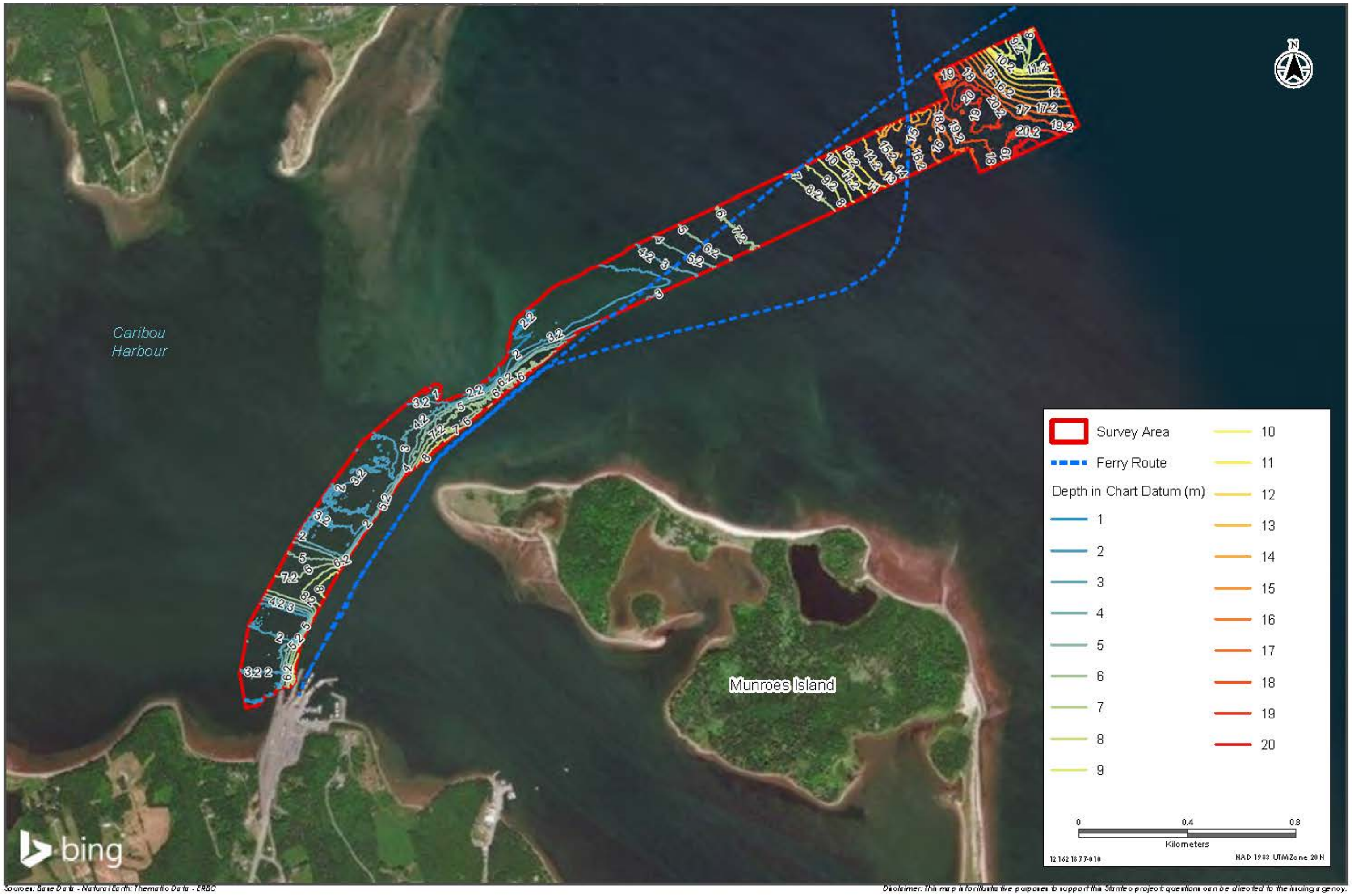


**Figure 3-9: Bathymetry associated with pipeline route and diffuser in Caribou Harbour (Stantec 2019b)**

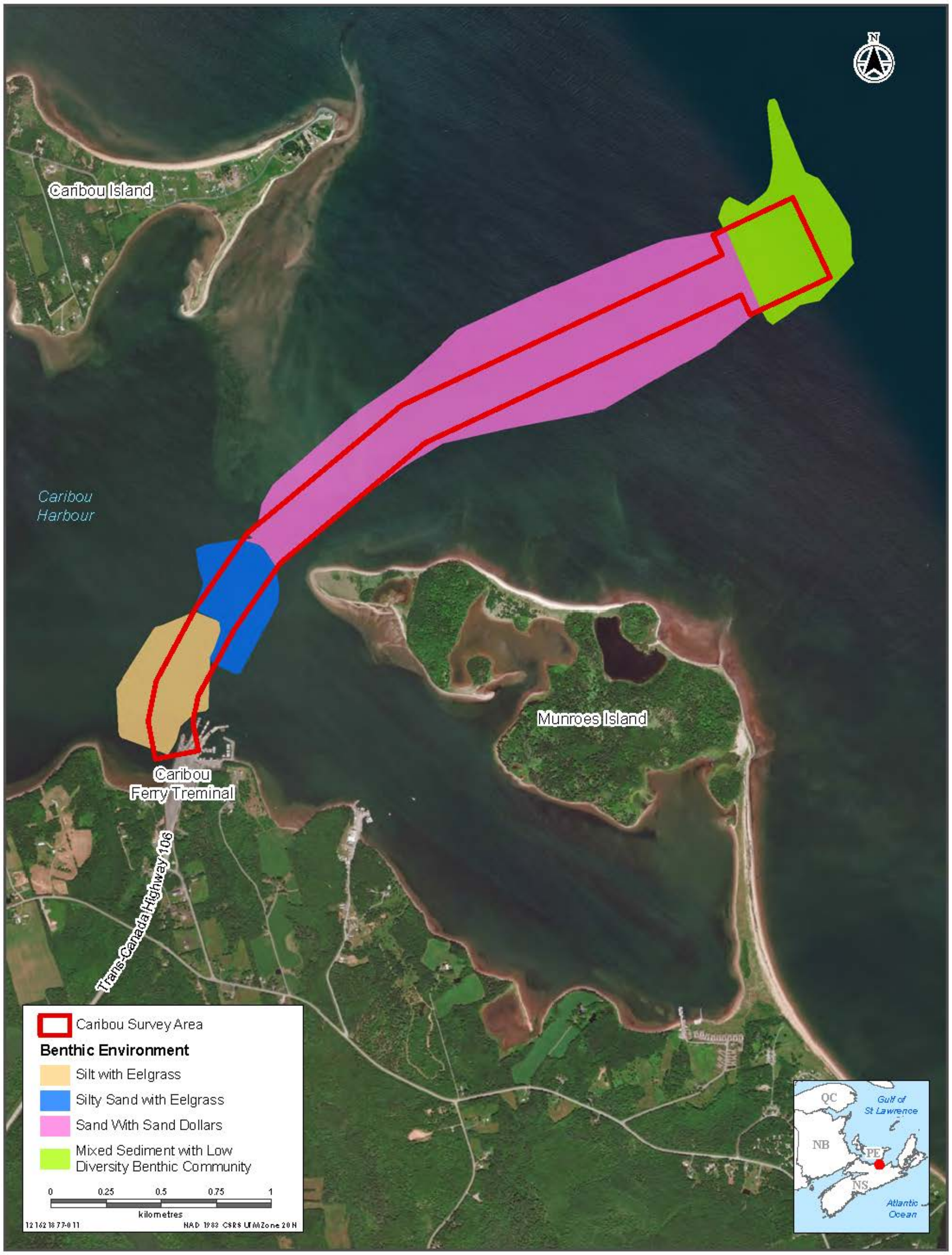


**Figure 3-10: Benthic Habitats Surveyed within Caribou Harbour (Stantec 2019b)**

### 3.5.2 Fish Distribution

The general distribution and occurrence of marine fish and shellfish species was provided in the EARD (Dillon 2019). The following section builds on this information and provides context with respect to marine fish communities within the marine RAA, followed by a more specific inventory of fish and fish habitats that have been documented to occur or are likely to occur due to habitat availability in the LAA. To this end, the following primary sources, which include past Indigenous knowledge, were consulted to create updated distribution and fishery mapping or qualitative inference of fish community presence within the RAA and LAA:

- *Atlas of Ecologically and Commercially Important Areas in the Southern Gulf of St. Lawrence* (JWEL 2001);
- Gulf of St. Lawrence Traditional Knowledge Mapping Series for DFO (J. Lee MacNeil and Associates 1998 in JWEL 2001);
- Species specific status report updated as provided by DFO;
- *Northumberland Strait Fish Assemblages: Patterns and Processes* (Bosman, 2009; M.Sc. Thesis);
- *Identification and Characterization of Important Areas based on Fish and Invertebrate Species in the Coastal Waters of the Southern Gulf of St. Lawrence.* Rondeau et al. (2016);
- *Northumberland Strait Ecosystem Overview Report Moncton, New Brunswick*. AMEC Earth & Environmental (2007).
- *Underwater Benthic Habitat Survey of Caribou Harbour and Pictou Harbour Pipeline Corridors*. (Stantec 2019)

Other sources as applicable were used with respect to particular species of interest and are referenced appropriately. RAA and LAA marine fish and fish habitat mapping is provided in **Figure 3-11** to **Figure 3-15.** Additional Indigenous knowledge is currently being collected by NPNS and will be incorporated as applicable when available.

The marine fish community may include secure species (least concern), as well as Species at Risk (SAR) and Species of Conservation Concern (SOCC), given the availability of appropriate habitat. The SAR species include those listed endangered, threatened, or special concern on Schedule 1 of the federal Species at Risk Act (SARA). The 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.

Marine species that are likely to occur in the RAA may include those provided in **Table 3-10** below. The list also indicates the group within which each species may be classified based on its habitat preferences or life-history traits (i.e. benthic, migratory, forage fish). The current SARA or COSEWIC status is also identified, as well as a ranking of likely occurrence in the LAA. This designation of having a high to low probability of being present within the LAA does not indicate zero potential of a species inhabiting the LAA; rather it is a reasonable representation of the likelihood of a species being present in the LAA based on the following:

1) Species habitat preferences and life history information;
2) LAA specific habitat availability including bathymetry and substrates as further detailed in Stantec (2019b) and Error! Reference source not found.; and,
3) Previous literature indicating the likelihood of species occurrence in the RAA and LAA (Rondeau et al. 2016).

Details including references and rationale and with respect to this ranking is provided in **Appendix D.**

## Table 3-10: Potential Fin Fish Species in the RAA

| Occurrence | Group | Common Name | SARA | COSEWIC | Likely Occurrence in LAA* | Notes | CRA Fishery? |
|---|---|---|---|---|---|---|---|
| Demersal | Benthic | Longhorn Sculpin | No Status | No Status | High | Possible habitat available in LAA | No |
| Demersal | Benthic | Sand Lance | No Status | No Status | High | Possible habitat available in LAA | No |
| Demersal | Benthic | White Hake | No Status | Endangered | High | Habitat available in the LAA for multiple life stages | No |
| Demersal | Benthic | Winter Flounder | No Status | No Status | High | Habitat available in the LAA for multiple life stages | Yes |
| Demersal | Benthic | Winter Skate | No Status | Endangered | High | Possible habitat available in LAA | No |
| Demersal | Benthic | Alligatorfish | No Status | No Status | Low | Inhabits depths greater than LAA | No |
| Demersal | Benthic | Arctic Rockling | No Status | No Status | Low | Inhabits depths greater than LAA | No |
| Demersal | Benthic | Atlantic Plaice | No Status | No Status | Low | Inhabits depths greater than LAA | |
| Demersal | Benthic | Atlantic Halibut | No Status | No Status | Low | Potential use of LAA by larval stages | Yes |
| Demersal | Benthic | Fourbeard Rockling | No Status | No Status | Low | Generally inhabits depths greater than LAA | No |
| Demersal | Benthic | Fourspine Stickleback | No Status | No Status | Low | Possible habitat available in LAA | No |
| Demersal | Benthic | Mailed Sculpin | No Status | No Status | Low | Generally inhabits depths greater than LAA | No |
| Demersal | Benthic | Sea Raven | No Status | No Status | Low | Generally inhabits depths greater than LAA | No |

| Occurrence | Group | Common Name | SARA | COSEWIC | Likely Occurrence in LAA* | Notes | CRA Fishery? |
|---|---|---|---|---|---|---|---|
| Demersal | Benthic | Silver Hake | No Status | No Status | Low | Generally, inhabits depths greater than LAA | No |
| Demersal | Benthic | Snakblenny | No Status | No Status | Low | Generally, inhabits depths greater than LAA | No |
| Demersal | Benthic | Wrymouth | No Status | No Status | Low | Limited soft muddy substrates available within the LAA | No |
| Demersal | Benthic | Yellowtail Flounder | No Status | No Status | Low | Generally, inhabits depths greater than LAA | Yes |
| Demersal | Benthic | Common Ocean Pout | No Status | No Status | Low-medium | Generally, inhabits depths greater than LAA | No |
| Demersal | Benthic | Eelpout | No Status | No Status | Low-medium | Potential use of habitats in LAA, but limited availability in LAA of rocky substrates | No |
| Demersal | Benthic | Fourline Snakeblenny | No Status | No Status | Low-medium | Generally, inhabits depths greater than LAA | No |
| Demersal | Benthic | Greenland Halibut | No Status | No Status | Low-medium | Generally, inhabits depths greater than LAA | Yes |
| Demersal | Benthic | Shorhorn Sculpin | No Status | No Status | Medium-high | Possible habitat available in LAA | No |
| Demersal | Benthic | Windowpane | No Status | No Status | Medium-high | Possible habitat available in LAA | No |
| Demersal | Benthic | Atlantic Tomcod | No Status | No Status | Medium-low | LAA outside the general influence of brackish water | No |
| Demersal | Benthic | Northern Sand Lance | No Status | No Status | Medium-low | Possible habitat available in LAA | No |
| Pelagic | Forage | Gaspereau / Alewife | No Status | No Status | High | Available habitat in LAA | Yes |

| Occurrence | Group | Common Name | SARA | COSEWIC | Likely Occurrence in LAA* | Notes | CRA Fishery? |
|---|---|---|---|---|---|---|---|
| Coastal | Forage | Banded Killifish | No Status | No Status | Low | LAA outside the general influence of brackish water | No |
| Coastal | Forage | Blackspotted Stickleback | No Status | No Status | Low | LAA outside the general influence of brackish water | No |
| Demersal | Forage | Butterfish | No Status | No Status | Low | Generally, inhabits depths greater than LAA | No |
| Pelagic | Forage | Capelin | No Status | No Status | Low | Not in Northumberland Strait | Yes |
| Pelagic | Forage | Mummichog | No Status | No Status | Low | LAA outside the general influence of brackish water, limited sheltered shoreline habitat available in the LAA | No |
| Coastal | Forage | Atlantic Silverside | No Status | No Status | Low-medium | LAA outside the general influence of brackish water | No |
| Coastal | Forage | Northern Pipefish | No Status | No Status | Low-medium | LAA outside the general influence of brackish water | No |
| Coastal | Forage | Cunner | No Status | No Status | Medium | Limited nearshore structure available near ferry terminal and Pictou causeway | No |
| Coastal | Forage | Threespine Stickleback | No Status | No Status | Medium-high | Possible habitat available in LAA | No |
| Coastal | Forage | Ninespine Stickleback | No Status | No Status | Medium-low | Possible movement into LAA from river habitats | No |
| Pelagic | Migratory | Atlantic Herring | No Status | No Status | High | Migratory and passing through the LAA to spawning areas, limited spawning habitat within the LAA | Yes |
| Pelagic | Migratory | Atlantic Mackerel | No Status | No Status | High | Habitat available in the LAA for multiple life stages | Yes |
| Pelagic | Migratory | Atlantic Bluefin Tuna | No Status | Endangered | Low | Migratory and passing through the LAA to feed | Yes |

| Occurrence | Group | Common Name | SARA | COSEWIC | Likely Occurrence in LAA* | Notes | CRA Fishery? |
|---|---|---|---|---|---|---|---|
| Coastal | Migratory | Rainbow Trout | No Status | No Status | Low | Introduced/invasive, not considered to be self-sustaining in Northumberland Strait | Yes |
| Pelagic | Migratory | Atlantic Salmon | No Status | Special Concern | Low-medium | Migratory and passing through the LAA to access spawning rivers and/or to feed as juveniles or adults during at sea stage | Yes |
| Coastal | Migratory | Brook Trout | No Status | No Status | Low-medium | Possible movement into LAA from river habitats | Yes |
| Demersal | Migratory | Atlantic Cod | No Status | Endangered | Medium | LAA possible migratory route and juvenile habitat | No |
| Demersal | Migratory | Greenland Cod | No Status | No Status | Medium | LAA possible migratory route and juvenile habitat | No |
| Coastal | Migratory | American Eel | No Status | Threatened | Medium-low | Migratory and passing through the LAA to spawning areas | Yes |
| Coastal | Migratory | Atlantic Striped Bass | No Status | Threatened | Medium-low | Migratory and passing through the LAA to spawning areas | Yes |
| Coastal | Migratory-Forage | Rainbow Smelt | No Status | No Status | High | Resident Feeding/nursery | Yes |

**Notes:**

* - based on the presence or proportional amount of available preferred habitat in the LAA as described by Caribou Harbour and Pictour Harbour Bathymetry and/or Stantec (2019b), Rondeau et al. 2016

CRA – Commercial, Recreational or Aboriginal Fishery in the RAA (Yes/No)

No marine fin-fish SAR are identified for the LAA, however, several species have been identified as SOCC that may inhabit the area including White Hake, Winter Skate, American Eel, Atlantic Striped Bass and Atlantic Bluefin Tuna.

Fin-fish species with a reasonable likelihood of being present (medium-low to high) in the LAA based on the criteria identified above are listed below.

**Table 3-11: Fin-fish Species Likely to Inhabit the Study Area**

| Group | Common Name | Likely Occurrence in LAA[2] | CRA Fishery? |
|---|---|---|---|
| Benthic | Longhorn Sculpin | High | No |
| Benthic | Sand Lance | High | No |
| Benthic | White Hake | High | No |
| Benthic | Winter Flounder | High | Yes |
| Benthic | Winter Skate | High | No |
| Benthic | Shorhorn Sculpin | Medium-high | No |
| Benthic | Windowpane | Medium-high | No |
| Benthic | Atlantic Tomcod | Medium-low | No |
| Benthic | Northern Sand Lance | Medium-low | No |
| Forage | Gaspereau / Alewife | High | Yes |
| Forage | Cunner | Medium | No |
| Forage | Threespine Stickleback | Medium-high | No |
| Forage | Ninespine Stickleback | Medium-low | No |
| Migratory | Atlantic Herring | High | Yes |
| Migratory | Atlantic Mackerel | High | Yes |
| Migratory | Atlantic Cod | Medium | No |
| Migratory | Greenland Cod | Medium | No |
| Migratory | American Eel | Medium-low | Yes |
| Migratory | Atlantic Striped Bass | Medium-low | Yes |
| Migratory-Forage | Rainbow Smelt | High | Yes |

## 3.6 Commercial, Recreational and Indigenous Fisheries Resources and Use in the Study Area

Recent surveys of local resource users indicated the following species of fish and/or shellfish have been harvested in the past year and specific to local sourced resources. Further information specific to fisheries is provided below.

**Table 3-12: Local Fisheries Resource Harvest Activity**

| Fish / Shellfish | Percent of individuals surveyed harvested |
|---|---|
| Lobster | 54% |
| Mussels | 22% |
| Mackerel | 19% |
| Oysters | 18% |
| Quahog (Surf Clam) | 18% |
| Brook Trout (Speckle) | 12% |
| Brown Trout | 12% |
| Scallops | 11% |
| Striped Bass | 10% |
| Atlantic Salmon | 10% |
| Lake Trout | 10% |
| Rainbow Trout | 9% |
| Soft Clam | 8% |
| Haddock | 7% |
| Don't know (VOL) | 6% |
| Other Clam | 5% |
| Smelt | 4% |
| Crab | 4% |
| Other Bass | 3% |

### 3.6.1 Commercial Fisheries

Commercially harvest fish species were described previously in the EARD (Dillon 2019). 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.

For the purposes of this assessment, distribution and commercial and Indigenous fishery information was incorporated as described in **Section 3.5.2** and in **Figures 3-11** to **Figure**

**3-15.** These were further assessed for the likelihood of known resource use being in contact with the LAA (physical interaction of pipeline and diffuser infrastructure with the resource use area, and/or within proximity (200 m to 1 km) to the diffuser location.

**Lobster**

American Lobster constitutes as large proportion of the commercial and Indigenous fisheries in Caribou Harbour and Pictou Harbour. The distribution of lobster at larval, juvenile and adult life-stages includes both Caribou Harbour and Pictou Harbour and therefore is of importance with respect to potential effects from the proposed pipeline and diffuser. **Figure 3-11** depicts the current understanding of the distribution and commercial/Indigenous harvest area of the adult American Lobster resource in the LAA. The pipeline would traverse the Scallop Buffer Zone, SFA 24, which is an area of prohibition of Scallop fishing designed to protect Lobster nursery habitat and therefore population recruitment. The proposed pipeline route and diffuser location will have a direct interaction with the Lobster fishery resource. Further discussion with respect to potential effects of the project on Lobster of larval and adult life stages is provided in **Sections 4.1.3, 4.1.5 and 4.1.6.**

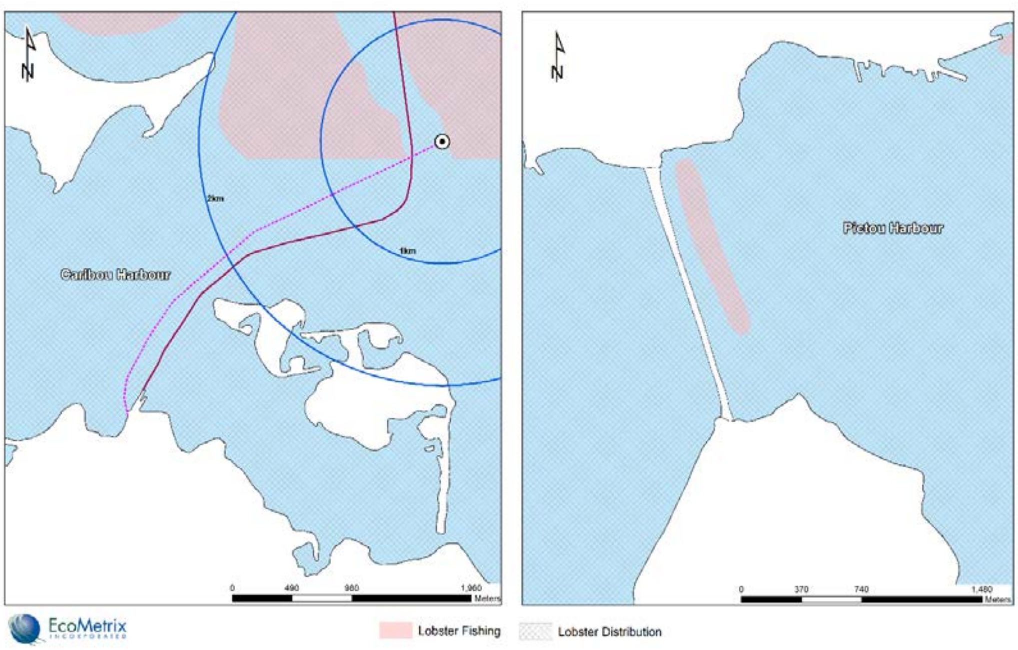


**Figure 3-11: Lobster distribution and harvest areas in the LAA**

### Mackerel and Herring

Atlantic Mackerel and Atlantic Herring resources in the LAA are limited to the outer Caribou Harbour / Northumberland Strait where depths approach 10 m and greater. The nearest Atlantic Mackerel harvest area is well outside the proposed pipeline route and greater than 2 km northwest of the proposed diffuser location. However, the proposed pipeline route will directly interact with the known Atlantic Herring resource (**Figure 3-12**)

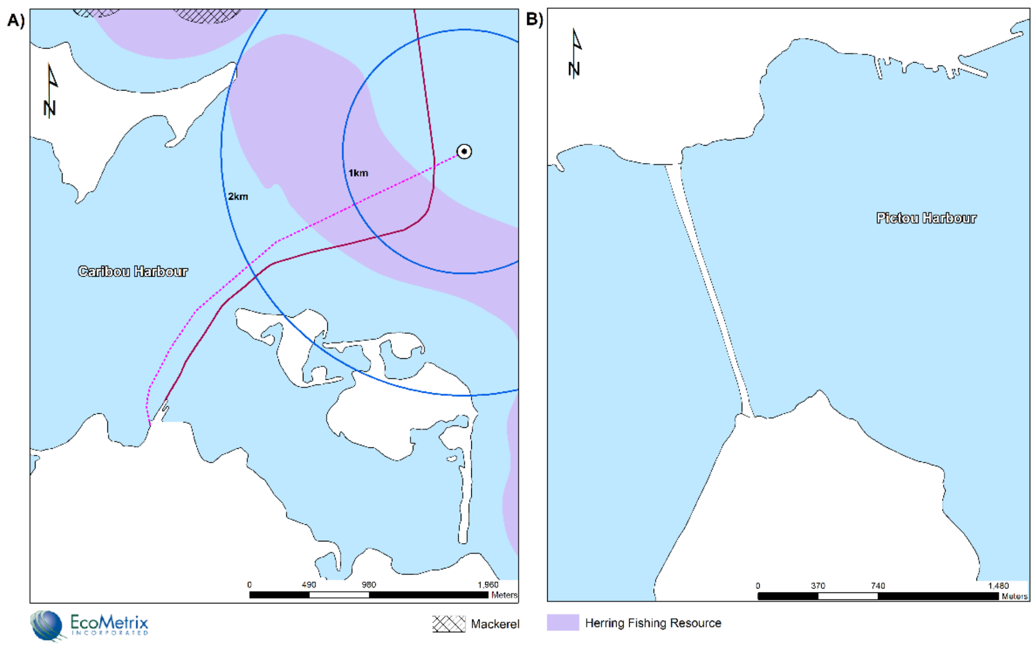


**Figure 3-12: Atlantic Mackerel and Atlantic Herring distribution and harvest areas**

### Plaice and Winter Flounder

Atlantic Plaice and Winter Flounder resources in the RAA are generally concentrated outside the proposed project LAA with both species occurring greater than 2 km beyond the diffuser location and associated with the northern shoreline of Caribou Island (**Figure 3-13**).

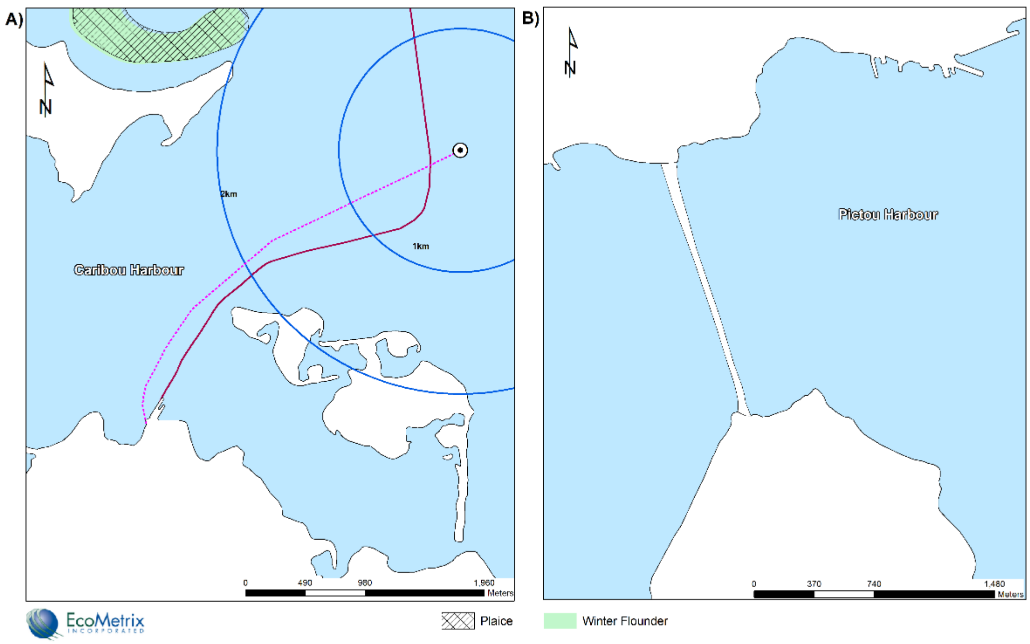


**Figure 3-13: Atlantic Plaice and Winter Flounder distribution and harvest areas**

**Scallop and Rock Crab**

Since 2014, a Scallop Buffer Zone in Scallop Fishing Area (SFA) 24 has prevented scallop fishing in the LAA. Scallop Buffer Zones SFA 24 is part of a system of Scallop Buffer Zones 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). The proposed 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 diffuser is outside the Scallop Buffer Zone but not within the area generally identified as used for Scallop harvesting (**Figure 3-14(A)**). Although not identified in great abundance along the proposed pipeline, Scallop was present and such habitat will directly interact with the proposed project.

Rock Crab represents one of the most important species harvested in the LAA by commercial and Indigenous fishers. Rock Crab is fished within Caribou Harbour along a majority of the proposed pipeline corridor, yet not at greater depths > 10 m based on bathymetry provided by Stantec (2019b) or in the vicinity of the diffuser location. The proposed project will directly interact with the Rock Crab resource.

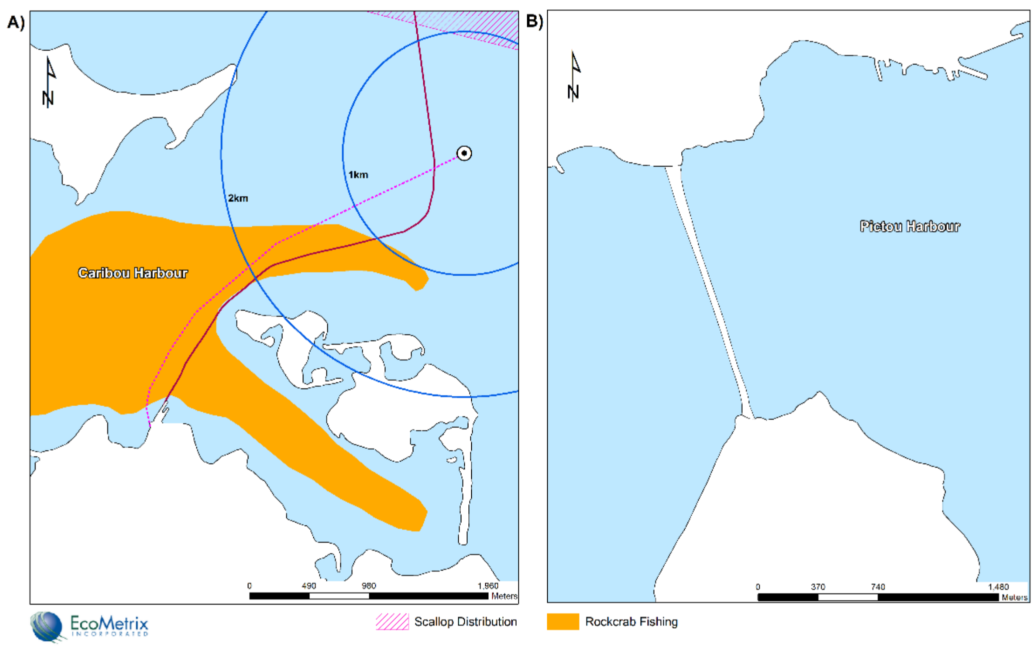


**Figure 3-14: Scallop and Rock Crab distribution and harvest areas**

### Seaweed

Seaweed harvest areas within the LAA are represented in **Figure 3-15**. The most harvested species of seaweed in the Maritimes historically has been Irish Moss (*Chondrus crispus*), brown alga "Rockweed" (*Ascophyllum nodosum*) and dulse (*Palmaria palmata*). More recently aquaculture of these and other marketable species have emerged (i.e. Nova Scotia Sea Parsley).

Current records of ongoing seaweed harvest and aquaculture within the area identified in **Figure 3-15** were not available. However, based on the available information, the area identified as providing seaweed harvesting opportunities will have direct interaction with the pipeline route yet is greater than 500 m outside the diffuser location.

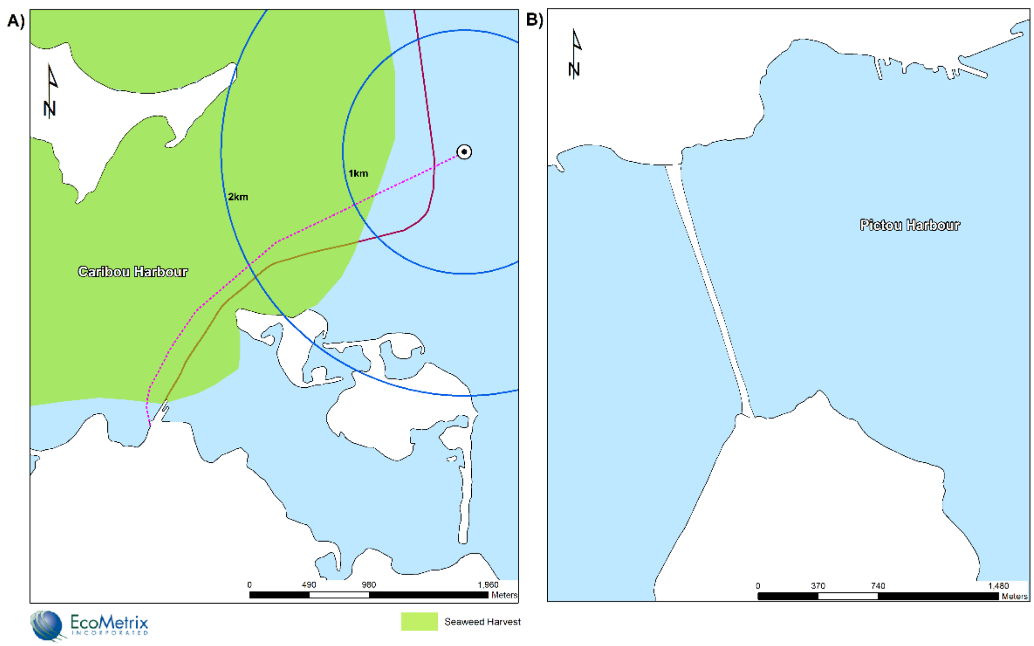


**Figure 3-15: Seaweed Harvest Areas**

### 3.6.2 Recreational Fisheries

Recreational fisheries exist in the study for several species including the following:

- Atlantic salmon – catch and release limit of 4 salmon during the open salmon fishing season;
- Shellfish - soft-shell clam, bar clam, quahaug, mussel, razor clam, scallop, oyster (as directed by bag limits and closure notices);
- Groundfish – including Atlantic Cod and White Hake to an aggregate of 15 per person;
- Atlantic Striped Bass – subject to stipulations of fishing only beginning 2 hours before sunrise and ending 2 hours after sunset in tidal waters and during the season stipulated by the DFO. A bag limit of 3 Stiped Bass using appropriate capture gear. The size window for the retention fishery is a minimal length of 50 cm and a maximum length of 65 cm.
- Atlantic Mackerel - The minimum length for mackerel in the commercial and recreational fisheries in the southern Gulf of St. Lawrence has been changed from 26.3 cm to 26.8 cm. There is no limit to the number of legal sized fish that can be taken.

### 3.6.3 Indigenous Fisheries

**Information to be provided following the completion and reporting of First Nation resource use survey.**

#### 3.6.3.1 Commercial Fishery

**Information to be provided following the completion and reporting of First Nation resource use survey.**

#### 3.6.3.2 Consumption Fishery

**Information to be provided following the completion and reporting of First Nation resource use survey.**

#### 3.6.3.3 Ceremonial Fishery

**Information to be provided following the completion and reporting of First Nation resource use survey.**

# 4.0 EFFECTS ASSESSMENT AND MITIGATION

## 4.1 Methodology

### 4.1.1 Spatial and Temporal Boundaries of the Assessment

It is necessary to define appropriate spatial and temporal boundaries relevant to the scale of the Project to assess potential Project-environment interactions and subsequently evaluate potential effects.

The spatial boundary for the assessment is depicted in **Figure 1-1** as follows:

- **Marine regional assessment area (RAA)** – The area inclusive of Pictou Harbour, Caribou Harbour and the south-eastern portion of the Northumberland Strait adjacent to the Marine local assessment area. This area provides the regional context within which the Project is located and the assessment of potential effects is considered.

- M**arine local assessment area (LAA)** - The area surrounding the confirmed pipeline footprint (within 200 m on either side of the linear pipeline footprint) and the effluent diffuser area (within a 200 m radius around the effluent discharge point). This includes the marine environment that is predicted to be exposed to relative effluent concentrations exceeding 1% that based on conservative predictive modeling will occur within 20 m of the discharge. Beyond such relative concentrations, actual constituent concentrations are practically indistinguishable from ambient conditions. At a distance of 200 m from the discharge the relative effluent concentration is conservatively predicted to be approximately 0.6%. This area provides the local context within which the Project is located and the assessment of potential effects is considered.

A description of the project phases and associated activities (including conceptual drawings) is provided in Section 5.3 of the EARD (Dillon, 2019). Below is a listing of the project phases and associated activities that may have some interaction with the marine environment and specific to the LAA is provided (**Table 4-1**).

The temporal boundaries for the proposed Project are defined by the duration of the individual Project phases - Construction and Commissioning, Operations, and Decommissioning. The timelines associated with each Project phase are shown in **Table 4-1**.

**Table 4-1: Project Phases, Schedule and Potential Interactions with Marine Environment (as per Table 5.4-1 of EARD)**

| Phase | Activity | Duration | Interaction with Marine Environment | Description of Interaction |
|---|---|---|---|---|
| Construction | Establishment of marine based staging area for temporary pipe and project vessel storage | 21 Months (weather dependent) | ✓ | Potential machinery/material spills, habitat disturbance by in-water infrastructure |
| | Final geotechnical investigations, marine seismic, and confirmation of marine pipeline alignment | 3 months | ✓ | Habitat disturbance during geo-technical studies, high intensity sounds |
| | Open-cut trenching and side-casting or disposal of material | 8 to 10 months | ✓ | Habitat disturbance, sedimentation, high intensity sounds |
| | Pipeline installation | | ✓ | |
| | Backfilling and grading | | ✓ | |
| | Land-marine pipeline connection – gravel access causeway construction (intertidal zone) | | ✓ | Habitat overprinting, habitat disturbance, sedimentation, high intensity sounds |
| | Land-marine pipeline connection trench excavation | | ✓ | Habitat disturbance, sedimentation, high intensity sounds |

| Phase | Activity | Duration | Interaction with Marine Environment | Description of Interaction |
|---|---|---|---|---|
| | Marine Outfall Construction – underwater welding | | ✓ | Habitat disturbance, sedimentation, high intensity sounds |
| | Pipeline Testing and Commissioning | 1 to 3 months | ✓ | Potential habitat disturbance |
| | Environmental Inspections | 21 Months (continuous throughout construction phase) | ✓ | Potential habitat disturbance |
| Operations and Maintenance | Discharge of treated pulp and paper effluent to the marine environment. | Commencing in 2021 for several decades | ✓ | Potential changes to water quality and therefore fish habitat including sedimentation |
| | Ongoing repair and maintenance of the constructed pipeline as necessary (possibly including incremental replacement of individual components) | Commencing in 2021 for several decades | ✓ | Habitat disturbance, sedimentation, high intensity sounds |
| | Regular outfall and diffuser operation, inspection and maintenance – SCUBA diver team inspections and repair as necessary | | ✓ | Habitat disturbance, sedimentation, high intensity sounds |
| Decommissioning | Removal of marine diffuser ports | Decommissioning of the ETF replacement will | ✓ | Habitat disturbance, sedimentation, |

| Phase | Activity | Duration | Interaction with Marine Environment | Description of Interaction |
|---|---|---|---|---|
| | | be conducted following the end of the useful service life of the project components or at the end of the life of the NPNS facility, whichever comes first. Decommissioning is assumed to have a duration of up to a year for the purposes of this assessment. | | high intensity sounds |
| | Capping of pipeline at terminus | | ✓ | Habitat disturbance, sedimentation, high intensity sounds |

### 4.1.2 Identification of Valued Ecosystem Components

A Valued Ecosystem Component or VEC can be defined as:

> *"an environmental element of an ecosystem that is identified as having scientific, ecological, social, cultural, economic, historical, archaeological or aesthetic importance. The value of an ecosystem component may be determined on the basis of cultural ideals or scientific concern."*

In practical terms a VEC is some component of the environment that has some "value" (where value could be inherent, or could be ascribed to it by an individual, community, society, etc.) and can be measured (either quantitatively or qualitatively).

VECs are tools that are used to measure the potential effects of a project on the environment. Given the large number of species, habitats and other ecosystem elements that could potentially occur within the EA study area, it is neither possible, nor particularly useful, to attempt to measure effects on all possible receptors. Rather, the impact assessment focuses on those ecosystem elements that have been deemed to be of some importance (i.e., the VECs).

For the purposes of this assessment VECs were selected based on:

- prior experience with similar projects;
- data that were collected as part of the baseline environmental program;
- information available with regards to species that are afforded protection by legislation;
- guidance from regulatory agencies; and,
- direct engagement with stakeholders and Indigenous communities.

For the purpose of the assessment, the overall VEC "Marine Fish and Fish Habitat" has been assessed. This VEC is comprised of a large number of ecological components and does not adequately reflect the biological complexity of the study area from the perspective of the assessment. In order to assess potential Project-related effects in a more fulsome manner, the VEC "Marine Fish and Fish Habitat" has been subdivided into several classes, and each class is further represented by a number of indicators. The proposed indicators are consistent with ecological, socio-economic, and Indigenous valued species and habitats. The classes and indicators are consistent with the previous assessment of groups, species or habitats that are likely to occur in the study area (see Sections **3.5.1, 3.5.2** and **3.6**). The classes and indicators associated with the VEC "Marine Fish and Fish Habitat" are presented in **Tables 4-2** below.

**Table 4-2: Proposed Key Indicators Specific to the Marine Fish and Fish Habitat VEC**

| Class | Group | Indicator | Rationale |
|---|---|---|---|
| Marine Fin-Fish | Benthic | White Hake | SOCC, Habitat available in the LAA for multiple life stages, recreational fishery |
| | Benthic | Winter Flounder | Habitat potentially available in the RAA for multiple life stages |
| | Benthic | Winter Skate | SOCC, possible habitat available in the RAA |
| | Migratory-Forage | Rainbow Smelt | Commercial and Indigenous Fisheries, harvested in the RAA |
| | Migratory | Atlantic Herring | Commercial and Indigenous Fisheries, harvested in the RAA |
| | Migratory | Atlantic Mackerel | Commercial, recreational and Indigenous Fisheries, harvested in the RAA |
| | Migratory | Atlantic Cod | recreational and Indigenous Fisheries, harvested in the RAA |
| | Migratory | American Eel | SOCC, Commercial (freshwater) and Indigenous fisheries |
| | Migratory | Atlantic Striped Bass | SOCC, recreational and Indigenous fishery |
| | Migratory | Atlantic Salmon | SOCC, recreational and Indigenous fishery, traditional sustenance species for the local First Nations |
| | Migratory | Atlantic Bluefin Tuna | SOCC, Targeted by commercial, recreational and Indigenous fisheries |
| Marine Shellfish | Crustacean | Rock Crab | Rock Crab represents one of the most important species harvested in the LAA by commercial and Indigenous fisheries |
| | Crustacean | American Lobster | Constitutes a large proportion of the commercial and Indigenous fisheries in Caribou Harbour and Pictou Harbour |
| | Shellfish | Sea Scallop | Targeted by commercial, recreational and Indigenous fisheries. Present in the LAA. |
| | | Soft-Shell, Bar, Razor Clams | Targeted by commercial, recreational and Indigenous fisheries |
| | | Blue Mussel | Targeted by recreational and Indigenous fisheries, commercial aquaculture, locally harvested. Important indicator of water quality and species that can be monitored post construction. |
| | | Oyster | Targeted by recreational and Indigenous fisheries |

| Class | Group | Indicator | Rationale |
|---|---|---|---|
| | | Quahaug | Targeted by recreational and Indigenous fisheries |
| Plankton | Phytoplankton | Phytoplankton abundance and diversity | Important indicator of water quality and primary production for local marine environment. Important indicator of water quality and can be consistently monitored post construction. |
| | Zooplankton | Zooplankton abundance and diversity | Important indicator of water quality and lower trophic level production in the local marine environment. Important indicator of water quality and can be consistently monitored post construction. |
| Benthic Invertebrates | Benthic Invertebrates | Benthic Invertebrate Community (BIC) | BIC important to sustaining the forage base for benthic fish species, and important indicators of sediment and water quality. |
| Marine Vegetation | Seaweed | Seaweed | Historic commercial harvest for seaweed in RAA |
| Marine Fish Habitat | Vegetation / Cover | Eel Grass Beds | Eelgrass beds are important habitat for stabilization for sediments and providing cover and protection for many marine species including SOCC (i.e., White Hake). Often associated with finer substrate materials in the LAA. |
| | Substrates / Cover | Cobble/rock | A less common substrate type within the study area which provides important cover, spawning, and nursery habitat to multiple species. |
| | Substrates / Cover | Sand / silt / gravel | The majority by area of the LAA consists of varying proportions of sand with silts and gravel. Represents the most abundant habitat type for marine species in the LAA. |
| | Water Quality | Receiving Environment Water Quality | Water quality within the context of baseline condition for contaminants of potential concern (COPCs) qualitatively and/or quantitatively compared to the predicted concentrations of COPCs in the effluent to identify potential impacts to aquatic biota. |

### 4.1.3 Project-Environment Interactions

The Marine fish and fish habitat VEC may be directly or indirectly impacted by activities and components of the project during construction, operation, maintenance, and decommissioning. Potential changes to the marine environment have the potential to impact fish species and fish habitat associated with one or many life stages thereby influencing fish populations. The impact assessment for the marine environment is focused on the direct mortality of fish (death of fish), sublethal effects to fish by which a stressor they affect some aspect of fish development, and/or the harmful alteration, disruption or destruction of fish habitats (HADD). Major categories of interactions are physical and related emissions. These are further discussed in the sections below.

#### 4.1.3.1 Potential Effects Arising from Physical Interactions

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 LAA and could experience mortality as a result of smothering or crushing (Dillon 2019).

The construction of marine-based infrastructure may affect marine benthic invertebrates, fish and fish habitat through a change the substrate particle size and distribution, available fish cover, change in water and sediment quality, or changes to acoustic quality. As such, the excavation, installation and back-filling portions of the construction phase will have a direct impact to the marine environment.

Sediment quality may be impacted as the disturbance of substrates through dredging / excavation. These activities may mobilize finer particles into suspension (Total Suspended Solids) and increasing the potential for sedimentation within the area. Increases in TSS and sedimentation can affect the life stages of all marine flora and fauna through reduced respiratory function, reduced feeding and changes to spawning and nursery habitat substrates. Background sediment quality, as identified by Stantec (2019a), was above CCME guideline criteria for some parameters both at surface and at depth. Redistribution of these sediments both vertically and horizontally may change the current state of sediment quality along the proposed pipeline corridor and diffuser location. Furthermore, disturbance of buried sediments can remobilize some parameters previously not bioavailable.

During construction and decommissioning vessel noise will be concentrated within the LAA and the majority of the anthropogenic sound in the marine environment generated will originate through trenching, pipe laying and backfilling. Acoustic disturbance would also be caused in the event that blasting is needed during the construction phase. Sound emitted to the marine environment during the construction phase has the potential to temporarily reduce the quality of fish and fish habitat in the marine LAA.

Continued interactions with the marine environment may occur during the operations and maintenance phases as routine repair and maintenance of the constructed pipeline as necessary (possibly including incremental replacement of individual components), as well as regular outfall and diffuser inspection and maintenance will be necessary. These activities may include the excavation of components for replacement thereby causing effects similar to the initial construction yet on a smaller scale (magnitude) and duration.

No sediment transport features were observed in the immediate vicinity of the proposed outfall area which, CSR concluded, may indicate an increase in gravel within the surficial sediments at this location (CSR 2019). Given this, and the 1 m height of diffuser ports above the seafloor, interactions of effluent sediments with marine sediments is expected to be minimal and entrainment of benthic sediment into the effluent plume is extremely unlikely.

These potential effects are assessed in more detail in **Sections 4.1.3.2** to **4.1.5**

#### 4.1.3.2 Potential Effects Arising from Project-Related Emissions

Project-related emissions for the purposes of this assessment are specific to the discharge of the treated effluent from the proposed ETF. For the purposes of this assessment the quality of treated effluent from the proposed ETF is considered to be consistent with the effluent currently discharged from the Boat Harbour facility at Point C.

A comparison of the chemical constituents of untreated and treated effluent to published effluent composition data showed that the mill's effluent shows no appreciable difference from effluent characteristics from other bleached kraft mills (KSH, 2019). An analysis of the current system's performance indicates that it provides effective treatment and is comparable, performance wise, to other mills in Canada and elsewhere. Based on its design criteria, the future ETF would also be expected to provide performance that is comparable to other mills in Canada and elsewhere, and it will meet the discharge quality limits prescribed by the federal PPERs[4] and the mill's provincial approval for its current effluent discharge. It is therefore quite reasonable, since current and future systems have comparable performance that Point C can be used as a credible and conservative representation of what the effluent from the new ETF will resemble (KSH 2019).

To investigate the potential impacts of the treated effluent when discharged to the proposed diffuser location in Caribou Harbour / Northumberland Strait, an assessment of the potential Contaminants of Potential Concern (COPCs) in the future treated effluent was carried out. The results of the approach are provided in **Appendix E**. Parameters analyzed in current effluent samples collected from the current compliance point of the ETC, Point C, in Boat Harbour, were used as the initial list of candidate parameters for the identification of the future effluent COPCs.

[4] The federal PPERs are currently under review and will likely see the reduction of allowable discharge limits for existing parameters and the adoption of limits for new parameters. Based on the current understanding of these pending changes the ETF effluent will meet the revised and new standards.

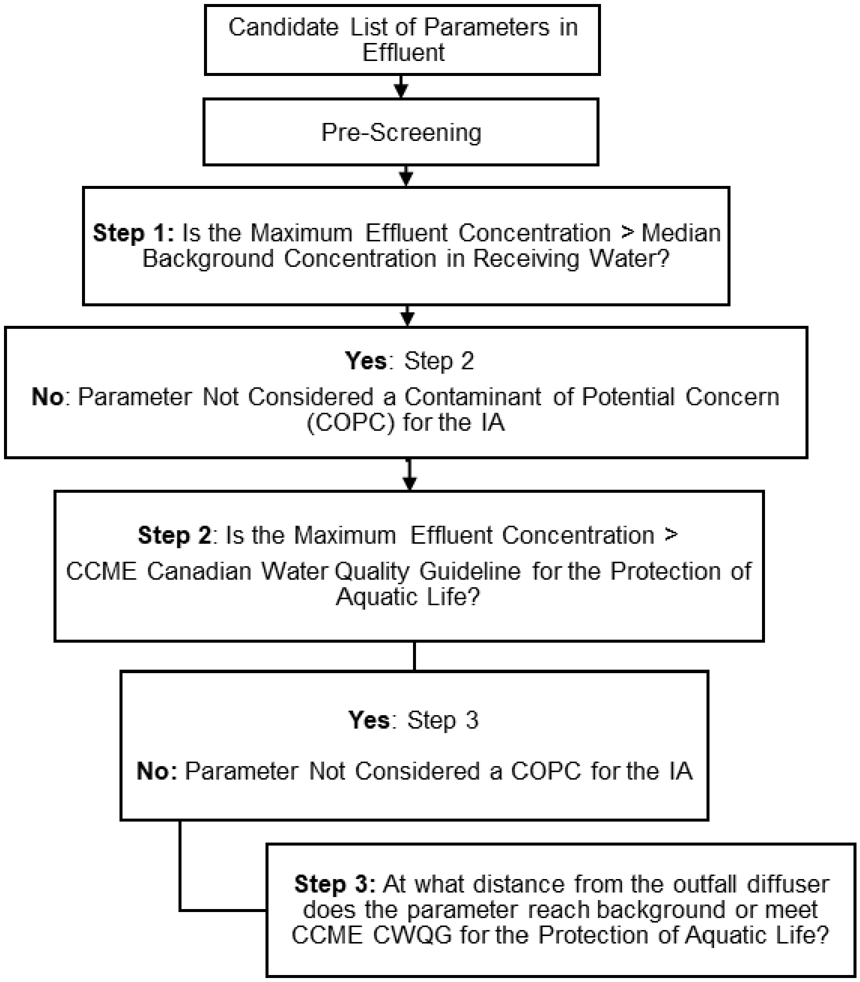


**Figure 4-1: Overview of Process for Identifying COPCs in Treated Effluent**

Parameters that were represented by others were removed. For example, the parameter AOX is representative of, or a surrogate for chlorinated compounds and as such is not used to assess parameter specific effects. Parameters with concentrations greater than the median background concentration, based on samples from the proposed diffuser area, or with no background concentration to compare to, were identified as possible future effluent COPCs, to be further screened against CCME Canadian Water Quality Guidelines (CWQG) for the Protection of Aquatic Life. The current treated effluent is a reasonable representation of the future treated effluent: the current treated effluent is comparable to other mills' effluent and the future ETF is expected to have comparable performance to other pulp and paper mills' treatment systems in Canada (KSH 2019).The summary of all the parameters, which when screened had maximum concentrations in the representative effluent greater than background is provided in **Appendix E**.

The groups of chemicals which had maximum concentrations in the effluent greater than the median background condition included:

- Alkalinity
- Total Phosphorus
- Orthophosphate
- Total Nitrogen and Ammonia (as N)
- Sulphide
- AOX
- Total Dioxins and Furans (see Appendix E for list of individual parameters)
- Fatty Acids (see Appendix E for list of individual parameters)
- pH
- Total Organic Carbon (TOC)
- Dissolved Organic Carbon (DOC)
- Total Suspended Solids (TSS)
- Turbidity
- Total Metals including Aluminum, Barium, Cadmium, Copper, Iron, Manganese, Mercury, Zinc
- Biochemical Oxygen Demand
- Petroleum Hydrocarbons (see Appendix E for list of individual parameters)
- Phenols (see Appendix E for list of individual parameters)
- PAHs (see Appendix E for list of individual parameters)
- Resin Acids (see Appendix E for list of individual parameters)
- VOCs including 1,1-Dichloroethylene, Ethylene Dibromide, Toluene

3-D modelling (Cormix) (Stantec 2019c) was conducted for a representative subset of these parameters. Modelling was undertaken to predict the concentration of parameters within the immediate vicinity of diffuser (i.e. 5 m) to represent a maximum exposure case, and at a relatively short distance (100 m) from the diffuser in order to encompass the area in which it is expected that water quality will be at background or ambient levels.

The results of these model estimates are provided in **Table 4-3** and are based on updated oceanographic data collected in 2019 and water quality data collected near the proposed diffuser location in 2018 and 2019.

For those parameters where a direct model analysis was not undertaken, the dilution factors as calculated by CORMIX (Stantec 2019c) for a representative parameter in the effluent with a concentration of 100 mg/L and assuming to have a linear rate of degradation due to mixing, were used. In these cases, the values provided in **Table 4-3** were calculated as:

Concentration of Parameter of interest / Dilution factor at distance

The dilution ratios at a particular distance are identified in this report specific to the 3D Cormix model identified as “Run B” in Stantec (2019c). This particular run was chosen as it was identified as representing the estimated dilution under the summer condition which has been identified as providing the most conservative estimate of mixing, and can therefore be considered the bounding scenario from that perspective.

As shown by MIKE 21 2D modelling presented in Stantec (2019c), effluent dispersion in winter is very similar to summer. Therefore, CORMIX modelling was undertaken for effluent quality parameters under conservative summer conditions. Open water (summer) conditions persist for a longer period in the year compared to the presence of ice. Temperature, however, was modelled in CORMIX as described in Stantec (2019c) for both winter and summer conditions because it could be of interest with respect to potential thermal impacts from sudden changes in temperature and thermal shock to marine organisms by the effluent temperature.

Furthermore, “Run B” utilized the July 2019 daily average of lowest hourly velocities with respect to tidal currents, thereby further representing the most conservative approach with respect to the ability for dilution to be reached in the mixing zone at any one point in time. The dilution factors as provided by this model are provided below in **Table 4-4**.

**Table 4-3: Marine Water Quality COPCs and Estimated Dilution**

| Parameter | Unit | CWQG (Marine) | Median Background Quality | | Maximum Effluent Quality (Point C) | Concentration at 5 m from Diffuser based on Dilution Ratios | Concentration at 100 m from Diffuser based on Dilution Ratios | Distance (m) from Diffuser Ambient Condition is Reached based on Dilution Ratios |
|---|---|---|---|---|---|---|---|---|
| | | | 2018 Value | 2019 Value | | | | |
| Effluent Flow | $m^3/s$ | | | | 0.984 | | | |
| Adsorbable Organic Halides (AOX) | mg/L | | n/a | n/a | 7.8 | 0.15 | 0.05 | n/a |
| Total Nitrogen (TN) | mg/L | | 0.24 | 0.17 | 15 | 0.46 | 0.17 | < 20 m |
| Total Phosphorus (TP) | mg/L | | 0.35 | 0.5 | 1.5 | 0.52 | 0.5 | < 2 m |
| Colour | TCU | | 10.8 | 4.5 | 750 | 19.0 | 5.1 | < 200 m |
| Chemical Oxygen Demand (COD) | mg/L | | n/a | n/a | 497 | 9.7 | 3.4 | n/a |
| Biochemical Oxygen Demand ($BOD_5$) | mg/L | | n/a | 2.5 | 29 | 3.02 | 2.5 | < 2 m |
| Total Suspended Solids (TSS) | mg/L | 5[1] | 8.5 | 2.5 | 42 | 3.3 | 2.5 | < 2 m |
| Dissolved Oxygen (DO) | mg/L | > 8.0[2] | 7.2 | 9.7 | 1.5 | 9.5 | 9.7 | < 2 m |
| pH | - | 7.0–8.7[3] | 8 | 7.8 | 7.7 | 7.8 | 7.8 | < 2 m |
| Temperature (summer) | °C | Narrative[4] | 17.6 | 16.8 | 35 | 17.2 | 16.8 | < 2 m |
| Temperature (winter) | °C | Narrative[4] | 0 | 1 | 35 | 1.5 | 1.0 | < 2 m |
| Salinity | g/L | Narrative[5] | 28 | 30 | 2 | 29.5 | 30.0 | < 2 m |
| Aluminum | µg/l | NG | | 50 | 2330 | 50 | 50 | < 2 m |

| Parameter | Unit | CWQG (Marine) | Median Background Quality | | Maximum Effluent Quality (Point C) | Concentration at 5 m from Diffuser based on Dilution Ratios | Concentration at 100 m from Diffuser based on Dilution Ratios | Distance (m) from Diffuser Ambient Condition is Reached based on Dilution Ratios |
|---|---|---|---|---|---|---|---|---|
| | | | 2018 Value | 2019 Value | | | | |
| Barium | µg/l | NG | | 10 | 450 | 10 | 10 | < 2 m |
| Cadmium | µg/l | 0.12 | n/a | 0.084 | 1.03 | 0.10 | 0.084 | < 2 m |
| Copper | µg/l | NG | | 5 | 7.5 | 5 | 5 | < 2 m |
| Iron | µg/l | NG | | 500 | 718 | ≤ 500 | ≤ 500 | < 2 m |
| Manganese | µg/l | NG | | 20 | 2800 | 54 | 19 | ≈ 50 m |
| Mercury | µg/l | 0.016 | | 0 | 0.028 | 0.028 | 0.028 | < 2 m |
| Zinc | µg/l | | | 50 | 160 | 50 | 50 | < 2m |
| Total Dioxins & Furans | pg/l | | n/a | 3.213 | 3.675 | 3.22 | 3.213 | < 2 m |
| Phenanthrene (PAH) | µg/l | | n/a | 0.01 | 0.044 | 0.01 | 0.01 | < 2 m |
| Total Resin Acids | mg/l | | n/a | 0.06 | 0.57 | 0.07 | 0.06 | < 2 m |
| Total Fatty Acids | mg/l | | n/a | 0.07 | 0.335 | 0.08 | 0.07 | < 2 m |
| Total P&P Phenols | µg/l | | n/a | 5 | 6.13 | 5.03 | 5.0 | < 2 m |

**Notes:**

Mixing zone results – parameter concentrations (Stantec 2019c)

Effluent Flow 85,000 $m^3$/day or 0.984 $m^3$/s

Cormix Model "Run B" - July 2019 Daily Average of Lowest Hourly Velocities (Ambient Velocity at Tidal Conditions, m/s - Max=0.85, Average=0.41)

Calculated using estimated dilution ratios as provided for a representative parameter with 100 mg/L concentration in effluent (Stantec 2019c)

[1]Narrative - clear flow - Maximum increase of 25 mg/L from background levels for any short-term exposure (e.g., 24-h period). Maximum average increase of 5 mg/L from background levels for longer term exposures (e.g., inputs lasting between 24 h and 30 d)

[2]Narrative - The recommended minimum concentration of DO in marine and estuarine waters is 8.0 mg/L

[3]Narrative - The pH of marine and estuarine waters should fall within the range of 7.0 – 8.7 units unless it can be demonstrated that such a pH is a result of natural processes. Within this range, pH should not vary by more than 0.2 pH units from the natural pH expected at that time. Where pH is naturally outside this range, human activities should not cause pH to change by more than 0.2 pH units from the natural pH expected at that time, and any change should tend towards the recommended range.

[4]Narrative – Interim Guideline - Human activities should not cause changes in ambient temperature of marine and estuarine water to exceed ±1°C at any time, location, or depth. The natural temperature cycle characteristic of the site should not be altered in amplitude of frequency by human activities. The maximum rate of any human-induced temperature change should not exceed 0.5 °C per hour.

[5]Narrative – Interim Guideline - Human activities should not cause the salinity (expressed as parts per thousand [‰]) of marine and estuarine waters to fluctuate by more than 10% of the natural level expected at that time and depth.

**Table 4-4: Dilution Ratios at Distance (Stantec 2019c)**

| Distance from the Diffuser Outfall | 3D CORMIX Model Run B Dilution Ratios (XX:1) |
|---|---|
| 2 m | 33.0 |
| 5 m | 51.4 |
| 10 m | 71.8 |
| 20 m | 100.1 |
| 50 m | 129.6 |
| 100 m | 145.7 |
| 200 m | 164.1 |

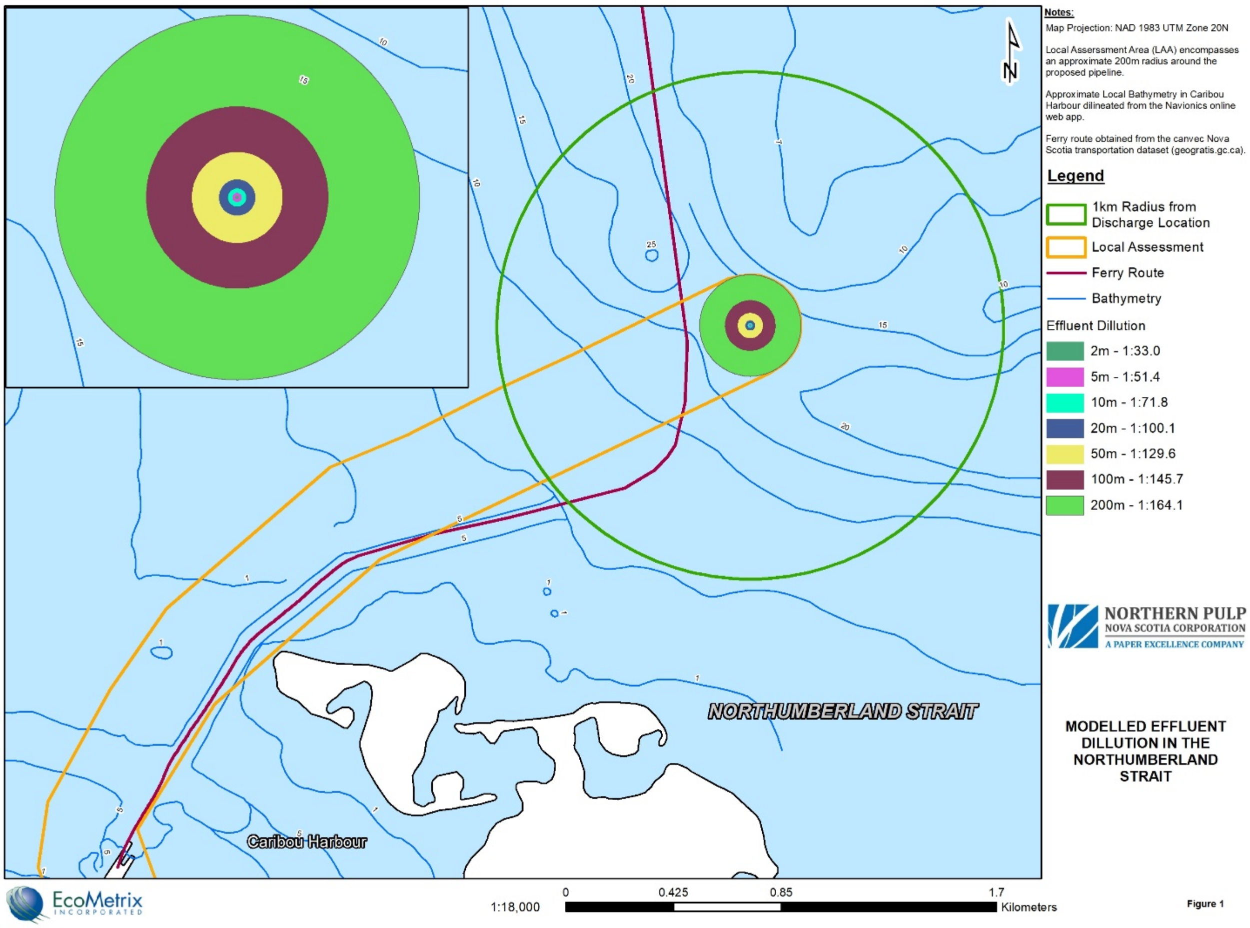


**Figure 4-2: Modelled Effluent Dilution at Diffuser Location (based on Stantec 2019c)**

The water quality modeling predictions indicate that the majority of parameters of concern will be at background conditions within less than 5 m off the diffuser outfall. Total nitrogen and manganese are predicted to meet background concentrations within 20 m and 50 m, respectively. Colour was also estimated as remaining elevated up to approximately 100 m from the discharge location when comparing to background conditions as sampled in 2019. However, if comparing to 2018 background information for colour, the background level will be realized within less than 50 m of the discharge location.

Furthermore, modelling indicates that the vertical mixing of the effluent plume will negate immediate interaction with the benthic environment of the Strait within a distance where effluent will be above background concentrations or meet CCME guidelines.

### 4.1.4 Mitigation

Mitigation measures were provided in the EARD (Dillon 2019) with respect to physical interactions during the construction, operation and maintenance phases. Mitigation measures as consistent with the construction phase would be consistent with those to be used during the decommissioning phase of the project.

Mitigation is the elimination, reduction or control of the adverse environmental effects of a project. Ideally, it is preferable where possible to implement mitigation strategies at source to prevent or control releases to the environment. This can be accomplished by adopting mitigation approaches based on the avoidance and reduction, such as, for example, in-design measures or placement of project components. Where mitigation at source is not possible alternative strategies may be adopted, including plans for restitution for any damage to the environment caused by such effects through replacement, restoration and/or compensation.

As it pertains to the Project, mitigation strategies are described where potential Project-related effects have been identified through the significance determination matrix (**Section 4.1.6**). All proposed mitigation is described by project phase, timing and duration. Detail has been provided as appropriate on methods, equipment, procedures and policies associated with the proposed mitigation as well as an assessment of whether residual effects are expected.

### 4.1.5 Identification of Residual Effects

Residual effects are those non-trivial effects identified through the effects assessment process for which no effective mitigation measures are available, or alternatively for which mitigation or compensation does not largely or entirely alleviate an identified effect. Where a residual effect is predicted it is advanced in the effects assessment process to the determination of significance phase (**Section 4.1.6**).

### 4.1.6 Consideration of the Significance of Residual Effects

Consideration of the significance of a residual effect is integral to the environmental assessment process. The significance of residual effects will be evaluated on the basis of various attributes and associated criteria that are identified and discussed below.

Attributes used to evaluate significance will include:

- Magnitude: a quantitative or qualitative measure of a given key indicator representing the potential effect after mitigation relative to the baseline condition.
- Extent: the geographic area over which an effect will occur.
- Duration: the period of time over which an effect will occur.

- Frequency: how often an effect will occur within a given time period.
- Reversibility: the degree to which the effect can or will be reversed.
- Likelihood: the probability of the effect occurring.
- Context / Value: a qualitative measure for environmental impacts identified as being meaningful based on input and feedback received regarding the Project from the public, local community members, government and Aboriginal peoples, as well as the professional of the project team.

Associated with each attribute is a set of criteria used to evaluate the attribute (**Table 4-5**). Criteria are categorized into three levels (Levels I, II, and III), where Level I is indicative of a negligible or limited potential to contribute to an overall significant environmental effect, and Level III is indicative of a high potential to contribute to an overall significant environmental effect. Level II will represent an intermediate condition.

If a Level I rating is achieved for any of the attributes involving magnitude, geographic extent, duration or frequency, then the effect is considered to be not significant. Effects are also assessed as to their likelihood of occurrence, yet a level is not provided for this attribute, recognizing that there is some overlap in the concepts of duration, frequency and likelihood.

The methodology is logical in that a predicted environmental effect is not likely to be significant if:

- It is of low magnitude and/or geographic extent, or;
- Of short-term duration including residual effects (i.e., the effect itself is of short-term duration), or;
- Is likely to occur very infrequently (or not at all) with little potential for long-lasting effects.

**Table 4-6** provides a summary of the consideration of significance of residual effects. Taking into account the criteria above within the context of applied mitigation. No significant residual effect has been identified for the Project.

However, in considering the input from stakeholder consultation, further discussion with respect to three specific indicator species representing the marine fish and fish habitat VEC is warranted. These include: American Lobster, Rock Crab and Atlantic Herring. Each of these species highly important to the commercial and Indigenous fisheries and areas of harvest occur directly within or within close vicinity to the LAA. For each species further context is provided pertaining to the potential effects, residual significance after mitigation and overall significance of effects.

#### 4.1.6.1 American Lobster

As stated, American Lobster is of high importance to the local commercial and Indigenous fisheries. Local and regional fisheries resource users have raised concerns over potential toxicological effects on fisheries resource use as the result of the proposed discharge of effluent. Some studies have demonstrated that changes in water temperature and salinity (i.e. freshwater inputs) can impact adult Lobster behaviour, movements and distribution due to increases in physiological stress and difficulty reading chemical sensory cues (Jury et al. 1994, Ross & Behringer 2019). Several studies have identified linkages between reduced survival and developmental differences of American Lobster larvae (stages I-III) and post-larvae (stage IV) when exposed to elevated temperatures (McLeese 1956, Templeman 2011, Quinn et al. 2013; Waller et al. 2017).

However, a significant residual effect was not identified through this assessment specific to changes in water quality (including temperature and salinity) as a result of the proposed treated effluent discharge to the Northumberland Strait. This conclusion was made for the following reasons:

- 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;
- Through mitigative design, the effluent diffuser will result in rapid mixing of the effluent within the receiving environment such that the zone that temperature and salinity may be greater than the background condition for the Northumberland Strait at the point of discharge (as measured during baseline water quality sampling throughout 2018 and 2019) is limited to a maximum of 5 m from the point of discharge (**Table 4-3**) (Stantec 2019c). Warmer and lower salinity effluent discharged within the receiving environment will reach almost instantaneous mixing (5 m). Within this zone, larval American Lobster (stages I to III) may be present, however in these free-swimming stages, the duration of their residence in this small zone of influence is likely to be very short, and any exposure will be transient in nature; and,
- Through mitigative design, the diffuser will deliver effluent to the receiving environment such that the vertical distribution of warmer and lower salinity effluent water will not interact with the benthic environment, therefore no direct interaction with adult Lobsters is likely;

Although significant residual effects to American Lobster are un-likely, the level of public interest, socio-economic and Indigenous importance warrants the inclusion of follow-up monitoring specific to American Lobster to confirm the performance of mitigative design and therefore lack of a significant residual effect to the resource. Further detail with respect to monitoring is provided in **Section 5.0**

#### 4.1.6.2 Rock Crab

Rock Crab represents one of the most important species harvested in the LAA by commercial and Indigenous fisheries. Rock Crab is fished within Caribou Harbour along a majority of the proposed pipeline corridor, though not typically at greater depths >10 m or in the vicinity of the diffuser location (**Figure 3-9, Figure 3-14**). Therefore, interactions with adult Rock Crab within the vicinity of the diffuser are expected to be minimal.

Within the effluent mixing zone, planktonic larval Rock Crab may be present, however this is predicted to be small in spatial extent and their occupation in this zone will be transient and of short duration. A relatively small proportion of larvae within the vicinity of the diffuser (up to 200m) will interact with treated effluent at concentrations of greater than 1%.

Although significant residual effects to American Lobster are un-likely, the level of public interest, socio-economic and Indigenous importance warrants the inclusion of follow-up monitoring specific to American Lobster to confirm the performance of mitigative design and therefore lack of a significant residual effect to the resource. Further detail with respect to monitoring is provided in **Section 5.0**

#### 4.1.6.3 Atlantic Herring

Atlantic Herring is a regionally important species to commercial, recreational and Indigenous fisheries and is harvested in the RAA.

Adult Herring are harvested in areas that are generally located outside the zone of influence of the discharge (**Figure 3-12**). Given the small spatial extent of the effluent mixing zone and their mobility, interactions with adult schools of Atlantic Herring within the effluent zone of influence are expected to be minimal, short-lived and transient.

Within the mixing zone, larval Atlantic Herring may be present, however in this planktonic stage, the duration of their residence in this small zone of influence is likely to be very short. As such, a very small proportion of larvae within the vicinity of the diffuser (up to 200m) will interact with treated effluent, and of those that may, their interaction with the effluent will be of short-duration and transient.

Although significant residual effects to Atlantic Herring are unlikely, the level of public interest, socio-economic and Indigenous importance warrants the inclusion of environmental monitoring specific to this species to confirm the performance of mitigative design and therefore lack of a significant residual effect to the resource. Further detail with respect to monitoring is provided in **Section 5.0**

**Table 4-5: Criteria to assess the significance of residual effects**

| Level | Context | Extent | | Frequency | Reversibility | Likelihood of Occurrence |
|---|---|---|---|---|---|---|
| | | Magnitude / Geographic Extent | Duration | | | |
| I | No meaningful adverse ecosystem effects. | Water quality effects in receiving waters consistent with applicable Federal and Provincial regulations and guidelines, or other scientifically defensible values; or if guidelines exceeded, no anticipated adverse environmental effects beyond any defined mixing zones.<br><br>Not net loss of productive capacity of habitats. | Short-term: effect not measurable beyond construction period. | Effect expected to occur infrequently or not at all. | Effect is readily reversible. | Unlikely to occur. |
| II | Adverse effects involve common species or communities, or resources of limited significance. | Water quality effects in the receiving waters have the potential to adversely effect aquatic life beyond any defined mixing zones.<br><br>Unacceptable loss of the productive capacity of local fish habitat. | Medium-term: effect likely to persist for the life of the project. | Effect expected to occur intermittently, possibly with some degree of regularity | Effect is reversible at substantial cost, or with difficulty. | Could reasonably be expected to occur. |
| III | Adverse effects involve locally or regionally important species, communities, or resources. | Water quality effects in the receiving waters are likely to adversely affect aquatic life beyond any defined mixing zones, likely resulting in an unacceptable effect.<br>Unacceptable loss of productive capacity of regional fish habitat. | Long-term: effect likely to persist beyond the life of the project. | Effect expected to occur regularly or continuously. | Effect is not reversible. | Will occur or is likely to occur. |

### Table 4-6: Significance Determinations of Residual Effects after Mitigation on the Marine Environment VEC

| Phase / Interaction / Component/ Class | Group | Indicator(s) | Potential Effect | Proposed Mitigation | Residual Effect | Residual Significance after Mitigation | | | | | Overall Significance | Likelihood |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Value of Group or Indicator | Magnitude / Geographic Extent | Duration | Frequency | Reversibility | | |
| Marine Fin-Fish | Benthic Species | Winter Flounder, Atlantic Plaice,<br><br>White Hake (SOCC), Winter Skate (SOCC) | **Physical** – disturbance to benthic habitat due to the staging, excavation, pipe placement and material backfilling, potential habitat overprinting associated with land-marine pipeline connection, increased sedimentation and potential change to sediment quality. | • Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages (i.e. spawning).<br>• Work during the construction phase will be scheduled to the extent practical to avoid periods of adverse weather or spring tides to reduce turbidity and sedimentation.<br>• Duration of in-water work will be managed to the shortest time that is practical.<br>• An Erosion and Sediment Control Plan (ESCP) will be developed for the site that reduces the risk of sedimentation to the marine environment and additional mitigation measures identified as applicable.<br>• Displaced substrate will be recovered to bury portions of the pipeline, wherever practical.<br>• Provision of habitat offsetting, if required. | With implementation of mitigation measures as proposed, including use of timing windows and consistent monitoring of turbidity and sedimentation the use of excavated materials to back-fill trenching (i.e. replace fish habitat), or habitat offsetting if required, the ecological function of the benthic marine environment will be maintained. | Regionally important species and resources (i.e. SOCC species: White Hake and Winter Skate). | Effects are considered to be minor and encompass a small area (confined to the pipeline corridor and diffuser area). | Medium-term: effects are specific to the period of construction and or decommissioning or short periods of maintenance as required throughout the life of the project. | Effect is expected to be continuous through construction, operation / maintenance and decommissioning of the project. | Effect is reversible over the duration of the project following backfilling and habitat offsetting as required. | Overall effects are considered to be generally minor, localized and generally reversible. | Effect will occur. |
| | | | | | | Level III | Level I | Level II | Level II | Level I | Not Significant | |

| Phase / Interaction / Component/ Class | Group | Indicator(s) | Potential Effect | Proposed Mitigation | Residual Effect | Residual Significance after Mitigation | | | | | Overall Significance | Likelihood |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Value of Group or Indicator | Magnitude / Geographic Extent | Duration | Frequency | Reversibility | | |
| | | | **Acoustic** – potential increase in sound and vibration during construction. | • 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).<br>• Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages (i.e. spawning). | With implementation of mitigation measures as proposed, including use of timing windows and meeting the requirements of DFO Guidelines the function of the benthic marine environment will be maintained. | Regionally important species and resources (i.e. SOCC species: White Hake and Winter Skate). | Effects are considered to be minor and encompass a small area (confined to the pipeline corridor and diffuser area). | Medium-term: effects are specific to the period of construction and or decommissioning or short periods of maintenance as required throughout the life of the project. | Effect is expected to be continuous through construction, operation / maintenance and decommissioning of the project. | Effect is reversible over the duration of the project following backfilling. | Overall effects are considered to be generally minor, localized and generally reversible. | Effect will occur. |
| | | | | | | Level III | Level I | Level II | Level II | Level I | Not Significant | |
| | | | **Water Quality** – changes to water quality due the discharge of treated effluent to the Northumberland Strait at the diffuser outfall location. | 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.<br>The diffuser configuration promotes rapid mixing of effluent to minimize the spatial extent over which constituent concentrations are expected to be distinguishable from background or ambient conditions. | Meeting industry design standards for effluent treatment and design of the effluent diffuser to maximize dilution of effluent in the marine environment, effects will ensure that any changes to water quality in the receiving environment are minimized to a small area (within 5 m of the outfall) prior to water quality meeting background or CCME guidelines for the protection of aquatic life. | Regionally important species and resources (i.e. SOCC species: White Hake and Winter Skate). | Effects are considered to be minor and encompass a small area within 5 m of the diffuser area. | Medium-term: effects are expected for the duration of the effluent (for the life of the Mill). | Effluent effects expected to occur continuously through life of Mill. | Effects are reversible following cessation of effluent discharge. | Overall effects are considered to be generally minor, localized and generally reversible. | Effect will occur |
| | | | | | | Level III | Level I | Level II | Level III | Level I | Not Significant | |

| Phase / Interaction / Component/ Class | Group | Indicator(s) | Potential Effect | Proposed Mitigation | Residual Effect | Residual Significance after Mitigation | | | | | Overall Significance | Likelihood |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Value of Group or Indicator | Magnitude / Geographic Extent | Duration | Frequency | Reversibility | | |
| Marine Fin-Fish | Migratory Species | Atlantic Herring, Atlantic Mackerel, Atlantic Cod, Rainbow Smelt | **Physical** – disturbance to benthic habitat due to the staging, excavation, pipe placement and material backfilling, potential habitat overprinting associated with land-marine pipeline connection, increased sedimentation and potential change to water quality. | • Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages (i.e. spawning).<br>• Work during the construction phase will be scheduled to the extent practical to avoid periods of adverse weather or spring tides to reduce turbidity and sedimentation.<br>• Duration of in-water work will be managed to the shortest time that is practical.<br>• An ESCP will be developed for the site that reduces the risk of sedimentation to the marine environment and additional mitigation measures identified as applicable.<br>• Provision of habitat offsetting, if required. | With implementation of mitigation measures as proposed, including use of timing windows and consistent monitoring of turbidity and sedimentation water quality effects minimized.<br>Mackerel harvest areas are generally located outside the RAA.<br>Herring harvest areas will be directly affected by the pipeline in outer Caribou Harbour and Northumberland Strait. | Regionally important species and resources to commercial, recreational and Indigenous fisheries, harvested in the RAA.<br>Level III | Herring harvest areas will be directly affected by the pipeline in outer Caribou Harbour and Strait.<br>Effects are considered to be minor and encompass a small area (confined to the pipeline corridor and diffuser area).<br>Mackerel harvest areas are generally located outside the RAA.<br>Level III | Medium-term: effects are specific to the period of construction and or decommissioning or short periods of maintenance as required throughout the life of the project.<br>Level II | Effect is expected to be continuous through construction, operation / maintenance and decommissioning of the project.<br>Level II | Effect is reversible over the duration of the project following backfilling and habitat offsetting as required.<br>Level I | Overall effects are considered to be generally minor, localized and generally reversible.<br>Not Significant | Effect will occur |
| | | | **Acoustic** – potential increase in sound and vibration during construction. | • 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).<br>• Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages (i.e. migratory period when plentiful in harvest areas). | With implementation of mitigation measures as proposed, including use of timing windows and meeting the requirements of DFO Guidelines the function of the migratory marine environment will be maintained. | Regionally important species and resources to commercial, recreational and Indigenous fisheries, harvested in the RAA.<br>Level III | Effects are considered to be minor and encompass a small area (confined to the pipeline corridor and diffuser area).<br>Level I | Medium-term: effects are specific to the period of construction and or decommissioning or short periods of maintenance as required throughout the life of the project.<br>Level II | Effect is expected to be continuous through construction, operation / maintenance and decommissioning of the project.<br>Level II | Effect is reversible over the duration of the project following backfilling and maintenance works.<br>Level I | Overall effects are considered to be generally minor, localized and generally reversible.<br>Not Significant | Effect will occur. |

| Phase / Interaction / Component/ Class | Group | Indicator(s) | Potential Effect | Proposed Mitigation | Residual Effect | Residual Significance after Mitigation | | | | | Overall Significance | Likelihood |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Value of Group or Indicator | Magnitude / Geographic Extent | Duration | Frequency | Reversibility | | |
| | | | **Water Quality** – changes to water quality due the discharge of treated effluent to the Northumberland Strait at the diffuser outfall location. | 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.<br><br>The diffuser configuration promotes rapid mixing of effluent to minimize the spatial extent over which constituent concentrations are expected to be distinguishable from background or ambient conditions. | Meeting industry design standards for effluent treatment and design of the effluent diffuser to maximize dilution of effluent in the marine environment, effects will ensure that any changes to water quality in the receiving environment are minimized to a small area (within 5 m of the outfall) prior to water quality meeting background or CCME guidelines for the protection of aquatic life. | Regionally important species and resources to commercial, recreational and Indigenous fisheries, harvested in the RAA.<br><br>Level III | Effects are considered to be minor and encompass a small area within 5 m of the diffuser area.<br><br>Mackerel and Herring resource and harvest areas are located well outside the zone of influence of the discharge.<br><br>Cod are considered migratory and of low abundance in the area.<br><br>Level I | Medium-term: effects are expected for the duration of the effluent (for the life of the Mill).<br><br>Level II | Effluent effects expected to occur continuously through life of Mill.<br><br>Level II | Effects are reversible following cessation of effluent discharge.<br><br>Level I | Overall effects are considered to be generally minor, localized and generally reversible.<br><br>Not Significant | Effect will occur. |
| Marine Fin-Fish | SOCC Migratory Species | Atlantic Salmon, Atlantic Striped Bass, American Eel, Atlantic Bluefin Tuna | **Physical** – disturbance to benthic habitat due to the staging, excavation, pipe placement and material backfilling, causing changes to water quality due to increased sedimentation. | • Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages.<br>• Work during the construction phase will be scheduled to the extent practical to avoid periods of adverse weather or spring tides to reduce turbidity and sedimentation.<br>• Duration of in-water work will be managed to the shortest time that is practical.<br>• An ESCP will be developed for the site that reduces the risk of sedimentation to the marine environment and additional mitigation measures identified as applicable. | With implementation of mitigation measures as proposed, including use of timing windows and consistent monitoring of turbidity and sedimentation, minimized effects to water quality will be realized.<br><br>SOCC migratory species are generally transient and sensitive life stages have minimal affinity for the habitat in the LAA. | Regionally important species and resources to commercial, recreational and Indigenous fisheries, harvested in the RAA.<br><br>Level III | Effects are considered to be minor and encompass a small area (confined to the pipeline corridor and diffuser area) that is utilized seasonally by SOCC migratory species.<br><br>Level I | Medium-term: effects are specific to the period of construction and or decommissioning or short periods of maintenance as required throughout the life of the project.<br><br>Level II | Effect is expected to be continuous through construction, operation / maintenance and decommissioning of the project.<br><br>Level III | Effect is reversible over the duration of the project following backfilling and habitat offsetting as required.<br><br>Level I | Overall effects are considered to be generally minor, localized and generally reversible.<br><br>Not Significant | Effect will occur. |

| Phase / Interaction / Component/ Class | Group | Indicator(s) | Potential Effect | Proposed Mitigation | Residual Effect | Residual Significance after Mitigation | | | | | Overall Significance | Likelihood |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Value of Group or Indicator | Magnitude / Geographic Extent | Duration | Frequency | Reversibility | | |
| | | | **Acoustic** – potential increase in sound and vibration during construction. | • 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).<br>• Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages (i.e. migratory period when plentiful in harvest areas). | With implementation of mitigation measures as proposed, including use of timing windows and meeting the requirements of DFO Guidelines the function of the migratory marine environment will be maintained. | Regionally important species and resources to commercial, recreational and Indigenous fisheries, harvested in the RAA. | Effects are considered to be minor and encompass a small area (confined to the pipeline corridor and diffuser area). | Medium-term: effects are specific to the period of construction and or decommissioning or short periods of maintenance as required throughout the life of the project. | Effect is expected to be continuous through construction, operation / maintenance and decommissioning of the project. | Effect is reversible over the duration of the project following backfilling and maintenance works. | Overall effects are considered to be generally minor, localized and generally reversible. | Effect will occur. |
| | | | | | | Level III | Level I | Level II | Level II | Level I | Not Significant | |
| | | | **Water Quality** – changes to water quality due the discharge of treated effluent to the Northumberland Strait at the diffuser outfall location. | 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.<br><br>The diffuser configuration promotes rapid mixing of effluent to minimize the spatial extent over which constituent concentrations are expected to be distinguishable from background or ambient conditions. | Meeting industry design standards for effluent treatment and design of the effluent diffuser to maximize dilution of effluent in the marine environment, effects will ensure that any changes to water quality in the receiving environment are minimized to a small area (within 5 m of the outfall) prior to water quality meeting background or CCME guidelines for the protection of aquatic life. | Regionally important species and resources to commercial, recreational and Indigenous fisheries, harvested in the RAA. | Effects are considered to be minor and encompass a small area within 5 m of the diffuser area.<br><br>The probability of interaction of SOCC migratory species with the outfall diffuser is generally low. | Medium-term: effects are expected for the duration of the effluent (for the life of the Mill). | Effluent effects expected to occur continuously through life of Mill. | Effects are reversible following cessation of effluent discharge. | Overall effects are considered to be generally minor, localized and generally reversible. | Effect will occur. |
| | | | | | | Level III | Level I | Level II | Level II | Level I | Not Significant | |

| Phase / Interaction / Component/ Class | Group | Indicator(s) | Potential Effect | Proposed Mitigation | Residual Effect | Residual Significance after Mitigation | | | | | Overall Significance | Likelihood |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Value of Group or Indicator | Magnitude / Geographic Extent | Duration | Frequency | Reversibility | | |
| Marine Shellfish | Crustacean | Rock Crab | **Physical** – disturbance to benthic habitat due to the staging, excavation, pipe placement and material backfilling, potential habitat overprinting associated with land-marine pipeline connection, increased sedimentation and potential change to sediment quality. | • Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages.<br>• Work during the construction phase will be scheduled to the extent practical to avoid periods of adverse weather or spring tides to reduce turbidity and sedimentation.<br>• Duration of in-water work will be managed to the shortest time that is practical.<br>• An ESCP will be developed for the site that reduces the risk of sedimentation to the marine environment and additional mitigation measures identified as applicable.<br>• Provision of habitat offsetting, if required. | Rock Crab is fished within Caribou Harbour along a majority of the proposed pipeline corridor, yet not at greater depths > 10 m or in the vicinity of the diffuser location. With implementation of mitigation and through offsetting as required, Rock Crab productivity will be maintained. | Rock Crab represents one of the most important species harvested in the LAA by commercial and Indigenous fisheries. | Effects are considered to be minor and encompass a small area (confined to the pipeline corridor. | Medium-term: effects are specific to the period of construction and or decommissioning or short periods of maintenance as required throughout the life of the project. | Effect is expected to be continuous through construction, operation / maintenance and decommissioning of the project. | Effect is reversible over the duration of the project following backfilling and maintenance works. | Overall effects are considered to be generally minor, localized and generally reversible. | Effect will occur |
| | | | | | | Level III | Level I | Level II | Level III | Level I | Not Significant | |
| | | | **Water Quality** – changes to water quality including salinity due the discharge of treated effluent to the Northumberland Strait at the diffuser outfall location. | 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.<br><br>The diffuser configuration promotes rapid mixing of effluent to minimize the spatial extent over which constituent concentrations are expected to be distinguishable from background or ambient conditions. | Rock Crab is fished within Caribou Harbour along a majority of the proposed pipeline corridor, yet not at greater depths > 10 m or in the vicinity of the diffuser location therefore no interaction is expected. | Regionally important species and resources to commercial, recreational and Indigenous fisheries, harvested in the RAA. | Effects are considered to be minor and encompass a small area within 5 m of the diffuser area. | Medium-term: effects are expected for the duration of the effluent (for the life of the Mill). | Effluent effects expected to occur continuously through life of Mill. | Effects are reversible following cessation of effluent discharge. | Overall effects are considered to be generally minor, localized and generally reversible. | No Effect |
| | | | | | | Level III | Level I | Level II | Level II | Level I | Not Significant | |

| Phase / Interaction / Component/ Class | Group | Indicator(s) | Potential Effect | Proposed Mitigation | Residual Effect | Residual Significance after Mitigation | | | | | Overall Significance | Likelihood |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Value of Group or Indicator | Magnitude / Geographic Extent | Duration | Frequency | Reversibility | | |
| Marine Shellfish | Crustacean | American Lobster | **Physical** – disturbance to benthic habitat due to the staging, excavation, pipe placement and material backfilling, potential habitat overprinting associated with land-marine pipeline connection, increased sedimentation and potential change to sediment quality. | • Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages.<br>• Work during the construction phase will be scheduled to the extent practical to avoid periods of adverse weather or spring tides to reduce turbidity and sedimentation.<br>• Duration of in-water work will be managed to the shortest time that is practical.<br>• An ESCP will be developed for the site that reduces the risk of sedimentation to the marine environment and additional mitigation measures identified as applicable.<br>• Provision of habitat offsetting, if required. | The Lobster resource and its habitat extent throughout Caribou Harbour and Pictou Harbour and will be directly impacted by the project. However, the areas of Lobster harvest are generally located outside of the LAA.<br><br>The LAA represents a small proportion of the area with suitable Lobster habitat.<br><br>With implementation of mitigation and through offsetting as required, Lobster productivity will be maintained in the RAA. | Lobster represents one of the most important species harvested in the LAA by commercial and Indigenous fisheries.<br><br>Level III | Effects are considered to be minor and encompass a small area (confined to the pipeline corridor and diffuser area).<br><br>Level I | Medium-term: effects are specific to the period of construction and or decommissioning or short periods of maintenance as required throughout the life of the project.<br><br>Level II | Effect is expected to be continuous through construction, operation / maintenance and decommissioning of the project.<br><br>Level III | Effect is reversible over the duration of the project following backfilling and maintenance works.<br><br>Level I | Overall effects are considered to be generally minor, localized and generally reversible.<br><br>Not Significant | Effect will occur |

| Phase / Interaction / Component/ Class | Group | Indicator(s) | Potential Effect | Proposed Mitigation | Residual Effect | Residual Significance after Mitigation | | | | | Overall Significance | Likelihood |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Value of Group or Indicator | Magnitude / Geographic Extent | Duration | Frequency | Reversibility | | |
| | | | **Water Quality** – changes to water quality due the discharge of treated effluent to the Northumberland Strait at the diffuser including reduced salinity and increased water temperature which may influence reproduction, survival and growth of larval and adult Lobster in the vicinity of the outfall location. | 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.<br><br>The diffuser configuration promotes rapid mixing of effluent to minimize the spatial extent over which constituent concentrations are expected to be distinguishable from background or ambient conditions. | Meeting industry design standards for effluent treatment and design of the effluent diffuser to maximize dilution of effluent in the marine environment, effects will ensure that any changes to water quality in the receiving environment are minimized to a small area (within 5 m of the outfall) at which water quality will meet background or CCME guidelines for the protection of aquatic life.<br><br>The vertical mixing at the diffuser due to differences in effluent density (i.e. temperature and salinity) will negate interactions of the effluent with the benthic environment and adult Lobster. | Regionally important species and resources to commercial, recreational and Indigenous fisheries, harvested in the RAA.<br><br>Level III | Effects are considered to be minor and encompass a small area within 5 m of the diffuser area.<br><br>Level I | Medium-term: effects are expected for the duration of the effluent (for the life of the Mill).<br><br>Level II | Effluent effects expected to occur continuously through life of Mill.<br><br>Level II | Effects are reversible following cessation of effluent discharge.<br><br>Level I | Overall effects are considered to be generally minor, localized and generally reversible.<br><br>Not Significant | Effect will occur |

| Phase / Interaction / Component/ Class | Group | Indicator(s) | Potential Effect | Proposed Mitigation | Residual Effect | Residual Significance after Mitigation | | | | | Overall Significance | Likelihood |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Value of Group or Indicator | Magnitude / Geographic Extent | Duration | Frequency | Reversibility | | |
| Marine Shellfish | Shellfish | Sea Scallop, Soft-Shell, Bar, Razor Clams, Blue Mussel, Oyster, Quahaug | **Physical** – direct mortality, disturbance to benthic habitat due to the staging, excavation, pipe placement and material backfilling, potential habitat overprinting associated with land-marine pipeline connection, increased sedimentation and potential change to sediment quality. | • Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages.<br>• Work during the construction phase will be scheduled to the extent practical to avoid periods of adverse weather or spring tides to reduce turbidity and sedimentation.<br>• Duration of in-water work will be managed to the shortest time that is practical.<br>• An ESCP will be developed for the site that reduces the risk of sedimentation to the marine environment and additional mitigation measures identified as applicable.<br>• Provision of habitat offsetting, if required. | With implementation of mitigation measures, as proposed including those to reduce turbidity and sedimentation and potential compensation through No Net Loss Plans and/or equivalent offsetting resource productivity will be maintained. | Regionally important species' and resources to commercial, recreational and Indigenous fisheries, harvested in the RAA.<br><br>Level III | Effects are considered to be minor and encompass a small area (confined to the pipeline corridor and diffuser area).<br><br>Level I | Medium-term: effects are specific to the period of construction and or decommissioning or short periods of maintenance as required throughout the life of the project.<br><br>Level II | Effect is expected to be continuous through construction, operation / maintenance and decommissioning of the project.<br><br>Level II | Effect is irreversible with respect to the potential loss of shellfish along the corridor and diffuser area.<br><br>Level III | Overall effects are considered to be generally minor, localized and not reversible and may require compensation.<br><br>Not Significant | Effect will occur |

| Phase / Interaction / Component/ Class | Group | Indicator(s) | Potential Effect | Proposed Mitigation | Residual Effect | Residual Significance after Mitigation | | | | | Overall Significance | Likelihood |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Value of Group or Indicator | Magnitude / Geographic Extent | Duration | Frequency | Reversibility | | |
| | | | **Water Quality** – changes to water quality due the discharge of treated effluent to the Northumberland Strait at the diffuser including reduced salinity and increased water temperature which may influence reproduction, survival and growth of larval and adult Shellfish | 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.<br><br>The diffuser configuration promotes rapid mixing of effluent to minimize the spatial extent over which constituent concentrations are expected to be distinguishable from background or ambient conditions. | Meeting industry design standards for effluent treatment and design of the effluent diffuser to maximize dilution of effluent in the marine environment, effects will ensure that any changes to water quality in the receiving environment are minimized to a small area (within 5 m of the outfall) at which water quality will meet background or CCME guidelines for the protection of aquatic life.<br><br>The vertical mixing at the diffuser due to differences in effluent density (i.e. temperature and salinity) will negate interactions of the effluent with the benthic environment | Regionally important species and resources to commercial, recreational and Indigenous fisheries, harvested in the RAA | Effects are considered to be minor and encompass a small area within 5 m of the diffuser area. | Medium-term: effects are expected for the duration of the effluent (for the life of the Mill) | Effluent effects expected to occur continuously through life of Mill | Effects are reversible following cessation of effluent discharge | Overall effects are considered to be generally minor, localized and generally reversible | Effect will occur |
| | | | | | | Level III | Level I | Level II | Level II | Level I | Not Significant | |

| Phase / Interaction / Component/ Class | Group | Indicator(s) | Potential Effect | Proposed Mitigation | Residual Effect | Residual Significance after Mitigation | | | | | Overall Significance | Likelihood |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Value of Group or Indicator | Magnitude / Geographic Extent | Duration | Frequency | Reversibility | | |
| Plankton | Phyto - & Zooplankton | Plankton Diversity and Abundance | **Physical** – disturbance to benthic habitat due to the staging, excavation, pipe placement and material backfilling, causing changes to water quality due to increased sedimentation. | • Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages<br>• Work during the construction phase will be scheduled to the extent practical to avoid periods of adverse weather or spring tides to reduce turbidity and sedimentation.<br>• Duration of in-water work will be managed to the shortest time that is practical.<br>• An ESCP will be developed for the site that reduces the risk of sedimentation to the marine environment and additional mitigation measures identified as applicable | With implementation of mitigation measures as proposed, including use of timing windows and consistent monitoring of turbidity and sedimentation, minimized effects to water quality will be realized. | Important indicator of water quality and primary production, forage resource and larval fish/shellfish survival for local marine environment.<br>Important indicator of water quality and can be consistently monitored post construction. | Effects are considered to be minor and encompass the direct area of the LAA and surrounding area associated with particle suspension and transport | Medium-term: effects are specific to the period of construction and or decommissioning or short periods of maintenance as required throughout the life of the project. | Effect is expected to be continuous through construction, operation / maintenance and decommissioning of the project | Effect is reversible over the duration of the project following backfilling and habitat offsetting as required. | Overall effects are considered to be generally minor, localized and generally reversible | Effect will occur |
| | | | | | | Level III | Level II | Level II | Level II | Level I | Not Significant | |
| | | | **Water Quality** – changes to water quality due the discharge of treated effluent to the Northumberland Strait at the diffuser outfall location | 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.<br>The diffuser configuration promotes rapid mixing of effluent to minimize the spatial extent over which constituent concentrations are expected to be distinguishable from background or ambient conditions. | Meeting industry design standards for effluent treatment and design of the effluent diffuser to maximize dilution of effluent in the marine environment, effects will ensure that any changes to water quality in the receiving environment are minimized to a small area (within 5 m of the outfall) prior to water quality meeting background or CCME guidelines for the protection of aquatic life | Important indicator of water quality and primary production, forage resource and larval fish/shellfish survival for local marine environment.<br>Important indicator of water quality and can be consistently monitored post construction. | Effects are considered to be minor and encompass a small area within 5 m of the diffuser area. | Medium-term: effects are expected for the duration of the effluent (for the life of the Mill) | Effluent effects expected to occur continuously through life of Mill | Effects are reversible following cessation of effluent discharge | Overall effects are considered to be generally minor, localized and generally reversible | Effect will occur |
| | | | | | | Level III | Level I | Level II | Level III | Level I | Not Significant | |

| Phase / Interaction / Component/ Class | Group | Indicator(s) | Potential Effect | Proposed Mitigation | Residual Effect | Residual Significance after Mitigation | | | | | Overall Significance | Likelihood |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Value of Group or Indicator | Magnitude / Geographic Extent | Duration | Frequency | Reversibility | | |
| Benthic Invertebrates | Benthic Invertebrates | Benthic Invertebrate Community (abundance, diversity, richness) | **Physical** – direct mortality, disturbance to benthic habitat due to the staging, excavation, pipe placement and material backfilling, potential habitat overprinting associated with land-marine pipeline connection, increased sedimentation and potential change to sediment quality | • Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages<br>• Work during the construction phase will be scheduled to the extent practical to avoid periods of adverse weather or spring tides to reduce turbidity and sedimentation.<br>• Duration of in-water work will be managed to the shortest time that is practical.<br>• An ESCP will be developed for the site that reduces the risk of sedimentation to the marine environment and additional mitigation measures identified as applicable. | With implementation of mitigation measures, as proposed including those to reduce turbidity and sedimentation and potential.<br>Re-use of sediment to backfill trench and therefore potential for recolonization within local environment | BIC important to sustaining the forage base for benthic fish species, and important indicators of sediment and water quality | Effects are considered to be minor and encompass a small area (confined to the pipeline corridor and diffuser area) | Medium-term: effects are specific to the period of construction and or decommissioning or short periods of maintenance as required throughout the life of the project. | Effect is expected to be continuous through construction, operation / maintenance and decommissioning of the project | Effect is reversible as re-use of sediment to backfill trench and therefore potential for recolonization within local environment. | Overall effects are considered to be generally minor, localized and generally reversible | Effect will occur |
| | | | | | | Level II | Level I | Level II | Level II | Level I | Not Significant | |

| Phase / Interaction / Component/ Class | Group | Indicator(s) | Potential Effect | Proposed Mitigation | Residual Effect | Residual Significance after Mitigation | | | | | Overall Significance | Likelihood |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Value of Group or Indicator | Magnitude / Geographic Extent | Duration | Frequency | Reversibility | | |
| | | | **Water Quality** – changes to water quality due the discharge of treated effluent to the Strait at the diffuser including reduced salinity and increased water temperature which may influence reproduction, survival and growth of larval and adult Shellfish | 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.<br><br>The diffuser configuration promotes rapid mixing of effluent to minimize the spatial extent over which constituent concentrations are expected to be distinguishable from background or ambient conditions. | Meeting industry design standards for effluent treatment and design of the effluent diffuser to maximize dilution of effluent in the marine environment, effects will ensure that any changes to water quality in the receiving environment are minimized to a small area (within 5 m of the outfall) at which water quality will meet background or CCME guidelines for the protection of aquatic life.<br><br>The vertical mixing at the diffuser due to differences in effluent density (i.e. temperature and salinity) will negate interactions of the effluent with the benthic environment | BIC important to sustaining the forage base for benthic fish species, and important indicators of sediment and water quality | Effects are considered to be minor and encompass a small area (confined to the pipeline corridor and diffuser area) | Medium-term: effects are expected for the duration of the effluent (for the life of the Mill) | Effluent effects expected to occur continuously through life of Mill | Effects are reversible following cessation of effluent discharge | Overall effects are considered to be generally minor, localized and generally reversible | Effect will occur |
| | | | | | | Level II | Level I | Level II | Level II | Level I | Not Significant | |
| Marine Vegetation | Seaweed | Seaweed | **Physical** – direct removal, disturbance of vegetation due to the staging, excavation, pipe placement and material backfilling, potential habitat overprinting associated with land-marine pipeline connection, increased sedimentation and potential change to sediment quality | • Work during the construction phase will be scheduled to the extent practical to avoid periods of adverse weather or spring tides to reduce turbidity and sedimentation.<br>• Duration of in-water work will be managed to the shortest time that is practical.<br>• An ESCP will be developed for the site that reduces the risk of sedimentation to the marine environment and additional mitigation measures identified as applicable. | Previous studies have not identified abundant seaweed beds along the proposed pipeline corridor or in the vicinity of the diffuser. Any loss of vegetation would be minor in the context of the RAA. Therefore, no residual effect is expected. | Seaweed historically harvested in the LAA and therefore of potential commercial importance. | Based on the available information, the area identified as providing seaweed harvesting (Figure 3-14) opportunities will have direct interaction with the pipeline route yet is greater than 500 m outside the diffuser location. | Long-term: impacts to the seaweed in the LAA may result in effects that extend beyond the life of the project | Effect is considered to be continuous through construction and operation and the life of the mill | Effects may be reversible through propagation of existing seaweed beds and recolonization of disturbed areas | Overall effects are considered to be generally minor as the effected vegetation will be specific to a small area within the context of the RAA. | Effect will occur |

| Phase / Interaction / Component/ Class | Group | Indicator(s) | Potential Effect | Proposed Mitigation | Residual Effect | Residual Significance after Mitigation | | | | | Overall Significance | Likelihood |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Value of Group or Indicator | Magnitude / Geographic Extent | Duration | Frequency | Reversibility | | |
| | | | | | | Level II | Level II | Level III | Level II | Level II | Not significant | |
| Marine Fish Habitat | Vegetation / Cover | Eel Grass Beds | **Physical** – direct removal, disturbance of highly important habitat type for multiple species and their life stages due to the staging, excavation, pipe placement and material backfilling, potential habitat overprinting associated with land-marine pipeline connection, increased sedimentation and potential change to sediment quality | • Work during the construction phase will be scheduled to the extent practical to avoid periods of adverse weather or spring tides to reduce turbidity and sedimentation.<br>• Avoid direct removal of eel grass beds where feasible along corridor<br>• An ESCP will be developed for the site that reduces the risk of sedimentation to the marine environment and additional mitigation measures identified as applicable.<br>• Provision of habitat offsetting, if required | Long-term, reversible or largely reversible loss of sensitive fish habitat, which concentrates numerous species | Eelgrass beds are important habitat for stabilization for sediments and providing cover and protection for many marine species including SOCC (i.e., White Hake).<br>Often associated with finer substrate materials in the LAA. | Often associated with finer substrate materials in the LAA with patchy distribution along the corridor | Long-term: impacts to the seaweed in the LAA may result in effects that extend beyond the life of the project | Effect is considered to be continuous through construction and operation and the life of the mill | Effects may be reversible through propagation of existing eel grass beds and recolonization of disturbed areas | Overall effects are considered to be generally minor as the effected vegetation will be specific to a small area within the context of the RAA. | Effect will occur |
| | | | | | | Level III | Level II | Level III | Level II | Level II | Not significant | |

| Phase / Interaction / Component/ Class | Group | Indicator(s) | Potential Effect | Proposed Mitigation | Residual Effect | Residual Significance after Mitigation | | | | | Overall Significance | Likelihood |
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| | | | | | | Value of Group or Indicator | Magnitude / Geographic Extent | Duration | Frequency | Reversibility | | |
| | Substrates / Cover | Cobble/rock, Sand / Silt / Gravel | **Physical** – direct removal, disturbance of existing substrates utilized by multiple species and their life stages due to the staging, excavation, pipe placement and material backfilling,<br><br>Potential habitat overprinting associated with land-marine pipeline connection, increased sedimentation and potential change to sediment quality | • Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages<br>• Work during the construction phase will be scheduled to the extent practical to avoid periods of adverse weather or spring tides to reduce turbidity and sedimentation.<br>• Duration of in-water work will be managed to the shortest time that is practical.<br>• An ESCP will be developed for the site that reduces the risk of sedimentation to the marine environment and additional mitigation measures identified as applicable.<br>• Provision of habitat offsetting, if required | With implementation of mitigation measures, as proposed including those to reduce turbidity and sedimentation and potential.<br><br>Re-use of existing sediment and rock to backfill trench and therefore potential for recolonization within local environment | Resident substrates and particles important to the reproduction and survival of multiple life stages of fin-fish and shell-fish species in the RAA. | Effects are considered to be minor and encompass a small area (confined to the pipeline corridor and diffuser area) | Medium-term: effects are specific to the period of construction and or decommissioning or short periods of maintenance as required throughout the life of the project. | Effect is expected to be continuous through construction, operation / maintenance and decommissioning of the project | Effect is reversible as re-use of sediment to backfill trench and therefore potential for recolonization within local environment. | Overall effects are considered to be generally minor, localized and generally reversible | Effect will occur |
| | | | | | | Level II | Level I | Level II | Level II | Level I | Not Significant | |

# 5.0 MONITORING AND MANAGEMENT

In the context of an EA, follow-up monitoring is used to determine the accuracy of the conclusions of the environmental assessment and the effectiveness of the mitigation measures that have been proposed/implemented. A follow-up program is used to:

- verify predictions of environmental effects identified in the environmental assessment;
- determine the effectiveness of mitigation measures in order to modify or implement new measures where required;
- support the implementation of adaptive management measures to address previously unanticipated adverse environmental effects;
- provide information on environmental effects and mitigation that can be used to improve and/or support future environmental assessments including cumulative environmental effects assessments; and
- support environmental management systems used to manage the environmental effects of projects[5].

There are two components to the follow-up monitoring program[6] that will be implemented at the Project site should the Project move forward. The mill will execute an Environmental Effects Monitoring Program as required by the PPER under the Fisheries Act, and will also execute a Follow-up Performance Monitoring Program that captures a broader range of issues that is not captured by EEM. The primary objective of the EA follow-up monitoring program is to evaluate EA-related predictions and expected ETP and outfall structure performance. This program is provisional at this time and is presented as a program framework, rather than a detailed study plan. Program details will be further developed based on discussions with stakeholders, First Nations and governmental agencies and where appropriate responses to the EA submission.

## 5.1 Environmental Effects Monitoring Program

The proposed EEM Investigations related to the NPNS relocation was provided as part of the original EA (EcoMetrix, 2018a). As noted in that report, the PPER impose various requirements on pulp and paper mills including for example:

[5] https://www.ceaa-acee.gc.ca/499F0D58-B7A1-46C3-BD7E-6E0BD88DED07/follow-up_programs-eng.pdf
[6] Monitoring that is specific to activities such as construction is considered elsewhere and not herein.

- installing, maintaining and calibrating monitoring equipment and keeping records of that equipment;
- monitoring effluent;
- submitting monthly reports containing effluent monitoring results and production information;
- notifying an inspector of a test result that indicates a failure or non-compliance with the Regulations;
- submitting identifying information;
- preparing and updating annually a remedial plan describing the measures to be taken by the operator to eliminate all unauthorized deposits of deleterious substances in the case where effluent fails an acute lethality test;
- preparing an emergency response plan and making it readily available on-site to persons who are to implement the plan;
- providing information related to the reference production rate;
- submitting information on outfall structures and depositing effluent only through those outfall structures;
- complying with requirements for environmental effects monitoring studies;
- keeping records available for inspection;
- requesting an authorization to combine effluents; and,
- providing written reports and additional sampling for the deposit of a deleterious substance in water frequented by fish that is not authorized under the Fisheries Act, which results or may result in detriment to fish, fish habitat or the use of fish by humans.

The amended PPER also prescribed effluent discharge quality criteria that limit the discharge of total suspended solids (TSS), biochemical oxygen demand (BOD) and the acute lethality of effluent. In addition, the amended PPER prescribed that all mills were required to participate in an Environmental Effects Monitoring program.

The EEM program studies are designed to detect and measure changes in aquatic ecosystems into which treated mill effluents are released (i.e., “receiving environments”). The pulp and paper EEM program is an iterative system of monitoring and interpretation phases that is used to help assess the effectiveness of environmental management measures, by evaluating the effects of effluents on fish, fish habitat and the use of fisheries resources by humans. The EEM program goes beyond end-of-pipe measurement of chemicals in effluent to examine the effectiveness of environmental protection measures directly in aquatic ecosystems. Long-term effects are assessed using regular cyclical monitoring and interpretation phases designed to assess and investigate the impacts on the same parameters and locations. In this way, both a spatial characterization of potential effects and a record through time to assess changes in receiving environments are obtained.

The EEM program is by its nature prescriptive and limited in scope. Laboratory and in-field biological assessment for EEM studies consist of:

- sublethal toxicity testing of effluent to monitor effluent quality (PPER section [s.] 29); and,
- biological monitoring studies in the aquatic receiving environment to determine if mill effluent is having an effect on fish, fish habitat or the use of fisheries resources (PPER s. 30).

Within the regulations there are provisions for the removal of the requirements for specific components of the EEM program based on the dilution of effluent to <1%. If the mill demonstrates that the effluent concentration is <1% at a distance of 250 m then the EEM does not require a fish community study component. Likewise, if the mill demonstrates that the effluent concentration is <1% at 100 m from the discharge then a benthic invertebrate community study is not required. The most recent 3D modeling of effluent dispersion in the local study area as part of the updated receiving water study (RWS) indicates that dilution to less <1% effluent will occur at approximately 20 m from the discharge (Stantec ,2019).

With this in mind, the predictions in the most recent RWS indicate there will be no requirement for NPNS to conduct either a fish community or benthic community study in the vicinity of the discharge. These predictions of effluent dilution will need to be confirmed as part of the first EEM study to determine the final components required as part of the EEM. If confirmed there is no regulator requirement for any further field investigations as part of the EEM program unless a major change in discharge volume.

As part of the EEM the mill will continue to be required to conduct, acute and sublethal toxicity testing, effluent parameter analysis and reporting and be subject to the effluent regulations. Although not regulated as part of the PPER some the fish and benthic component studies are still warranted as part of the EA Follow-up Performance Monitoring Program (see below).

## 5.2 EA Follow-up Performance Monitoring Program

A provisional EA Follow-up Monitoring Performance Program was submitted as part of the original EA. (EcoMetrix, 2018b). This provisional program included the following main components:

- Toxicity Testing of Treated Effluent;
- Phytoplankton Community Assessment;
- Zooplankton Community Assessment;
- Benthic Invertebrate Community;
- Water Quality Monitoring; and,
- Fish and Shellfish Tissue Chemistry Investigations.

Fish community and fisheries resource use information has been complied as part of the EA process. Given the level of detail associated with the available information no additional in-field survey programs are proposed.

A brief outline of the provisional sampling program for each component is provide below, as well as the rationale for the inclusion of this in the program. As indicated above, it is expected that specific program details will be further developed based on further discussions with stakeholders, First Nations and governmental agencies and where appropriate responses to the EA submission.

**Toxicity Testing of Treated Effluent**

Local and regional fisheries resource users have raised concerns over potential toxicological effects on fisheries resource use as the result of the proposed discharge of effluent. The primary concerns are related to the potential effects of the new discharge on larval lobster and herring, both locally important species.

To address these concerns, NPNS will continue to investigate the feasibility of performing toxicity testing to determine both potential acute and sublethal effects on immature stages of lobster and herring. Standardized toxicity testing protocols are not available for lobster and herring; however, custom tests have been developed that can be completed using larval lobster and herring embryos. The tests will include Stage I-IV larval lobster and include a live-dead (acute) assessment of the various stages, as well as the assessment of sublethal effects on moulting time and growth. Herring tests on embryos would be similar in that they would assess acute toxicity to eggs, as well as the growth post-hatch for a number of days.

**Phytoplankton Community Assessment**

Seasonal phytoplankton sampling will be conducted. Phytoplankton will be collected in a depth integrated manner. Samples will be collected at top, middle and bottom of the water column and a 250 mL subsample of this composite will be preserved for analysis. Phytoplankton will be identified to the lowest practical taxonomic level. Phytoplankton data will be summarized in terms of species composition, distribution and abundance. Performance monitoring results will be compared to the baseline collections in 2019.

**Zooplankton Community Assessment**

Zooplankton sampling, including live-dead assessments, will provide information concerning species composition, distribution and abundance in the study area. Seasonal zooplankton sampling will be conducted, with samples collected coincident with phytoplankton sampling. Zooplankton will be collected by oblique and vertical tows. The plankton net (1 m diameter, 300 micron mesh) will be pulled through the water column as the boat drifts for the oblique tows and from the bottom to surface with the boat anchored for vertical tows. Samples will be collected at the same locations as for phytoplankton. Zooplankton will be identified to the lowest practical taxonomic level. Zooplankton data will be summarized in terms of species composition, distribution and abundance. Performance monitoring results will be compared to the baseline collections in 2019.

**Benthic Invertebrate Community**

The benthic invertebrate community may be affected by both construction activities associated with the new proposed effluent pipeline and outfall structure, as well as with the potential exposure to effluent once the discharge of effluent has commenced. As mentioned above the requirement for a benthic community assessment as part of the federally regulated EEM program may not be necessary due to rapid dilution of the effluent after discharge. However, sampling to determine the recolonization of the disturbed areas will be undertaken along the pipeline corridor, as well as in the vicinity of the discharge. Additionally, although not a requirement of the EEM and study design that is similar in scope may be warranted to address some of the stakeholder's concerns about the potential impacts of the discharge. The scope of the monitoring outside the immediate disturbed areas will need to be finalized following acceptance of the proposed Project.

It is proposed that benthic samples will be collected at a minimum of three stations within the various substrate types along the in-water portion of the pipeline corridor. Conservatively, this would total approximately 15 stations along the corridor. Samples will be collected with a petit Ponar grab and sieved through 500 micron mesh. Detailed taxonomic identification of the resident benthic taxa in the samples will be undertaken. Invertebrates will be identified to the lowest practical taxonomic level. Raw data will be summarized to express the benthic invertebrate community in terms of metrics of abundance, diversity and community structure.

Sampling that occurs following the construction of the proposed ETP and discharge structure and commencement of treated effluent discharge will be compared to baseline data collected in 2019.

**Water quality**

Baseline water samples have been collected for the measurement of:

- dissolved oxygen levels;

- temperature;
- salinity;
- colour;
- pH;
- total suspended solids;
- turbidity;
- dissolved organic carbon;
- total organic carbon;
- total Kjeldahl nitrogen;
- total phosphorus;
- total nitrogen;
- metal scan;
- low level mercury;
- Resin fatty acids;
- $BOD_5$;
- Dioxins;
- Furans;
- Total phenols; and,
- AOX

Water sampling would be implemented following the commencement of discharge from the new ETF. Samples would be collected in areas in close proximity to the discharge and at areas further removed from the discharge at surface and at depth on a seasonal basis to test the predictions made by the surface water quality assessment (Stantec, 2019).

**Fish and Shellfish Tissue Chemistry Investigations**

To date, baseline data has been collected for lobster, rock crab and quahogs in the general vicinity of the proposed new discharge. These samples were analyzed to support the Human Health Risk Assessment (HHRA) and can also be used as baseline data to which future data can be compared.

Following completion of the HHRA, the potential utility of a continued fish tissue monitoring program following commissioning of the effluent treatment system and subsequent discharge will need to be discussed with First Nations, stakeholders and government agencies. The potential studies are still likely to target: lobster, rock crab, scallop, blue mussel, softshell clam, oyster, and locally relevant finfish (e.g., Eel, Smelt, Gaspereau, Striped Bass, Mackerel, Atlantic Herring). Given the likely timing for EA approval and the subsequent construction and commissioning of the proposed ETF, it will be possible to target collections of any of the species identified above that have not already been collected for baseline purposes (i.e., predevelopment) should engagement indicate the need.

It should be noted that dioxin and furan testing in fish or shellfish tissues for EEM is not likely to be required by the PPER based on current and predicted future levels of these constituents in mill effluent. Annual testing of treated effluent for dioxins and furans in the future treated effluent will continue to be performed as per the requirements set out in the Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations.

# 6.0 ASSESSMENT SUMMARY AND CONCLUSIONS

A summary of the assessment findings and conclusions are provided below.

- The current assessment has concluded that following mitigation there are no significant residual effects associated with the Project on any of the VECs
- In general potential effects that are associated with physical disturbance are small in terms of spatial extent (e.g., limited to the construction area), are of short duration (e.g., are limited to the construction timing window) and are reversible (e.g., once construction is complete the areas that are affected will be suitable to be re-inhabited by marine fauna)
- In general potential effects that are associated with chemical disturbance are small in magnitude (e.g., the concentrations of chemical parameters in the Northumberland Strait are less than water quality guideline levels for the protection of aquatic life) and are small in terms of spatial extent (e.g., the concentrations of chemical parameters in the Northumberland Strait will be indistinguishable from background levels within metres of the discharge.
- Based on the socio-economic importance of American Lobster, Rock Crab and Atlantic Mackerel that may have a higher potential for interaction with the project than some other indicators that were assessed specific to the Marine Fish and Fish Habitat VEC, it is recommended that EA Follow-up Monitoring be undertaken. The purpose of such monitoring should be to identify if predictions with respect to water quality and potential impacts are consistent with the conducted assessment.

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# Appendix A Terms of Reference for the Preparation of the Focus Report Regarding the Replacement Effluent Treatment Facility Project Proposed by Northern Pulp Nova Scotia Corporation

# TERMS OF REFERENCE FOR THE PREPARATION OF A FOCUS REPORT

## Regarding the Replacement Effluent Treatment Facility Project Proposed by Northern Pulp Nova Scotia Corporation

**NOVA SCOTIA ENVIRONMENT**
**April 23, 2019**

## INTRODUCTION

The Replacement Effluent Treatment Facility Project (the Project or undertaking) proposed by Northern Pulp Nova Scotia Corporation (NPNS) was registered on February 7, 2019 for environmental assessment (EA) as a Class 1 undertaking pursuant to Part IV of the *Environment Act* and the Environmental Assessment Regulations.

On March 29, 2019, the Minister of Environment released a decision concerning this review. The Minister has determined that the EA Registration Document (EARD) is insufficient to make a decision on the Project, and a Focus Report is required in accordance with clause 13(1)c of the Environmental Assessment Regulations, pursuant to Part IV of the *Environment Act*.

NPNS is required to submit the Focus Report within one year of receipt of the Terms of Reference. Upon submission of the Focus Report by NPNS, Nova Scotia Environment (NSE) has 14 days to publish a notice advising the public where the Focus Report can be accessed for review and comment.

A 30-day public consultation period of the Focus Report follows. At the conclusion of the 30-day public consultation period, NSE has 25 days to review comments, and provide a recommendation to the Minister.

The Minister of Environment will have the following decision options, following the review of the Focus Report:

a. the undertaking is approved subject to specified terms and conditions and any other approvals required by statute or regulation;

b. an Environmental-Assessment Report is required; or

c. the undertaking is rejected.

During the preparation of the Focus Report, it is strongly recommended that NPNS continues to engage with relevant stakeholders and the Mi'kmaq including Pictou Landing First Nation, and to share relevant studies and reports.

**Within the Focus Report, all impact assessment, mitigation and impact conclusions outlined in the Environmental Assessment Registration Document must be updated based upon the information requirements outlined below. The Addendum to this document includes additional questions for consideration and response. Consultation with NSE in the development of the Focus Report is required.**

**TERMS OF REFERENCE**

**The following items must be included in the Focus Report submission:**

## 1. PUBLIC, MI'KMAQ AND GOVERNMENT ENGAGEMENT

1.1 Provide a response (via a concordance table) to questions and comments raised by the public, Mi'kmaq and government departments, and incorporate these comments in the Focus Report where applicable. Comments may be summarized prior to providing the response.

1.2 Provide a plan to share future reports and/or studies relevant to this Project with the public and the Mi'kmaq such as the Pictou Landing First Nation, including but not limited to the future Environmental Effects Monitoring results for the new effluent treatment facility.

## 2. PROJECT DESCRIPTION

2.1 Provide the following information regarding the on-land portion of the effluent pipeline:
- a re-alignment route for the effluent pipeline, given Department of Transportation and Infrastructure Renewal does not permit the pipeline to be placed in the shoulder of Highway 106;
- maps and/or drawings of the new pipeline location;
- a list of properties (ie., Premises Identification number or PID) that will intersect with the new pipeline alignment.

2.2 Conduct geotechnical surveys and provide the survey results to confirm viability of the marine portion of the pipeline route. The surveys must determine the potential impacts of ice scour on the pipeline.

2.3 Submit data regarding the complete physical and chemical characterization of NPNS' raw wastewater (ie., influent at Point A for the Project), to support the assessment of the appropriateness of the proposed treatment technology. The influent characterization results must be compared against the proposed treatment technology specifications.

2.4 Submit a complete physical and chemical characterisation of NPNS's expected effluent following treatment by the proposed technology. To assess the efficacy of the proposed treatment technology, the following must be included:
- Data from laboratory trials on NPNS's raw wastewater that were conducted at Veolia/AnoxKaldnes in Lund, Sweden in May 2018;
- Modelling results using the raw wastewater parameters and quality;
- A comparison of the effluent characterization results from the laboratory trials and modelling work, against appropriate regulations and/or guidelines.

2.5 Provide any proposed changes to the pipeline construction methodology and other associated pipeline construction work, related to the potential changes to the marine portion of the pipeline route (e.g., infilling, trenching, temporary access roads, excavation, blasting, disposal at sea, and others where applicable).

## 3. FACILITY DESIGN, CONSTRUCTION & OPERATION AND MAINTENANCE

3.1 Submit treatment technology specifications (e.g., optimal performance range of the technology) and an assessment of the efficacy of the proposed treatment technology for use at the NPNS facility, to the satisfaction of NSE. For example, peak effluent temperature is proposed to be above the generally accepted range of temperatures to achieve optimal biological treatment. Explain how the proposed higher than optimal treatment temperature would affect the treatment performance.

3.2 Provide effluent flow data to support the proposed peak treatment capacity of 85,000 $m^3$ maximum flow of effluent per day. At a minimum, data from 2017 and 2018 is required. Provide flow data for Point A, clarify source of the effluent flow volumes given in the EARD, and provide other relevant data and information to support the proposed treatment system design. If the 85,000 $m^3$ cannot be justified based on historical data, identify water reduction projects, or re-evaluate the treatment system design and update the receiving water study accordingly.

3.3 Effluent discharge parameters must be updated (where necessary) based upon the results of the effluent characterization in Section 2.4 and relevant additional studies. Refer also to Addendum item 2.0

3.4 Provide the following information regarding the spill basin:

- Submit information to assess the sizing and appropriateness of the design of the spill basin. The EARD indicates a retention time of 10-13 hours at a design capacity of 35,000 $m^3$. The basis of this design has not been provided. If flows exceed 85,000$m^3$ per day on a consistent basis (e.g., during summer months), confirm that there will be sufficient recovery time in the treatment system to empty the basin before the additional volume is required;
- Explain where the overflow will be directed in the event of unforeseen scenarios (e.g., power outage).

3.5 Provide the following information regarding the effluent pipeline:

- Provide viable options including the selected option for leak detection technologies and inspection methodologies, with specific consideration to any portion of the pipeline located in the Town of Pictou's water supply protection area;
- Provide viable options including the selected option for the enhanced pipeline protection, such as trench lining and justify how the chosen option is an adequate option for secondary containment. Be sure to address any potential changes in flow regimes, especially within the Town of Pictou's water supply protection area, due to the installation

of the pipeline and secondary containment. If different options are provided for different areas of the proposed re-aligned pipeline route, the locations for each option must be identified.

3.6 Clarify where the potential releases of waste dangerous goods at the Project site will be directed for treatment and/or disposal. It is important to note that the new treatment facility is not proposed to treat waste dangerous goods based on the information provided in the EARD and requirements of NSE.

## 4. MARINE WATER AND MARINE SEDIMENT

4.1 Conduct baseline studies for the marine environment (such as marine water quality and marine sediment) in the vicinity of proposed marine outfall location.

4.2 Update the receiving water study to model for all potential contaminants of concern in the receiving environment (based on the results of the effluent characterization and/or other relevant studies such as Human Health Risk Assessment). Baseline water quality data for Caribou harbour must be applied to this study. Refer also to Addendum 3.0.

4.3 Provide results of sediment transport modelling work to understand the impacts of potential accumulation of sediment within near field and far field model areas. This should include chemical and physical characterization of the solids proposed to be discharged by NPNS as well as a discussion of how these solids will interact with the marine sediments and what the potential impact will be on the marine environment as a result.

## 5. FRESH WATER RESOURCES

5.1 Complete a wetland baseline survey along the proposed re-aligned effluent pipeline route (if wetlands are expected to be altered).

5.2 Provide monitoring methodologies for areas with significant risk of pipeline leaks or spills (e.g., two areas where the pipeline crosses the Source Water Protection Delineated Boundary for the Town of Pictou wellfields; below water table; important wetlands; watercourse crossings; etc.).

## 6. AIR QUALITY

6.1 Provide a revised inventory of all potential air contaminants to be emitted from the proposed project, including but not limited to, speciated volatile organic compounds, semi-volatile organic compounds, reduced sulphur compounds, polyaromatic hydrocarbons and metals.

6.2 Update the air dispersion modelling for the pulp mill facility for all potential air contaminants of concern related to the Project.

6.3 Complete an updated ambient air monitoring plan for the Project site based on the air dispersion modelling results. This plan must include the potential air contaminants to be monitored and proposed air monitoring location(s).

## 7. FISH AND FISH HABITAT

7.1 Conduct fish and fish habitat baseline surveys for the freshwater environment, to the satisfaction of Fisheries and Oceans Canada.

7.2 Conduct fish habitat baseline surveys for the marine environment, to the satisfaction of Fisheries and Oceans Canada.

7.3 Conduct additional impact assessment of treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. This must be based upon updated information, additional studies and/or an understanding of expected movement of contaminants. Assessment methodology must first be agreed upon by NSE in consultation with relevant federal departments.

7.4 Submit an updated Environmental Effects Monitoring (EEM) program based on the results of various relevant baseline studies and an updated receiving water study. Refer also to Addendum item 4.0

7.5 Clarify what contingency measures will be in place to mitigate potential impacts (e.g., thermal shock to fish) due to potential large and rapid fluctuations in water temperature in the winter at the diffuser location during low production or maintenance shut down periods.

## 8. FLORA AND FAUNA

8.1 Complete a plant baseline survey along the proposed re-aligned effluent pipeline route.

8.2 Complete a migratory bird survey along the re-aligned pipeline route.

8.3 Complete a bird baseline survey for common nighthawk (*Chordeiles minor*), double crested cormorants (*Phalacrocorax auratus*), owls, and raptors and raptor nests, for the entire project area which includes the re-aligned pipeline route.

8.4 Complete a herptile survey for the Project area which includes the re-aligned pipeline route.

## 9. HUMAN HEALTH

9.1 Complete baseline studies for fish and shellfish tissue (via chemical analysis) of representative key marine species important for commercial, recreational and Aboriginal fisheries in the vicinity of the proposed effluent pipeline and diffuser location.

9.2 Commence a Human Health Risk Assessment (HHRA) to assess potential project-related impacts on human health. The risk assessment must consider human consumption of fish and other seafood, consumption of potentially contaminated drinking water, exposure to recreational water and sediment, outdoor air inhalation, and any other potential exposure pathways. The analysis must inform the identification of contaminants of concern and updating of the receiving water study.

## 10. ARCHAEOLOGY

10.1 Complete an Archaeological Resource Impact Assessment for the marine environment related to the Project.

10.2 Complete shovel testing for areas in the terrestrial environment that are identified to have elevated or medium potential of archaeological resources, to confirm the presence or absence of these resources.

## 11. INDIGENOUS PEOPLE’S USE OF LAND AND RESOURCES

11.1 Complete a Mi’kmaq Ecological Knowledge Study (MEKS) for the Project.

**ADDENDUM: Items Raised by Reviewers Requiring Clarification**

**The following items must be addressed with NSE and included in the Focus Report where appropriate:**

1.0 Provide information regarding whether and when new technology and equipment will be installed at the NPNS pulp mill to improve the effluent quality, including but not limited to the following:

- Will $O_2$ delignification be installed at the NPNS pulp mill?
- What other technology and equipment will be installed at the NPNS pulp mill?
- How will each proposed new technology and/or equipment improve the effluent quality?

2.0 With respect to the effluent discharge parameters:

- Explain why the total nitrogen parameter has changed to 6 mg/L (daily maximum) from the 3 mg/L (proposed in the August 11, 2017 receiving water study);
- Provide data to support assertions that chemical oxygen demand (COD) can be reduced to the proposed limit.

3.0 With respect to the updating of the Receiving Water Study:

- Provide a response to questions and comments on the receiving water study (not already outlined in this document) from Environment and Climate Change Canada's EARD review submission dated March 18, 2019, and update the receiving water study as applicable;
- Explain how the initial mixing and dispersal of the plume was taken into account when simulating far-field extent and concentrations of effluent in Section 3 of Appendix E1 of EARD. It appears that the far-field model simulations were run before the near-field model. One could expect that the behaviour of the plume further afield depends a large extent on how it behaved at the diffuser, i.e. how quickly it mixed and spread and rose to the surface;
- Confirm dilution ratios and distances required to achieve background level for water quality parameters in Appendix E1 of the EARD, as the dilution ratios and distances may be overestimated;
- Explain if the salinity and temperature differential between the effluent and the receiving waters has been accounted for in the model. When the buoyancy differential between the effluent and receiving waters are greater in winter, it results in a faster rising plume. This can potentially affect the visibility of the effluent in the receiving environment. Has this been accounted for in the model? Also provide results for winter conditions;
- Explain if re-entrainment of effluent and sediment at the diffuser location was accounted for in the one-hour period surrounding slack tide. Support this explanation with model results using a smaller time step (30 minutes) if necessary.

4.0 It is important to note that the following field study and monitoring are likely to be required as part of an EEM program regulated under the Pulp and Paper Effluent Regulations for the Project if it is approved:

- Field delineation of treated effluent plume to confirm the prediction from the receiving water study;
- Monitoring of marine water quality and marine sediment quality;
- Sublethal toxicity testing and chemistry testing of the treated effluent; and
- Biological monitoring studies including benthic invertebrate community study, fish population study, and dioxin and furan levels in fish as applicable.

# Appendix B Baseline Water Quality Results

## Appendix B-1: Background Water Quality at Diffuser Location (2018 - 2019)

| Parameter | Units | CCME Guideline | Total Count | Count (<RDL) | Minimum | Median | Maximum |
|---|---|---|---|---|---|---|---|
| **General Chemistry & Phyiscal Parameters** | | | | | | | |
| Colour | TCU | - | 14 | 13 | <5 | <5 | <250 |
| Conductivity | µS/cm | - | 14 | 0 | 40000 | 40000 | 44000 |
| pH | pH | 7 - 8.7 | 14 | 0 | 7.53 | 7.675 | 7.8 |
| Salinity | N/A | - | 14 | 0 | 26 | 29 | 30 |
| Dissolved Organic Carbon (C) | mg/L | - | 13 | 9 | 1.6 | <5 | <5 |
| Total Organic Carbon (C) | mg/L | - | 14 | 9 | 1.9 | <5 | <5 |
| Total Dissolved Solids | mg/L | - | 14 | 0 | 26000 | 27000 | 29000 |
| Total Suspended Solids | mg/L | - | 14 | 0 | 1 | 2.1 | 7.4 |
| Turbidity | NTU | - | 14 | 0 | 0.36 | 0.77 | 1.7 |
| **Oxygen Demand** | | | | | | | |
| Biochemical Oxygen Demand | mg/L | - | 1 | 1 | <12 | <12 | <12 |
| Dissolved Biochemical Oxygen Demand | mg/L | - | 1 | 0 | 670 | 670 | 670 |
| Carbonaceous BOD | mg/L | - | 13 | 13 | <5 | <5 | <17 |
| Total Chemical Oxygen Demand | mg/L | - | 14 | 0 | 840 | 935 | 1800 |
| Dissolved Chemical Oxygen Demand | mg/L | - | 1 | 1 | <20 | <20 | <20 |
| Volatile Suspended Solids | mg/L | - | 13 | 6 | <2 | 2.2 | <20 |
| **Anions and Nutrients** | | | | | | | |
| Total Residual Chlorine | mg/L | 0.50 | 1 | 1 | <0.1 | <0.1 | <0.1 |
| Total Alkalinity (Total as CaCO3) | mg/L | - | 14 | 0 | 90 | 92.5 | 96 |
| Hardness (CaCO3) | mg/L | - | 14 | 0 | 4900 | 5200 | 5400 |
| Dissolved Chlorate (ClO3-) | mg/L | - | 10 | 10 | <1 | <1 | <1 |
| Dissolved Chloride (Cl-) | mg/L | - | 14 | 0 | 13000 | 14000 | 17000 |
| Dissolved Chlorite (CLO2-) | mg/L | - | 14 | 14 | <0.6 | <1 | <1 |
| Dissolved Fluoride (F-) | mg/L | - | 1 | 1 | <0.1 | <0.1 | <0.1 |
| Total Phosphorus | mg/L | - | 14 | 13 | <0.02 | <0.02 | <0.04 |
| Orthophosphate (P) | mg/L | - | 14 | 14 | <0.01 | <0.01 | <0.01 |
| Total Nitrogen (N) | mg/L | - | 14 | 0 | 0.118 | 0.1475 | 0.524 |
| Total Kjeldahl Nitrogen (TKN) | mg/L | - | 14 | 0 | 0.12 | 0.155 | 0.42 |
| Nitrogen (Ammonia Nitrogen) | mg/L | - | 14 | 13 | <0.05 | <0.05 | 0.067 |
| Nitrate (N) | mg/L | 45.2 | 14 | 13 | <0.05 | <0.05 | 0.071 |
| Nitrate + Nitrite (N) | mg/L | - | 14 | 13 | <0.05 | <0.05 | 0.071 |
| Nitrite (N) | mg/L | - | 14 | 14 | <0.01 | <0.01 | <0.01 |
| Sulphide (as H2S) | mg/L | - | 4 | 4 | <0.011 | <0.011 | <0.011 |
| Sulphide | mg/L | - | 5 | 5 | <0.02 | <0.1 | <0.1 |
| Dissolved Sulphate (SO4) | mg/L | - | 14 | 0 | 1900 | 2100 | 2400 |
| Reactive Silica (SiO2) | mg/L | - | 14 | 13 | <0.5 | <0.5 | 0.54 |
| Total Cyanide (CN) | mg/L | - | 14 | 14 | <0.001 | <0.005 | <0.005 |
| **Oil and Grease** | | | | | | | |
| Total Oil & Grease | mg/L | - | 1 | 0 | 2 | 2 | 2 |
| **Metals** | | | | | | | |
| Total Aluminum (Al) | µg/L | - | 14 | 13 | <5 | <50 | 5700 |
| Total Antimony (Sb) | µg/L | - | 14 | 14 | <1 | <10 | <10 |
| Total Arsenic (As) | µg/L | 12.5 | 14 | 14 | <1 | <10 | <10 |
| Total Barium (Ba) | µg/L | - | 14 | 5 | <1 | 10 | 13 |
| Total Beryllium (Be) | µg/L | - | 14 | 14 | <1 | <10 | <10 |
| Total Bismuth (Bi) | µg/L | - | 14 | 14 | <2 | <20 | <20 |
| Total Boron (B) | µg/L | - | 14 | 0 | 3600 | 3950 | 4500 |
| Total Cadmium (Cd) | µg/L | 0.12 | 14 | 13 | <0.01 | <0.1 | 0.12 |
| Total Calcium (Ca) | µg/L | - | 14 | 0 | 310000 | 330000 | 340000 |
| Total Chromium (Cr) | µg/L | 56 | 14 | 14 | <1 | <10 | <10 |
| Total Cobalt (Co) | µg/L | - | 14 | 14 | <0.4 | <4 | <4 |
| Total Copper (Cu) | µg/L | - | 14 | 14 | <0.5 | <5 | <5 |
| Total Iron (Fe) | µg/L | - | 14 | 14 | <50 | <500 | <500 |
| Total Lead (Pb) | µg/L | - | 14 | 14 | <0.5 | <5 | <5 |
| Total Magnesium (Mg) | µg/L | - | 14 | 0 | 1000000 | 1100000 | 1100000 |
| Total Manganese (Mn) | µg/L | - | 14 | 14 | <2 | <20 | <20 |
| Total Mercury (Hg) | µg/L | 0.016 | 14 | 12 | <0.002 | <0.00225 | <0.013 |
| Total Molybdenum (Mo) | µg/L | - | 14 | 14 | <2 | <20 | <20 |
| Total Nickel (Ni) | µg/L | - | 14 | 14 | <2 | <20 | <20 |
| Total Phosphorus (P) | µg/L | - | 14 | 14 | <100 | <1000 | <1000 |
| Total Potassium (K) | µg/L | - | 14 | 0 | 290000 | 310000 | 320000 |
| Total Selenium (Se) | µg/L | - | 14 | 14 | <1 | <10 | <10 |
| Total Silver (Ag) | µg/L | 7.5 | 14 | 14 | <0.1 | <1 | <1 |
| Total Sodium (Na) | µg/L | - | 14 | 0 | 8200000 | 8600000 | 8900000 |
| Total Strontium (Sr) | µg/L | - | 14 | 0 | 5600 | 6050 | 6300 |
| Total Thallium (Tl) | µg/L | - | 14 | 14 | <0.1 | <1 | <1 |
| Total Tin (Sn) | µg/L | - | 14 | 14 | <2 | <20 | <20 |

## Appendix B-1: Background Water Quality at Diffuser Location (2018 - 2019)

| Parameter | Units | CCME Guideline | Total Count | Count (<RDL) | Minimum | Median | Maximum |
|---|---|---|---|---|---|---|---|
| Total Titanium (Ti) | µg/L | - | 14 | 14 | <2 | <20 | <20 |
| Total Uranium (U) | µg/L | - | 14 | 0 | 2.2 | 2.6 | 2.9 |
| Total Vanadium (V) | µg/L | - | 14 | 14 | <2 | <20 | <20 |
| Total Zinc (Zn) | µg/L | - | 14 | 14 | <5 | <50 | <50 |
| **Dioxins & Furans** | | | | | | | |
| 2,3,7,8-Tetra CDD | pg/L | - | 13 | 13 | <0.788 | <1.11 | <1.18 |
| C13-2378 TetraCDD | % | - | 9 | 0 | 64 | 86 | 101 |
| 1,2,3,7,8-Penta CDD | pg/L | - | 13 | 13 | <0.96 | <1.08 | <1.63 |
| C13-12378 PentaCDD | % | - | 9 | 0 | 77 | 95 | 112 |
| 1,2,3,4,7,8-Hexa CDD | pg/L | - | 13 | 13 | <0.971 | <1.18 | <9.48 |
| 1,2,3,6,7,8-Hexa CDD | pg/L | - | 13 | 13 | <0.952 | <1.05 | <9.48 |
| 1,2,3,7,8,9-Hexa CDD | pg/L | - | 13 | 13 | <0.891 | <1.07 | <1.64 |
| C13-123678 HexaCDD | % | - | 9 | 0 | 79 | 97 | 105 |
| 1,2,3,4,6,7,8-Hepta CDD | pg/L | - | 13 | 13 | <0.912 | <1.57 | <3.79 |
| C13-1234678 Hepta CDD | % | - | 9 | 0 | 102 | 127 | 138 |
| Octa CDD | pg/L | - | 13 | 5 | 1.38 | <11.3 | 47.5 |
| C13-OCDD | % | - | 9 | 0 | 104 | 127 | 143 |
| Total Tetra CDD | pg/L | - | 13 | 13 | <0.963 | <1.11 | <9.48 |
| Total Penta CDD | pg/L | - | 13 | 13 | <0.96 | <1.11 | <9.48 |
| Total Hexa CDD | pg/L | - | 13 | 13 | <0.986 | <1.11 | <17.9 |
| Total Hepta CDD | pg/L | - | 13 | 10 | <0.912 | <2.68 | 4.45 |
| 2,3,7,8-Tetra CDF | pg/L | - | 13 | 13 | <0.822 | <1.02 | <1.14 |
| C13-2378 TetraCDF | % | - | 9 | 0 | 68 | 84 | 92 |
| 1,2,3,7,8-Penta CDF | pg/L | - | 13 | 13 | <0.964 | <1.08 | <1.42 |
| 2,3,4,7,8-Penta CDF | pg/L | - | 13 | 13 | <0.992 | <1.09 | <1.46 |
| C13-12378 PentaCDF | % | - | 9 | 0 | 63 | 75 | 87 |
| 1,2,3,7,8,9-Hexa CDF | pg/L | - | 13 | 13 | <1 | <1.3 | <1.98 |
| 1,2,3,4,7,8-Hexa CDF | pg/L | - | 13 | 13 | <0.922 | <1.02 | <9.48 |
| 1,2,3,6,7,8-Hexa CDF | pg/L | - | 13 | 13 | <0.8 | <0.938 | <9.48 |
| 2,3,4,6,7,8-Hexa CDF | pg/L | - | 13 | 13 | <0.906 | <1.14 | <1.74 |
| C13-123678 HexaCDF | % | - | 9 | 0 | 59 | 76 | 81 |
| 1,2,3,4,6,7,8-Hepta CDF | pg/L | - | 13 | 13 | <0.87 | <1.42 | <2.42 |
| 1,2,3,4,7,8,9-Hepta CDF | pg/L | - | 13 | 13 | <0.999 | <1.92 | <3.27 |
| C13-1234678 HeptaCDF | % | - | 9 | 0 | 99 | 122 | 129 |
| Octa CDF | pg/L | - | 13 | 13 | <0.553 | <2.48 | <4.3 |
| Total Tetra CDF | pg/L | - | 13 | 13 | <0.934 | <1.05 | <9.48 |
| Total Penta CDF | pg/L | - | 13 | 13 | <0.978 | <1.09 | <9.48 |
| Total Hexa CDF | pg/L | - | 13 | 13 | <0.911 | <1.08 | <1.65 |
| Total Hepta CDF | pg/L | - | 13 | 13 | <0.935 | <1.84 | <2.78 |
| **Organic Halogens** | | | | | | | |
| Adsorbable Organic Halogen | mg/L | - | 5 | 5 | <0.25 | <0.25 | <0.25 |
| **Glycols** | | | | | | | |
| Diethylene Glycol | mg/L | - | 1 | 1 | <5 | <5 | <5 |
| Ethylene Glycol | mg/L | - | 1 | 1 | <3 | <3 | <3 |
| Propylene Glycol | mg/L | - | 1 | 1 | <5 | <5 | <5 |
| Triethylene Glycol | mg/L | - | 1 | 1 | <5 | <5 | <5 |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | | |
| 1-Chloronaphthalene | µg/L | - | 1 | 1 | <4 | <4 | <4 |
| 1-Methylnaphthalene | µg/L | - | 14 | 14 | <0.05 | <0.05 | <0.05 |
| 2-Chloronaphthalene | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| 2-Methylnaphthalene | µg/L | - | 14 | 14 | <0.05 | <0.05 | <0.05 |
| Acenaphthene | µg/L | - | 14 | 14 | <0.01 | <0.01 | <0.01 |
| Acenaphthylene | µg/L | - | 14 | 14 | <0.01 | <0.01 | <0.03 |
| Anthracene | µg/L | - | 14 | 14 | <0.01 | <0.01 | <0.02 |
| Benzo(a)anthracene | µg/L | - | 14 | 14 | <0.01 | <0.01 | <0.01 |
| Benzo(a)pyrene | µg/L | - | 14 | 14 | <0.01 | <0.01 | <0.01 |
| Benzo(b)fluoranthene | µg/L | - | 14 | 14 | <0.01 | <0.01 | <0.01 |
| Benzo(b/j)fluoranthene | µg/L | - | 14 | 14 | <0.02 | <0.02 | <0.02 |
| Benzo(g,h,i)perylene | µg/L | - | 14 | 14 | <0.01 | <0.01 | <0.01 |
| Benzo(j)fluoranthene | µg/L | - | 14 | 14 | <0.01 | <0.01 | <0.01 |
| Benzo(k)fluoranthene | µg/L | - | 14 | 14 | <0.01 | <0.01 | <0.01 |
| Chrysene | µg/L | - | 14 | 14 | <0.01 | <0.01 | <0.01 |
| Dibenz(a,h)anthracene | µg/L | - | 14 | 14 | <0.01 | <0.01 | <0.01 |
| Fluoranthene | µg/L | - | 14 | 14 | <0.01 | <0.01 | <0.01 |
| Fluorene | µg/L | - | 14 | 14 | <0.01 | <0.01 | <0.1 |
| Indeno(1,2,3-cd)pyrene | µg/L | - | 14 | 14 | <0.01 | <0.01 | <0.01 |
| Naphthalene | µg/L | 1.4 | 14 | 14 | <0.2 | <0.2 | <0.2 |
| Perylene | µg/L | - | 14 | 14 | <0.01 | <0.01 | <0.01 |

## Appendix B-1: Background Water Quality at Diffuser Location (2018 - 2019)

| Parameter | Units | CCME Guideline | Total Count | Count (<RDL) | Minimum | Median | Maximum |
|---|---|---|---|---|---|---|---|
| Phenanthrene | µg/L | - | 14 | 14 | <0.01 | <0.01 | <0.01 |
| Pyrene | µg/L | - | 14 | 14 | <0.01 | <0.01 | <0.02 |
| **Volatile Organics** | | | | | | | |
| 1,1,1-Trichloroethane | µg/L | - | 14 | 14 | <1 | <1 | <1 |
| 1,1,2,2-Tetrachloroethane | µg/L | - | 14 | 14 | <0.5 | <0.5 | <0.5 |
| 1,1,2-Trichloroethane | µg/L | - | 14 | 14 | <1 | <1 | <1 |
| 1,1-Dichloroethane | µg/L | - | 14 | 14 | <2 | <2 | <2 |
| 1,1-Dichloroethylene | µg/L | - | 14 | 14 | <0.5 | <0.5 | <71 |
| 1,2-Dichlorobenzene | µg/L | 42 | 14 | 14 | <0.5 | <0.5 | <0.5 |
| 1,2-Dichloroethane | µg/L | - | 14 | 14 | <1 | <1 | <1 |
| 1,2-Dichloropropane | µg/L | - | 14 | 14 | <0.5 | <0.5 | <0.5 |
| 1,3-Dichlorobenzene | µg/L | - | 14 | 14 | <1 | <1 | <1 |
| 1,4-Dichlorobenzene | µg/L | - | 14 | 14 | <1 | <1 | <1 |
| Benzene_VOC | mg/L | 0.11 | 14 | 14 | <0.001 | <0.001 | <0.001 |
| Bromodichloromethane | µg/L | - | 14 | 14 | <0.2 | <1 | <1 |
| Bromoform | µg/L | - | 14 | 14 | <0.2 | <1 | <1 |
| Bromomethane | µg/L | - | 14 | 14 | <0.5 | <0.5 | <0.5 |
| Carbon Tetrachloride | µg/L | - | 14 | 14 | <0.5 | <0.5 | <0.5 |
| Chlorobenzene | µg/L | 25 | 14 | 14 | <1 | <1 | <1 |
| Chloroethane | µg/L | - | 14 | 14 | <8 | <8 | <8 |
| Chloroform | µg/L | - | 14 | 14 | <0.2 | <1 | <1 |
| Chloromethane | µg/L | - | 14 | 14 | <8 | <8 | <8 |
| cis-1,2-Dichloroethylene | µg/L | - | 14 | 14 | <0.5 | <0.5 | <0.5 |
| cis-1,3-Dichloropropene | µg/L | - | 14 | 14 | <0.5 | <0.5 | <0.5 |
| Dibromochloromethane | µg/L | - | 14 | 14 | <0.2 | <1 | <1 |
| Ethylbenzene_VOC | mg/L | 0.025 | 14 | 14 | <0.001 | <0.001 | <0.001 |
| Ethylene Dibromide | µg/L | - | 14 | 14 | <0.2 | <0.2 | <1 |
| Methyl t-butyl ether (MTBE) | µg/L | 5000 | 14 | 14 | <2 | <2 | <2 |
| Methylene Chloride(Dichloromethane) | µg/L | - | 14 | 14 | <3 | <3 | <3 |
| o-Xylene_VOC | µg/L | - | 14 | 14 | <1 | <1 | <1 |
| p+m-Xylene_VOC | µg/L | - | 14 | 14 | <2 | <2 | <2 |
| Styrene | µg/L | - | 14 | 14 | <1 | <1 | <1 |
| Tetrachloroethylene | µg/L | - | 14 | 14 | <1 | <1 | <1 |
| Toluene_VOC | mg/L | 0.215 | 14 | 14 | <0.001 | <0.001 | <0.001 |
| Total Trihalomethanes | µg/L | - | 14 | 14 | <1 | <1 | <1 |
| Total Xylenes_VOC | mg/L | - | 14 | 14 | <0.001 | <0.001 | <0.001 |
| trans-1,2-Dichloroethylene | µg/L | - | 14 | 14 | <0.5 | <0.5 | <0.5 |
| trans-1,3-Dichloropropene | µg/L | - | 14 | 14 | <0.5 | <0.5 | <0.5 |
| Trichloroethylene | µg/L | - | 14 | 14 | <1 | <1 | <1 |
| Trichlorofluoromethane (FREON 11) | µg/L | - | 14 | 14 | <8 | <8 | <8 |
| Vinyl Chloride | µg/L | - | 14 | 14 | <0.5 | <0.5 | <2 |
| **Semi-Volatile Organics** | | | | | | | |
| 1,2,3,4-Tetrachlorobenzene | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| 1,2,3,5-Tetrachlorobenzene | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| 1,2,3-Trichlorobenzene | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| 1,2,4,5-Tetrachlorobenzene | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| 1,2,4-Trichlorobenzene | µg/L | 5.4 | 1 | 1 | <2 | <2 | <2 |
| 1,3,5-Trichlorobenzene | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| 2,4-Dinitrophenol | µg/L | - | 1 | 1 | <25 | <25 | <25 |
| 2,4-Dinitrotoluene | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| 2,6-Dinitrotoluene | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| 3,3-Dichlorobenzidine | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| 4-Bromophenyl phenyl ether | µg/L | - | 1 | 1 | <1.2 | <1.2 | <1.2 |
| 4-Chlorophenyl phenyl ether | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| Benzyl butyl phthalate | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| Biphenyl | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| Bis(2-chloroethoxy)methane | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| Bis(2-chloroethyl)ether | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| Bis(2-chloroisopropyl)ether | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| Bis(2-ethylhexyl)phthalate | µg/L | - | 1 | 1 | <8 | <8 | <8 |
| Diethyl phthalate | µg/L | - | 1 | 1 | <4 | <4 | <4 |
| Dimethyl phthalate | µg/L | - | 1 | 1 | <4 | <4 | <4 |
| Di-N-butyl phthalate | µg/L | - | 1 | 1 | <8 | <8 | <8 |
| di-n-octyl phthalate | µg/L | - | 1 | 1 | <3.2 | <3.2 | <3.2 |
| Diphenyl Ether | µg/L | - | 1 | 1 | <1.2 | <1.2 | <1.2 |
| Hexachlorobenzene | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| Hexachlorobutadiene | µg/L | - | 1 | 1 | <1.6 | <1.6 | <1.6 |
| Hexachlorocyclopentadiene | µg/L | - | 1 | 1 | <8 | <8 | <8 |

## Appendix B-1: Background Water Quality at Diffuser Location (2018 - 2019)

| Parameter | Units | CCME Guideline | Total Count | Count (<RDL) | Minimum | Median | Maximum |
|---|---|---|---|---|---|---|---|
| Hexachloroethane | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| Isophorone | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| Nitrobenzene | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| Nitrosodiphenylamine/Diphenylamine | µg/L | - | 1 | 1 | <4 | <4 | <4 |
| N-Nitroso-di-n-propylamine | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| p-Chloroaniline | µg/L | - | 1 | 1 | <4 | <4 | <4 |
| Pentachlorobenzene | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| **Petroleum Hydrocarbons with Atl. RBCA V3.1 method** | | | | | | | |
| C6 - C10 (less BTEX) | mg/L | - | 14 | 14 | <0.01 | <0.1 | <0.1 |
| >C10-C16 Hydrocarbons | mg/L | - | 14 | 14 | <0.05 | <0.05 | <0.05 |
| >C16-C21 Hydrocarbons | mg/L | - | 14 | 14 | <0.05 | <0.05 | <0.05 |
| >C21-<C32 Hydrocarbons | mg/L | - | 14 | 13 | <0.1 | <0.1 | 0.12 |
| Benzene_RBCA | mg/L | 0.11 | 14 | 14 | <0.001 | <0.001 | <0.001 |
| Ethylbenzene_RBCA | mg/L | 0.025 | 14 | 14 | <0.001 | <0.001 | <0.001 |
| Toluene_RBCA | mg/L | 0.215 | 14 | 14 | <0.001 | <0.001 | <0.001 |
| Total Xylenes_RBCA | mg/L | - | 14 | 14 | <0.002 | <0.002 | <0.002 |
| Modified TPH (Tier1) | mg/L | - | 14 | 13 | <0.1 | <0.1 | 0.12 |
| **Petroleum Hydrocarbons with CCME PHC-CWS method** | | | | | | | |
| F1 (C6-C10) | µg/L | - | 1 | 1 | <25 | <25 | <25 |
| F1 (C6-C10) - BTEX | µg/L | - | 1 | 1 | <25 | <25 | <25 |
| F2 (C10-C16 Hydrocarbons) | µg/L | - | 1 | 1 | <100 | <100 | <100 |
| F3 (C16-C34 Hydrocarbons) | µg/L | - | 1 | 1 | <200 | <200 | <200 |
| F4 (C34-C50 Hydrocarbons) | µg/L | - | 1 | 1 | <200 | <200 | <200 |
| Benzene_PHC | mg/L | 0.11 | 1 | 1 | <0.0002 | <0.0002 | <0.0002 |
| Ethylbenzene_PHC | mg/L | - | 1 | 1 | <0.0002 | <0.0002 | <0.0002 |
| o-Xylene_PHC | µg/L | 0.025 | 1 | 1 | <0.2 | <0.2 | <0.2 |
| p+m-Xylene_PHC | µg/L | - | 1 | 1 | <0.4 | <0.4 | <0.4 |
| Toluene_PHC | mg/L | 0.215 | 1 | 1 | <0.0002 | <0.0002 | <0.0002 |
| Total Xylenes_PHC | mg/L | - | 1 | 1 | <0.0004 | <0.0004 | <0.0004 |
| **Polychlorinated Biphenyls** | | | | | | | |
| Total PCBs | µg/L | 0.10 | 5 | 5 | <0.05 | <0.05 | <0.06 |
| Aroclor 1016 | µg/L | - | 5 | 5 | <0.05 | <0.05 | <0.06 |
| Aroclor 1221 | µg/L | - | 5 | 5 | <0.05 | <0.05 | <0.06 |
| Aroclor 1232 | µg/L | - | 5 | 5 | <0.05 | <0.05 | <0.06 |
| Aroclor 1242 | µg/L | - | 5 | 5 | <0.05 | <0.05 | <0.06 |
| Aroclor 1248 | µg/L | - | 5 | 5 | <0.05 | <0.05 | <0.06 |
| Aroclor 1254 | µg/L | - | 5 | 5 | <0.05 | <0.05 | <0.06 |
| Aroclor 1260 | µg/L | - | 5 | 5 | <0.05 | <0.05 | <0.06 |
| **Fatty Acids** | | | | | | | |
| 9,10-Dichlorostearic acid | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.05 |
| Decanoic Acid (C10) | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.05 |
| Docosanoic acid (C22) | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.06 |
| Dodecanoic acid (C12) | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.05 |
| Eicosanoic acid (C20) | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.05 |
| Hexadecanoic acid (C16) | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.05 |
| Linoleic acid (C18:2) | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.05 |
| Linolenic acid (C18:3) | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.05 |
| Octadecanoic acid (C18) | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.006 |
| Oleic acid (C18:1) | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.006 |
| Tetradecanoic acid (C14) | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.006 |
| Undecanoic acid (C11) | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.006 |
| Total Fatty Acids | mg/L | - | 13 | 13 | <0.072 | <0.072 | <0.072 |
| **Resin Acids** | | | | | | | |
| 12,14-Dichlorodehydroabietic acid | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.006 |
| 12-Chlorodehydroabietic acid | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.006 |
| 14-Chlorodehydroabietic acid | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.006 |
| Abietic acid | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.06 |

## Appendix B-1: Background Water Quality at Diffuser Location (2018 - 2019)

| Parameter | Units | CCME Guideline | Total Count | Count (<RDL) | Minimum | Median | Maximum |
|---|---|---|---|---|---|---|---|
| Dehydroabietic acid | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.06 |
| Isopimaric acid | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.06 |
| Neoabietic acid | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.006 |
| Palustric acid | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.006 |
| Pimaric acid | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.006 |
| Sandaracopimaric acid | mg/L | - | 13 | 13 | <0.006 | <0.006 | <0.006 |
| Total Resin Acids | mg/L | - | 13 | 13 | <0.06 | <0.06 | <0.06 |
| **Phenols** | | | | | | | |
| Total of Reg.P&P phenols | µg/L | - | 14 | 12 | <1 | <1.5 | 20 |
| 2,3 Dichlorophenol | µg/L | - | 5 | 5 | <1 | <1 | <2 |
| 2,3,4 Trichlorophenol | µg/L | - | 5 | 5 | <1 | <1 | <2 |
| 2,3,4,5 Tetrachlorophenol | µg/L | - | 5 | 5 | <1 | <1 | <1.6 |
| 2,3,4,6 Tetrachlorophenol | µg/L | - | 5 | 5 | <1 | <1 | <2 |
| 2,3,5 Trichlorophenol | µg/L | - | 5 | 5 | <1 | <1 | <2 |
| 2,3,5,6 Tetrachlorophenol | µg/L | - | 5 | 5 | <1 | <1 | <2 |
| 2,3,6 Trichlorophenol | µg/L | - | 5 | 5 | <1 | <1 | <2 |
| 2,4 +2.5- Dichlorophenol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| 2,4 Dimethylphenol | µg/L | - | 5 | 5 | <1 | <1 | <2 |
| 2,4,5 Trichlorophenol | µg/L | - | 5 | 5 | <1 | <1 | <2 |
| 2,4,6-Trichlorophenol | µg/L | - | 5 | 5 | <1 | <1 | <2 |
| 2,4-Dichlorophenol | µg/L | - | 1 | 1 | <1.2 | <1.2 | <1.2 |
| 2,5-Dichlorophenol | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| 2,6 Dichlorophenol | µg/L | - | 5 | 5 | <1 | <1 | <2 |
| 23,4,5 Trichlorocatechol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| 2-Chlrophenol | µg/L | - | 5 | 5 | <1 | <1 | <1.2 |
| 2-Nitrophenol | µg/L | - | 5 | 5 | <2 | <2 | <2 |
| 3 & 4-Chlorophenol | µg/L | - | 1 | 1 | <0.4 | <0.4 | <0.4 |
| 3,4 Dichlorophenol | µg/L | - | 5 | 5 | <1 | <1 | <2 |
| 3,4,5 Trichloroguaiacol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| 3,4,5 Trichlorophenol | µg/L | - | 5 | 5 | <1 | <1 | <2 |
| 3,4,5 Trichlorosyringol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| 3,4,5 Trichloroveratrol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| 3,4,5,6 Tetrachloroveratrol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| 3,5 Dichlorocatechol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| 3,5 Dichlorophenol | µg/L | - | 5 | 5 | <1 | <1 | <2 |
| 3-Chlorophenol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| 4 Chlorocatechol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| 4,5 Dichlorocatechol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| 4,5 Dichloroguaiacol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| 4,5 Dichloroveratrol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| 4,5,6 Trichloroguaiacol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| 4,6 Dichloroguaiacol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| 4,6-Dinitro-2-methylphenol | µg/L | - | 1 | 1 | <8 | <8 | <8 |
| 4-Chloroguaiacol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| 4-Chlorophenol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| 4-Nitrophenol | µg/L | - | 5 | 5 | <5.6 | <10 | <10 |
| 5,6-Dichlorovanillin | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| 6-Chlorovanillin | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| Catechol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| Eugebol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| Guaiacol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| Isoeugenol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| m/p-Cresol | µg/L | - | 1 | 1 | <2 | <2 | <2 |
| m-Cresol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| o-Cresol | µg/L | - | 5 | 5 | <0.5 | <0.5 | <3 |
| p-Cresol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| Pentachlorophenol | µg/L | - | 5 | 5 | <1 | <1 | <4 |
| Tetrachlorocatechol | µg/L | - | 4 | 4 | <1 | <1 | <1 |
| Tetrachloroguaiacol | µg/L | - | 5 | 5 | <1 | <1 | <2 |

Notes:

1. The summary time is between 01-Jan-1900 and 10-Sep-2019.
2. The reporting locations are: "Diffuser".
3. The reporting lab track IDs are: .

## Appendix B-2: Background Water Quality at Pipeline Corridor (2018 - 2019)

| Location | Parameter | Units | CCME Guideline | Total Count | Count (<RDL) | Minimum | Percentile_5th | Percentile_50th | Percentile_95th | Maximum |
|---|---|---|---|---|---|---|---|---|---|---|
| Caribou1 | **General Chemistry & Phyiscal Parameters** | | | | | | | | | |
| | Colour | TCU | - | 5 | 3 | <5 | <5 | <5 | 8.8 | 9.1 |
| | Conductivity | µS/cm | - | 5 | 0 | 40000 | 40000 | 40000 | 41800 | 42000 |
| | pH | pH | 7 - 8.7 | 4 | 0 | 7.56 | 7.5645 | 7.625 | 7.6685 | 7.67 |
| | Salinity | N/A | - | 5 | 1 | <2 | <7.4 | 29 | 29.8 | 30 |
| | Dissolved Organic Carbon (C) | mg/L | - | 5 | 3 | 2.1 | 2.14 | <5 | <5 | <5 |
| | Total Organic Carbon (C) | mg/L | - | 5 | 3 | 2.5 | 2.6 | <5 | <5 | <5 |
| | Total Dissolved Solids | mg/L | - | 5 | 0 | 27000 | 27000 | 28000 | 28000 | 28000 |
| | Total Suspended Solids | mg/L | - | 5 | 0 | 1.6 | 1.64 | 2 | 2.52 | 2.6 |
| | Turbidity | NTU | - | 5 | 0 | 0.38 | 0.426 | 0.83 | 1.18 | 1.2 |
| | **Oxygen Demand** | | | | | | | | | |
| | Carbonaceous BOD | mg/L | - | 5 | 5 | <5 | <5 | <5 | <15.6 | <17 |
| | Total Chemical Oxygen Demand | mg/L | - | 5 | 0 | 890 | 890 | 890 | 1396 | 1500 |
| | Volatile Suspended Solids | mg/L | - | 5 | 3 | <2 | <2 | 2.4 | <16.56 | <20 |
| | **Anions and Nutrients** | | | | | | | | | |
| | Total Alkalinity (Total as CaCO3) | mg/L | - | 5 | 0 | 89 | 89.2 | 90 | 92.8 | 93 |
| | Hardness (CaCO3) | mg/L | - | 5 | 0 | 5000 | 5020 | 5200 | 5300 | 5300 |
| | Dissolved Chlorate (ClO3-) | mg/L | - | 5 | 5 | <1 | <1 | <1 | <5 | <5 |
| | Dissolved Chloride (Cl-) | mg/L | - | 5 | 0 | 15000 | 15000 | 15000 | 15800 | 16000 |
| | Dissolved Chlorite (CLO2-) | mg/L | - | 5 | 5 | <0.6 | <0.68 | <1 | <4.2 | <5 |
| | Total Phosphorus | mg/L | - | 5 | 4 | <0.02 | <0.02 | <0.02 | <6.228 | 7.78 |
| | Orthophosphate (P) | mg/L | - | 5 | 5 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Total Nitrogen (N) | mg/L | - | 5 | 0 | 0.117 | 0.1208 | 0.156 | 0.1636 | 0.165 |
| | Total Kjeldahl Nitrogen (TKN) | mg/L | - | 5 | 0 | 0.16 | 0.164 | 0.19 | 0.232 | 0.24 |
| | Nitrogen (Ammonia Nitrogen) | mg/L | - | 5 | 5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | Nitrate (N) | mg/L | 45.2 | 5 | 5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | Nitrate + Nitrite (N) | mg/L | - | 5 | 5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | Nitrite (N) | mg/L | - | 5 | 5 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulphide (as H2S) | mg/L | - | 2 | 2 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 |
| | Sulphide | mg/L | - | 2 | 2 | <0.01 | <0.0145 | <0.055 | <0.0955 | <0.1 |
| | Dissolved Sulphate (SO4) | mg/L | - | 5 | 0 | 1900 | 1900 | 2000 | 2200 | 2200 |
| | Reactive Silica (SiO2) | mg/L | - | 5 | 4 | <0.5 | <0.5 | <0.5 | <20.1 | 25 |
| | Total Cyanide (CN) | mg/L | - | 5 | 5 | <0.0001 | <0.00108 | <0.005 | <0.005 | <0.005 |
| | **Metals** | | | | | | | | | |
| | Total Aluminum (Al) | µg/L | - | 5 | 5 | <50 | <50 | <50 | <50 | <50 |
| | Total Antimony (Sb) | µg/L | - | 5 | 5 | <10 | <10 | <10 | <10 | <10 |
| | Total Arsenic (As) | µg/L | 12.5 | 5 | 5 | <10 | <10 | <10 | <10 | <10 |
| | Total Barium (Ba) | µg/L | - | 5 | 2 | <10 | <10 | <10 | 13.8 | 14 |
| | Total Beryllium (Be) | µg/L | - | 5 | 5 | <10 | <10 | <10 | <10 | <10 |
| | Total Bismuth (Bi) | µg/L | - | 5 | 5 | <20 | <20 | <20 | <20 | <20 |
| | Total Boron (B) | µg/L | - | 5 | 0 | 3500 | 3520 | 3900 | 4260 | 4300 |
| | Total Cadmium (Cd) | µg/L | 0.12 | 5 | 5 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| | Total Calcium (Ca) | µg/L | - | 5 | 0 | 320000 | 322000 | 330000 | 330000 | 330000 |
| | Total Chromium (Cr) | µg/L | 56 | 5 | 5 | <10 | <10 | <10 | <10 | <10 |
| | Total Cobalt (Co) | µg/L | - | 5 | 5 | <4 | <4 | <4 | <4 | <4 |
| | Total Copper (Cu) | µg/L | - | 5 | 5 | <5 | <5 | <5 | <5 | <5 |
| | Total Iron (Fe) | µg/L | - | 5 | 5 | <500 | <500 | <500 | <500 | <500 |
| | Total Lead (Pb) | µg/L | - | 5 | 5 | <5 | <5 | <5 | <5 | <5 |
| | Total Magnesium (Mg) | µg/L | - | 5 | 0 | 1000000 | 1000000 | 1100000 | 1100000 | 1100000 |
| | Total Manganese (Mn) | µg/L | - | 5 | 4 | <20 | <20 | <20 | <20 | <20 |
| | Total Mercury (Hg) | µg/L | 0.016 | 5 | 3 | <0.002 | <0.00202 | 0.0034 | <0.013 | <0.013 |
| | Total Molybdenum (Mo) | µg/L | - | 5 | 5 | <20 | <20 | <20 | <20 | <20 |
| | Total Nickel (Ni) | µg/L | - | 5 | 5 | <20 | <20 | <20 | <20 | <20 |
| | Total Phosphorus (P) | µg/L | - | 5 | 5 | <1000 | <1000 | <1000 | <1000 | <1000 |
| | Total Potassium (K) | µg/L | - | 5 | 0 | 300000 | 300000 | 310000 | 318000 | 320000 |
| | Total Selenium (Se) | µg/L | - | 5 | 5 | <10 | <10 | <10 | <10 | <10 |
| | Total Silver (Ag) | µg/L | 7.5 | 5 | 5 | <1 | <1 | <1 | <1 | <1 |
| | Total Sodium (Na) | µg/L | - | 5 | 0 | 8200000 | 8260000 | 8500000 | 8860000 | 8900000 |
| | Total Strontium (Sr) | µg/L | - | 5 | 0 | 5900 | 5920 | 6000 | 6200 | 6200 |
| | Total Thallium (Tl) | µg/L | - | 5 | 5 | <1 | <1 | <1 | <1 | <1 |
| | Total Tin (Sn) | µg/L | - | 5 | 5 | <20 | <20 | <20 | <20 | <20 |
| | Total Titanium (Ti) | µg/L | - | 5 | 5 | <20 | <20 | <20 | <20 | <20 |
| | Total Uranium (U) | µg/L | - | 5 | 0 | 2.4 | 2.44 | 2.7 | 2.7 | 2.7 |
| | Total Vanadium (V) | µg/L | - | 5 | 5 | <20 | <20 | <20 | <20 | <20 |
| | Total Zinc (Zn) | µg/L | - | 5 | 5 | <50 | <50 | <50 | <50 | <50 |
| | **Dioxins & Furans** | | | | | | | | | |
| | 2,3,7,8-Tetra CDD | pg/L | - | 5 | 5 | <1.01 | <1.012 | <1.09 | <1.348 | <1.35 |
| | 1,2,3,7,8-Penta CDD | pg/L | - | 5 | 5 | <0.993 | <0.9938 | <1.12 | <1.176 | <1.19 |
| | 1,2,3,4,7,8-Hexa CDD | pg/L | - | 5 | 5 | <1.1 | <1.104 | <1.52 | <1.646 | <1.66 |
| | 1,2,3,7,8,9-Hexa CDD | pg/L | - | 5 | 5 | <0.947 | <0.9636 | <1.42 | <1.538 | <1.55 |
| | 1,2,3,6,7,8-Hexa CDD | pg/L | - | 5 | 5 | <0.974 | <0.9758 | <1.35 | <1.468 | <1.48 |
| | 1,2,3,4,6,7,8-Hepta CDD | pg/L | - | 5 | 5 | <1.02 | <1.028 | <1.12 | <2.124 | <2.29 |
| | Octa CDD | pg/L | - | 5 | 1 | <1.08 | <1.674 | 17.1 | 31.7 | 32.2 |
| | Total Tetra CDD | pg/L | - | 5 | 5 | <1.01 | <1.012 | <1.09 | <1.348 | <1.35 |
| | Total Penta CDD | pg/L | - | 5 | 5 | <0.993 | <0.9938 | <1.12 | <1.176 | <1.19 |
| | Total Hexa CDD | pg/L | - | 5 | 5 | <1.01 | <1.016 | <1.43 | <1.546 | <1.56 |
| | Total Hepta CDD | pg/L | - | 5 | 4 | <1.02 | <1.028 | <1.12 | <3.292 | 3.75 |
| | Total Tetra CDD | pg/L | - | 5 | 5 | <1.01 | <1.012 | <1.09 | <1.348 | <1.35 |
| | 2,3,7,8-Tetra CDF | pg/L | - | 5 | 5 | <0.89 | <0.9102 | <1.13 | <1.324 | <1.33 |

## Appendix B-2: Background Water Quality at Pipeline Corridor (2018 - 2019)

| Location | Parameter | Units | CCME Guideline | Total Count | Count (<RDL) | Minimum | Percentile_5th | Percentile_50th | Percentile_95th | Maximum |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1,2,3,7,8-Penta CDF | pg/L | - | 5 | 5 | <1.04 | <1.054 | <1.39 | <1.482 | <1.49 |
| | 2,3,4,7,8-Penta CDF | pg/L | - | 5 | 5 | <1.07 | <1.078 | <1.44 | <1.532 | <1.54 |
| | 1,2,3,4,7,8-Hexa CDF | pg/L | - | 5 | 5 | <0.806 | <0.8346 | <1.27 | <1.39 | <1.42 |
| | 1,2,3,6,7,8-Hexa CDF | pg/L | - | 5 | 5 | <0.672 | <0.7142 | <1.18 | <1.292 | <1.32 |
| | 1,2,3,7,8,9-Hexa CDF | pg/L | - | 5 | 5 | <0.842 | <0.9196 | <1.64 | <1.8 | <1.84 |
| | 2,3,4,6,7,8-Hexa CDF | pg/L | - | 5 | 5 | <0.76 | <0.824 | <1.44 | <1.586 | <1.62 |
| | 1,2,3,4,6,7,8-Hepta CDF | pg/L | - | 5 | 5 | <0.874 | <0.8828 | <0.938 | <1.0798 | <1.11 |
| | 1,2,3,4,7,8,9-Hepta CDF | pg/L | - | 5 | 5 | <1.09 | <1.108 | <1.24 | <1.454 | <1.5 |
| | Octa CDF | pg/L | - | 5 | 4 | <1.01 | <1.118 | <1.61 | <2.794 | 2.91 |
| | Total Tetra CDF | pg/L | - | 5 | 5 | <0.89 | <0.9102 | <1.13 | <1.324 | <1.33 |
| | Total Penta CDF | pg/L | - | 5 | 5 | <1.06 | <1.07 | <1.42 | <1.502 | <1.51 |
| | Total Hexa CDF | pg/L | - | 5 | 5 | <0.765 | <0.816 | <1.36 | <1.496 | <1.53 |
| | Total Hepta CDF | pg/L | - | 5 | 5 | <1.01 | <1.012 | <1.06 | <1.24 | <1.28 |
| | **Organic Halogens** | | | | | | | | | |
| | Adsorbable Organic Halogen | mg/L | - | 2 | 2 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| | **Polycyclic Aromatic Hydrocarbons** | | | | | | | | | |
| | 1-Methylnaphthalene | µg/L | - | 5 | 5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | 2-Methylnaphthalene | µg/L | - | 5 | 5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | Acenaphthene | µg/L | - | 5 | 5 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Acenaphthylene | µg/L | - | 5 | 5 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Anthracene | µg/L | - | 5 | 5 | <0.01 | <0.01 | <0.01 | <0.02 | <0.02 |
| | Benzo(a)anthracene | µg/L | - | 5 | 5 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Benzo(a)pyrene | µg/L | - | 5 | 5 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Benzo(b)fluoranthene | µg/L | - | 5 | 5 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Benzo(b/j)fluoranthene | µg/L | - | 5 | 5 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| | Benzo(g,h,i)perylene | µg/L | - | 5 | 5 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Benzo(j)fluoranthene | µg/L | - | 5 | 5 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Benzo(k)fluoranthene | µg/L | - | 5 | 5 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Chrysene | µg/L | - | 5 | 5 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Dibenz(a,h)anthracene | µg/L | - | 5 | 5 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Fluoranthene | µg/L | - | 5 | 5 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Fluorene | µg/L | - | 5 | 5 | <0.01 | <0.01 | <0.01 | <0.1 | <0.1 |
| | Indeno(1,2,3-cd)pyrene | µg/L | - | 5 | 5 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Naphthalene | µg/L | 1.4 | 5 | 5 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| | Perylene | µg/L | - | 5 | 5 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Phenanthrene | µg/L | - | 5 | 5 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Pyrene | µg/L | - | 5 | 5 | <0.01 | <0.01 | <0.01 | <0.02 | <0.02 |
| | **Volatile Organics** | | | | | | | | | |
| | 1,1,1-Trichloroethane | µg/L | - | 5 | 5 | <1 | <1 | <1 | <1 | <1 |
| | 1,1,2,2-Tetrachloroethane | µg/L | - | 5 | 5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| | 1,1,2-Trichloroethane | µg/L | - | 5 | 5 | <1 | <1 | <1 | <1 | <1 |
| | 1,1-Dichloroethane | µg/L | - | 5 | 5 | <2 | <2 | <2 | <2 | <2 |
| | 1,1-Dichloroethylene | µg/L | - | 5 | 5 | <0.5 | <0.5 | <0.5 | <1 | <1 |
| | 1,2-Dichlorobenzene | µg/L | 42 | 5 | 5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| | 1,2-Dichloroethane | µg/L | - | 5 | 5 | <1 | <1 | <1 | <1 | <1 |
| | 1,2-Dichloropropane | µg/L | - | 5 | 5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| | 1,3-Dichlorobenzene | µg/L | - | 5 | 5 | <1 | <1 | <1 | <1 | <1 |
| | 1,4-Dichlorobenzene | µg/L | - | 5 | 5 | <1 | <1 | <1 | <1 | <1 |
| | Benzene_VOC | mg/L | 0.11 | 5 | 5 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | Bromodichloromethane | µg/L | - | 5 | 5 | <0.2 | <0.2 | <1 | <1 | <1 |
| | Bromoform | µg/L | - | 5 | 5 | <0.2 | <0.2 | <1 | <1 | <1 |
| | Bromomethane | µg/L | - | 5 | 5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| | Carbon Tetrachloride | µg/L | - | 5 | 5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| | Chlorobenzene | µg/L | 25 | 5 | 5 | <1 | <1 | <1 | <1 | <1 |
| | Chloroethane | µg/L | - | 5 | 5 | <8 | <8 | <8 | <8 | <8 |
| | Chloroform | µg/L | - | 5 | 5 | <0.2 | <0.2 | <1 | <1 | <1 |
| | Chloromethane | µg/L | - | 5 | 5 | <8 | <8 | <8 | <8 | <8 |
| | cis-1,2-Dichloroethylene | µg/L | - | 5 | 5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| | cis-1,3-Dichloropropene | µg/L | - | 5 | 5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| | Dibromochloromethane | µg/L | - | 5 | 5 | <0.2 | <0.2 | <1 | <1 | <1 |
| | Ethylbenzene_VOC | mg/L | 0.025 | 5 | 5 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | Ethylene Dibromide | µg/L | - | 5 | 5 | <0.2 | <0.2 | <0.2 | <0.5 | <0.5 |
| | Methyl t-butyl ether (MTBE) | µg/L | 5000 | 5 | 5 | <2 | <2 | <2 | <2 | <2 |
| | Methylene Chloride(Dichloromethane) | µg/L | - | 5 | 5 | <3 | <3 | <3 | <3 | <3 |
| | o-Xylene_VOC | µg/L | - | 5 | 5 | <1 | <1 | <1 | <1 | <1 |
| | p+m-Xylene_VOC | µg/L | - | 5 | 5 | <2 | <2 | <2 | <2 | <2 |
| | Styrene | µg/L | - | 5 | 5 | <1 | <1 | <1 | <1 | <1 |
| | Tetrachloroethylene | µg/L | - | 5 | 5 | <1 | <1 | <1 | <1 | <1 |
| | Toluene_VOC | mg/L | 0.215 | 5 | 5 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | Total Trihalomethanes | µg/L | - | 5 | 5 | <1 | <1 | <1 | <1 | <1 |
| | Total Xylenes_VOC | mg/L | - | 5 | 5 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | trans-1,2-Dichloroethylene | µg/L | - | 5 | 5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| | trans-1,3-Dichloropropene | µg/L | - | 5 | 5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| | Trichloroethylene | µg/L | - | 5 | 5 | <1 | <1 | <1 | <1 | <1 |
| | Trichlorofluoromethane (FREON 11) | µg/L | - | 5 | 5 | <8 | <8 | <8 | <8 | <8 |
| | Vinyl Chloride | µg/L | - | 5 | 5 | <0.5 | <0.5 | <0.5 | <2 | <2 |
| | **Petroleum Hydrocarbons with Atl. RBCA V3.1 method** | | | | | | | | | |
| | C6 - C10 (less BTEX) | mg/L | - | 5 | 5 | <0.01 | <0.01 | <0.1 | <0.1 | <0.1 |
| | >C10-C16 Hydrocarbons | mg/L | - | 5 | 5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |

## Appendix B-2: Background Water Quality at Pipeline Corridor (2018 - 2019)

| Location | Parameter | Units | CCME Guideline | Total Count | Count (<RDL) | Minimum | Percentile_5th | Percentile_50th | Percentile_95th | Maximum |
|---|---|---|---|---|---|---|---|---|---|---|
| | >C16-C21 Hydrocarbons | mg/L | - | 5 | 5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | >C21-<C32 Hydrocarbons | mg/L | - | 5 | 5 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| | Benzene_RBCA | mg/L | 0.11 | 5 | 5 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | Ethylbenzene_RBCA | mg/L | 0.025 | 5 | 5 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | Toluene_RBCA | mg/L | 0.215 | 5 | 5 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | Total Xylenes_RBCA | mg/L | - | 5 | 5 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| | Modified TPH (Tier1) | mg/L | - | 5 | 5 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| | **Polychlorinated Biphenyls** | | | | | | | | | |
| | Total PCBs | µg/L | 0.10 | 2 | 2 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 |
| | Aroclor 1016 | µg/L | - | 2 | 2 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 |
| | Aroclor 1221 | µg/L | - | 2 | 2 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 |
| | Aroclor 1232 | µg/L | - | 2 | 2 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 |
| | Aroclor 1242 | µg/L | - | 2 | 2 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 |
| | Aroclor 1248 | µg/L | - | 2 | 2 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 |
| | Aroclor 1254 | µg/L | - | 2 | 2 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 |
| | Aroclor 1260 | µg/L | - | 2 | 2 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 |
| | **Fatty Acids** | | | | | | | | | |
| | 9,10-Dichlorostearic acid | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.05 | <0.05 |
| | Decanoic Acid (C10) | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.05 | <0.05 |
| | Docosanoic acid (C22) | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.05 | <0.05 |
| | Dodecanoic acid (C12) | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.05 | <0.05 |
| | Eicosanoic acid (C20) | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.05 | <0.05 |
| | Hexadecanoic acid (C16) | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.05 | <0.05 |
| | Linoleic acid (C18:2) | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.05 | <0.05 |
| | Linolenic acid (C18:3) | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.05 | <0.05 |
| | Octadecanoic acid (C18) | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Oleic acid (C18:1) | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Tetradecanoic acid (C14) | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Undecanoic acid (C11) | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Total Fatty Acids | mg/L | - | 5 | 5 | <0.072 | <0.072 | <0.072 | <0.072 | <0.072 |
| | **Resin Acids** | | | | | | | | | |
| | 12,14-Dichlorodehydroabietic acid | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | 12-Chlorodehydroabietic acid | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | 14-Chlorodehydroabietic acid | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Abietic acid | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.06 | <0.06 |
| | Dehydroabietic acid | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.06 | <0.06 |
| | Isopimaric acid | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.06 | <0.06 |
| | Neoabietic acid | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Palustric acid | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Pimaric acid | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Sandaracopimaric acid | mg/L | - | 5 | 5 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Total Resin Acids | mg/L | - | 5 | 5 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 |
| | **Phenols** | | | | | | | | | |
| | Total of Reg.P&P phenols | µg/L | - | 5 | 3 | <1 | <2.8 | <10 | 12.6 | 13 |
| | 2,3 Dichlorophenol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 2,3,4 Trichlorophenol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 2,3,4,5 Tetrachlorophenol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 2,3,4,6 Tetrachlorophenol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 2,3,5 Trichlorophenol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 2,3,5,6 Tetrachlorophenol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 2,3,6 Trichlorophenol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 2,4 +2.5- Dichlorophenol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 2,4 Dimethylphenol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 2,4,5 Trichlorophenol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 2,4,6-Trichlorophenol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 2,6 Dichlorophenol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 23,4,5 Trichlorocatechol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 2-Chlrophenol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 2-Nitrophenol | µg/L | - | 2 | 2 | <2 | <2 | <2 | <2 | <2 |
| | 3,4 Dichlorophenol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 3,4,5 Trichloroguaiacol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 3,4,5 Trichlorophenol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 3,4,5 Trichlorosyringol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 3,4,5 Trichloroveratrol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 3,4,5,6 Tetrachloroveratrol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 3,5 Dichlorocatechol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 3,5 Dichlorophenol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 3-Chlorophenol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 4 Chlorocatechol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 4,5 Dichlorocatechol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 4,5 Dichloroguaiacol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 4,5 Dichloroveratrol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 4,5,6  Trichloroguaiacol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 4,6 Dichloroguaiacol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 4-Bromofluorobenzene | % | - | 3 | 0 | 95 | 95.1 | 96 | 96 | 96 |
| | 4-Chloroguaiacol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 4-Chlorophenol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | 4-Nitrophenol | µg/L | - | 2 | 2 | <10 | <10 | <10 | <10 | <10 |
| | 5,6-Dichlorovanillin | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |

## Appendix B-2: Background Water Quality at Pipeline Corridor (2018 - 2019)

| Location | Parameter | Units | CCME Guideline | Total Count | Count (<RDL) | Minimum | Percentile_5th | Percentile_50th | Percentile_95th | Maximum |
|---|---|---|---|---|---|---|---|---|---|---|
| | 6-Chlorovanillin | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | Catechol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | Eugebol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | Guaiacol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | Isoeugenol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | m-Cresol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | o-Cresol | µg/L | - | 2 | 2 | <0.5 | <0.525 | <0.75 | <0.975 | <1 |
| | p-Cresol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | Pentachlorophenol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | Tetrachlorocatechol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| | Tetrachloroguaiacol | µg/L | - | 2 | 2 | <1 | <1 | <1 | <1 | <1 |
| Caribou 2 | **General Chemistry & Phyiscal Parameters** | | | | | | | | | |
| | Colour | TCU | - | 3 | 3 | <5 | <5 | <5 | <5 | <5 |
| | Conductivity | µS/cm | - | 3 | 0 | 40000 | 40000 | 40000 | 40900 | 41000 |
| | pH | pH | 7 - 8.7 | 3 | 0 | 7.67 | 7.671 | 7.68 | 7.68 | 7.68 |
| | Salinity | N/A | - | 3 | 0 | 30 | 30 | 30 | 30 | 30 |
| | Dissolved Organic Carbon (C) | mg/L | - | 3 | 3 | <5 | <5 | <5 | <5 | <5 |
| | Total Organic Carbon (C) | mg/L | - | 3 | 3 | <5 | <5 | <5 | <5 | <5 |
| | Total Dissolved Solids | mg/L | - | 3 | 0 | 27000 | 27000 | 27000 | 27000 | 27000 |
| | Total Suspended Solids | mg/L | - | 3 | 0 | 2.4 | 2.56 | 4 | 4.36 | 4.4 |
| | Turbidity | NTU | - | 3 | 0 | 0.51 | 0.512 | 0.53 | 0.692 | 0.71 |
| | **Oxygen Demand** | | | | | | | | | |
| | Carbonaceous BOD | mg/L | - | 3 | 3 | <5 | <5 | <5 | <5 | <5 |
| | Total Chemical Oxygen Demand | mg/L | - | 3 | 0 | 840 | 845 | 890 | 1079 | 1100 |
| | Volatile Suspended Solids | mg/L | - | 3 | 0 | 2 | 2 | 2 | 3.26 | 3.4 |
| | **Anions and Nutrients** | | | | | | | | | |
| | Total Alkalinity (Total as CaCO3) | mg/L | - | 3 | 0 | 88 | 88.4 | 92 | 94.7 | 95 |
| | Hardness (CaCO3) | mg/L | - | 3 | 0 | 5200 | 5200 | 5200 | 5380 | 5400 |
| | Dissolved Chlorate (ClO3-) | mg/L | - | 3 | 3 | <1 | <1 | <1 | <1 | <1 |
| | Dissolved Chloride (Cl-) | mg/L | - | 3 | 0 | 14000 | 14100 | 15000 | 15000 | 15000 |
| | Dissolved Chlorite (CLO2-) | mg/L | - | 3 | 3 | <1 | <1 | <1 | <1 | <1 |
| | Total Phosphorus | mg/L | - | 3 | 3 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| | Orthophosphate (P) | mg/L | - | 3 | 3 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Total Nitrogen (N) | mg/L | - | 3 | 0 | 0.12 | 0.1201 | 0.121 | 0.1255 | 0.126 |
| | Total Kjeldahl Nitrogen (TKN) | mg/L | - | 3 | 0 | 0.12 | 0.122 | 0.14 | 0.167 | 0.17 |
| | Nitrogen (Ammonia Nitrogen) | mg/L | - | 3 | 3 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | Nitrate (N) | mg/L | 45.2 | 3 | 3 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | Nitrate + Nitrite (N) | mg/L | - | 3 | 3 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | Nitrite (N) | mg/L | - | 3 | 3 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Dissolved Sulphate (SO4) | mg/L | - | 3 | 0 | 2100 | 2100 | 2100 | 2190 | 2200 |
| | Reactive Silica (SiO2) | mg/L | - | 3 | 3 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| | Total Cyanide (CN) | mg/L | - | 3 | 3 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| | **Metals** | | | | | | | | | |
| | Total Aluminum (Al) | µg/L | - | 3 | 3 | <50 | <50 | <50 | <50 | <50 |
| | Total Antimony (Sb) | µg/L | - | 3 | 3 | <10 | <10 | <10 | <10 | <10 |
| | Total Arsenic (As) | µg/L | 12.5 | 3 | 3 | <10 | <10 | <10 | <10 | <10 |
| | Total Barium (Ba) | µg/L | - | 3 | 2 | <10 | <10 | <10 | <11.8 | 12 |
| | Total Beryllium (Be) | µg/L | - | 3 | 3 | <10 | <10 | <10 | <10 | <10 |
| | Total Bismuth (Bi) | µg/L | - | 3 | 3 | <20 | <20 | <20 | <20 | <20 |
| | Total Boron (B) | µg/L | - | 3 | 0 | 3900 | 3910 | 4000 | 4360 | 4400 |
| | Total Cadmium (Cd) | µg/L | 0.12 | 3 | 3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| | Total Calcium (Ca) | µg/L | - | 3 | 0 | 330000 | 331000 | 340000 | 349000 | 350000 |
| | Total Chromium (Cr) | µg/L | 56 | 3 | 3 | <10 | <10 | <10 | <10 | <10 |
| | Total Cobalt (Co) | µg/L | - | 3 | 3 | <4 | <4 | <4 | <4 | <4 |
| | Total Copper (Cu) | µg/L | - | 3 | 3 | <5 | <5 | <5 | <5 | <5 |
| | Total Iron (Fe) | µg/L | - | 3 | 3 | <500 | <500 | <500 | <500 | <500 |
| | Total Lead (Pb) | µg/L | - | 3 | 3 | <5 | <5 | <5 | <5 | <5 |
| | Total Magnesium (Mg) | µg/L | - | 3 | 0 | 1100000 | 1100000 | 1100000 | 1100000 | 1100000 |
| | Total Manganese (Mn) | µg/L | - | 3 | 3 | <20 | <20 | <20 | <20 | <20 |
| | Total Mercury (Hg) | µg/L | 0.016 | 3 | 2 | <0.002 | <0.002 | <0.002 | <0.00236 | 0.0024 |
| | Total Molybdenum (Mo) | µg/L | - | 3 | 3 | <20 | <20 | <20 | <20 | <20 |
| | Total Nickel (Ni) | µg/L | - | 3 | 3 | <20 | <20 | <20 | <20 | <20 |
| | Total Phosphorus (P) | µg/L | - | 3 | 3 | <1000 | <1000 | <1000 | <1000 | <1000 |
| | Total Potassium (K) | µg/L | - | 3 | 0 | 310000 | 311000 | 320000 | 320000 | 320000 |
| | Total Selenium (Se) | µg/L | - | 3 | 3 | <10 | <10 | <10 | <10 | <10 |
| | Total Silver (Ag) | µg/L | 7.5 | 3 | 3 | <1 | <1 | <1 | <1 | <1 |
| | Total Sodium (Na) | µg/L | - | 3 | 0 | 8600000 | 8600000 | 8600000 | 8690000 | 8700000 |
| | Total Strontium (Sr) | µg/L | - | 3 | 0 | 5800 | 5820 | 6000 | 6090 | 6100 |
| | Total Thallium (Tl) | µg/L | - | 3 | 3 | <1 | <1 | <1 | <1 | <1 |
| | Total Tin (Sn) | µg/L | - | 3 | 3 | <20 | <20 | <20 | <20 | <20 |
| | Total Titanium (Ti) | µg/L | - | 3 | 3 | <20 | <20 | <20 | <20 | <20 |
| | Total Uranium (U) | µg/L | - | 3 | 0 | 2.5 | 2.51 | 2.6 | 2.6 | 2.6 |
| | Total Vanadium (V) | µg/L | - | 3 | 3 | <20 | <20 | <20 | <20 | <20 |
| | Total Zinc (Zn) | µg/L | - | 3 | 3 | <50 | <50 | <50 | <50 | <50 |
| | **Dioxins & Furans** | | | | | | | | | |
| | 2,3,7,8-Tetra CDD | pg/L | - | 3 | 3 | <1.05 | <1.064 | <1.19 | <1.424 | <1.45 |
| | 1,2,3,7,8-Penta CDD | pg/L | - | 3 | 3 | <1.03 | <1.036 | <1.09 | <1.234 | <1.25 |
| | 1,2,3,4,7,8-Hexa CDD | pg/L | - | 3 | 3 | <1.29 | <1.296 | <1.35 | <1.647 | <1.68 |
| | 1,2,3,6,7,8-Hexa CDD | pg/L | - | 3 | 3 | <1.15 | <1.155 | <1.2 | <1.47 | <1.5 |

## Appendix B-2: Background Water Quality at Pipeline Corridor (2018 - 2019)

| Location | Parameter | Units | CCME Guideline | Total Count | Count (<RDL) | Minimum | Percentile_5th | Percentile_50th | Percentile_95th | Maximum |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1,2,3,7,8,9-Hexa CDD | pg/L | - | 3 | 3 | <1.21 | <1.215 | <1.26 | <1.539 | <1.57 |
| | 1,2,3,4,6,7,8-Hepta CDD | pg/L | - | 3 | 3 | <1.73 | <1.743 | <1.86 | <2.301 | <2.35 |
| | Octa CDD | pg/L | - | 3 | 1 | <15 | <15.59 | 20.9 | 22.7 | 22.9 |
| | Total Tetra CDD | pg/L | - | 3 | 3 | <1.05 | <1.064 | <1.19 | <1.424 | <1.45 |
| | Total Penta CDD | pg/L | - | 3 | 3 | <1.03 | <1.036 | <1.09 | <1.234 | <1.25 |
| | Total Hexa CDD | pg/L | - | 3 | 3 | <1.22 | <1.225 | <1.27 | <1.549 | <1.58 |
| | Total Hepta CDD | pg/L | - | 3 | 3 | <1.73 | <1.743 | <1.86 | <2.301 | <2.35 |
| | 2,3,7,8-Tetra CDF | pg/L | - | 3 | 3 | <1.04 | <1.054 | <1.18 | <1.306 | <1.32 |
| | 1,2,3,7,8-Penta CDF | pg/L | - | 3 | 3 | <1.06 | <1.099 | <1.45 | <1.531 | <1.54 |
| | 2,3,4,7,8-Penta CDF | pg/L | - | 3 | 3 | <1.09 | <1.13 | <1.49 | <1.58 | <1.59 |
| | 1,2,3,4,7,8-Hexa CDF | pg/L | - | 3 | 3 | <1.11 | <1.127 | <1.28 | <1.325 | <1.33 |
| | 1,2,3,6,7,8-Hexa CDF | pg/L | - | 3 | 3 | <1.03 | <1.047 | <1.2 | <1.227 | <1.23 |
| | 1,2,3,7,8,9-Hexa CDF | pg/L | - | 3 | 3 | <1.43 | <1.453 | <1.66 | <1.705 | <1.71 |
| | 2,3,4,6,7,8-Hexa CDF | pg/L | - | 3 | 3 | <1.26 | <1.28 | <1.46 | <1.505 | <1.51 |
| | 1,2,3,4,6,7,8-Hepta CDF | pg/L | - | 3 | 3 | <0.922 | <0.926 | <0.962 | <1.1492 | <1.17 |
| | 1,2,3,4,7,8,9-Hepta CDF | pg/L | - | 3 | 3 | <1.25 | <1.255 | <1.3 | <1.552 | <1.58 |
| | Octa CDF | pg/L | - | 3 | 3 | <1.83 | <1.85 | <2.03 | <2.093 | <2.1 |
| | Total Tetra CDF | pg/L | - | 3 | 3 | <1.04 | <1.054 | <1.18 | <1.306 | <1.32 |
| | Total Penta CDF | pg/L | - | 3 | 3 | <1.08 | <1.119 | <1.47 | <1.551 | <1.56 |
| | Total Hexa CDF | pg/L | - | 3 | 3 | <1.19 | <1.209 | <1.38 | <1.416 | <1.42 |
| | Total Hepta CDF | pg/L | - | 3 | 3 | <1.06 | <1.065 | <1.11 | <1.326 | <1.35 |
| | **Polycyclic Aromatic Hydrocarbons** | | | | | | | | | |
| | 1-Methylnaphthalene | µg/L | - | 3 | 3 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | 2-Methylnaphthalene | µg/L | - | 3 | 3 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | Acenaphthene | µg/L | - | 3 | 3 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Acenaphthylene | µg/L | - | 3 | 3 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Anthracene | µg/L | - | 3 | 3 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Benzo(a)anthracene | µg/L | - | 3 | 3 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Benzo(a)pyrene | µg/L | - | 3 | 3 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Benzo(b)fluoranthene | µg/L | - | 3 | 3 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Benzo(b/j)fluoranthene | µg/L | - | 3 | 3 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| | Benzo(g,h,i)perylene | µg/L | - | 3 | 3 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Benzo(j)fluoranthene | µg/L | - | 3 | 3 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Benzo(k)fluoranthene | µg/L | - | 3 | 3 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Chrysene | µg/L | - | 3 | 3 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Dibenz(a,h)anthracene | µg/L | - | 3 | 3 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Fluoranthene | µg/L | - | 3 | 3 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Fluorene | µg/L | - | 3 | 3 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Indeno(1,2,3-cd)pyrene | µg/L | - | 3 | 3 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Naphthalene | µg/L | 1.4 | 3 | 3 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| | Perylene | µg/L | - | 3 | 3 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Phenanthrene | µg/L | - | 3 | 3 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Pyrene | µg/L | - | 3 | 3 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | **Volatile Organics** | | | | | | | | | |
| | 1,1,1-Trichloroethane | µg/L | - | 3 | 3 | <1 | <1 | <1 | <1 | <1 |
| | 1,1,2,2-Tetrachloroethane | µg/L | - | 3 | 3 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| | 1,1,2-Trichloroethane | µg/L | - | 3 | 3 | <1 | <1 | <1 | <1 | <1 |
| | 1,1-Dichloroethane | µg/L | - | 3 | 3 | <2 | <2 | <2 | <2 | <2 |
| | 1,1-Dichloroethylene | µg/L | - | 3 | 3 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| | 1,2-Dichlorobenzene | µg/L | 42 | 3 | 3 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| | 1,2-Dichloroethane | µg/L | - | 3 | 3 | <1 | <1 | <1 | <1 | <1 |
| | 1,2-Dichloropropane | µg/L | - | 3 | 3 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| | 1,3-Dichlorobenzene | µg/L | - | 3 | 3 | <1 | <1 | <1 | <1 | <1 |
| | 1,4-Dichlorobenzene | µg/L | - | 3 | 3 | <1 | <1 | <1 | <1 | <1 |
| | Benzene_VOC | mg/L | 0.11 | 3 | 3 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | Bromodichloromethane | µg/L | - | 3 | 3 | <1 | <1 | <1 | <1 | <1 |
| | Bromoform | µg/L | - | 3 | 3 | <1 | <1 | <1 | <1 | <1 |
| | Bromomethane | µg/L | - | 3 | 3 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| | Carbon Tetrachloride | µg/L | - | 3 | 3 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| | Chlorobenzene | µg/L | 25 | 3 | 3 | <1 | <1 | <1 | <1 | <1 |
| | Chloroethane | µg/L | - | 3 | 3 | <8 | <8 | <8 | <8 | <8 |
| | Chloroform | µg/L | - | 3 | 3 | <1 | <1 | <1 | <1 | <1 |
| | Chloromethane | µg/L | - | 3 | 3 | <8 | <8 | <8 | <8 | <8 |
| | cis-1,2-Dichloroethylene | µg/L | - | 3 | 3 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| | cis-1,3-Dichloropropene | µg/L | - | 3 | 3 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| | Dibromochloromethane | µg/L | - | 3 | 3 | <1 | <1 | <1 | <1 | <1 |
| | Ethylbenzene_VOC | mg/L | 0.025 | 3 | 3 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | Ethylene Dibromide | µg/L | - | 3 | 3 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| | Methyl t-butyl ether (MTBE) | µg/L | 5000 | 3 | 3 | <2 | <2 | <2 | <2 | <2 |
| | Methylene Chloride(Dichloromethane) | µg/L | - | 3 | 3 | <3 | <3 | <3 | <3 | <3 |
| | Modified TPH (Tier1) | mg/L | - | 3 | 3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| | n-Dotriacontane - Extractable | % | - | 3 | 0 | 93 | 93.3 | 96 | 101.4 | 102 |
| | o-Xylene_VOC | µg/L | - | 3 | 3 | <1 | <1 | <1 | <1 | <1 |
| | p+m-Xylene_VOC | µg/L | - | 3 | 3 | <2 | <2 | <2 | <2 | <2 |
| | Styrene | µg/L | - | 3 | 3 | <1 | <1 | <1 | <1 | <1 |
| | Tetrachloroethylene | µg/L | - | 3 | 3 | <1 | <1 | <1 | <1 | <1 |
| | Toluene_VOC | mg/L | 0.215 | 3 | 3 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | Total Trihalomethanes | µg/L | - | 3 | 3 | <1 | <1 | <1 | <1 | <1 |
| | Total Xylenes_VOC | mg/L | - | 3 | 3 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

## Appendix B-2: Background Water Quality at Pipeline Corridor (2018 - 2019)

| Location | Parameter | Units | CCME Guideline | Total Count | Count (<RDL) | Minimum | Percentile_5th | Percentile_50th | Percentile_95th | Maximum |
|---|---|---|---|---|---|---|---|---|---|---|
| | trans-1,2-Dichloroethylene | µg/L | - | 3 | 3 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| | trans-1,3-Dichloropropene | µg/L | - | 3 | 3 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| | Trichloroethylene | µg/L | - | 3 | 3 | <1 | <1 | <1 | <1 | <1 |
| | Trichlorofluoromethane (FREON 11) | µg/L | - | 3 | 3 | <8 | <8 | <8 | <8 | <8 |
| | Vinyl Chloride | µg/L | - | 3 | 3 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| | **Petroleum Hydrocarbons with Atl. RBCA V3.1 method** | | | | | | | | | |
| | C6 - C10 (less BTEX) | mg/L | - | 3 | 3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| | >C10-C16 Hydrocarbons | mg/L | - | 3 | 3 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | >C16-C21 Hydrocarbons | mg/L | - | 3 | 3 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | >C21-<C32 Hydrocarbons | mg/L | - | 3 | 3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| | Benzene_RBCA | mg/L | 0.11 | 3 | 3 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | Ethylbenzene_RBCA | mg/L | 0.025 | 3 | 3 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | Toluene_RBCA | mg/L | 0.215 | 3 | 3 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | Total Xylenes_RBCA | mg/L | - | 3 | 3 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| | **Fatty Acids** | | | | | | | | | |
| | 9,10-Dichlorostearic acid | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Decanoic Acid (C10) | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Docosanoic acid (C22) | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Dodecanoic acid (C12) | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Eicosanoic acid (C20) | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Hexadecanoic acid (C16) | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Linoleic acid (C18:2) | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Linolenic acid (C18:3) | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Octadecanoic acid (C18) | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Oleic acid (C18:1) | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Tetradecanoic acid (C14) | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Total Fatty Acids | mg/L | - | 3 | 3 | <0.072 | <0.072 | <0.072 | <0.072 | <0.072 |
| | Undecanoic acid (C11) | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | **Resin Acids** | | | | | | | | | |
| | 12,14-Dichlorodehydroabietic acid | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | 12-Chlorodehydroabietic acid | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | 14-Chlorodehydroabietic acid | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Abietic acid | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Dehydroabietic acid | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Isopimaric acid | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Neoabietic acid | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Palustric acid | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Pimaric acid | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Sandaracopimaric acid | mg/L | - | 3 | 3 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| | Total Resin Acids | mg/L | - | 3 | 3 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 |
| | Total of Reg.P&P phenols | µg/L | - | 3 | 3 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

Notes:

1. The summary time is between 01-Jan-1900 and 10-Sep-2019.
2. The reporting locations are: "Caribou1", "Caribou2".
3. The reporting lab track IDs are: .

# Appendix C Baseline Sediment Quality Results

## Appendix C-1: Sediment Grain Size Analysis Results

| Area | Location | Sample | Grain Size Proportion (%) | | | | Classification |
|---|---|---|---|---|---|---|---|
| | | | Clay | Silt | Sand | Gravel | |
| Northumberland Strait | Diffuser | S1 | 0.94 | 0.1 | 98 | 1.2 | Sand |
| Northumberland Strait | Diffuser | S2 | 1.7 | 0.76 | 78 | 20 | Sand/Gravel |
| Northumberland Strait | Diffuser | VC-01-SFC | 4.3 | 14 | 81 | 1.2 | Silty Sand |
| Northumberland Strait | Diffuser | VC-02C-1 | 1.6 | 1.8 | 57 | 40 | Sand/Gravel |
| Northumberland Strait | Pipeline | VC-03B-1 | 1.3 | 0.77 | 80 | 18 | Sand/Gravel |
| Northumberland Strait | Pipeline | VC-04A | 1.6 | 2.1 | 91 | 5.5 | Sand |
| Northumberland Strait | Pipeline | VC-04B | 1.3 | 1.1 | 96 | 1.7 | Sand |
| Northumberland Strait | Pipeline | VC-05-1 | 8.3 | 16 | 73 | 2.4 | Silty Sand |
| Northumberland Strait | Pipeline | VC-07A | 1.2 | 0.47 | 95 | 3.8 | Sand |
| Northumberland Strait | Pipeline | VC-10B-1 | 1.3 | 0.43 | 98 | 0.68 | Sand |
| Northumberland Strait | Pipeline | VC-23A-1 | 7 | 10 | 83 | 0.18 | Silty Sand |
| Caribou Harbour | Pipeline | S3 | 16 | 58 | 26 | 0.32 | Sandy Silt |
| Caribou Harbour | Pipeline | S4 | 10 | 54 | 36 | 0.1 | Sandy Silt |
| Caribou Harbour | Pipeline | VC-11A-1 | 8.2 | 7.1 | 84 | 0.43 | Clay/Silty Sand |
| Caribou Harbour | Pipeline | VC-12-1 | 4.4 | 13 | 77 | 6.2 | Silty Sand |
| Caribou Harbour | Pipeline | VC-14-1 | 19 | 67 | 14 | 0.1 | Clay & Sandy Silt |
| Caribou Harbour | Pipeline | VC-15A-1 | 11 | 54 | 34 | 0.43 | Sandy Silt |
| Caribou Harbour | Pipeline | VC-16-1 | 25 | 42 | 28 | 4.9 | Sandy Silt |
| Caribou Harbour | Pipeline | VC-19A-1 | 19 | 34 | 47 | 0.11 | Silt/Sand |
| Caribou Harbour | Pipeline | VC-20A-1 | 17 | 29 | 53 | 0.34 | Silty Sand |
| Caribou Harbour | Pipeline | VC-21A-1 | 23 | 54 | 24 | 0.1 | Clay & Sandy Silt |
| Caribou Harbour | Pipeline | VC-22A-1 | 4.4 | 13 | 82 | 0.24 | Silty Sand |
| Pictou Harbour | Pipeline | VC-50C-1 | 42 | 46 | 10 | 1.7 | Clay/Silt |
| Pictou Harbour | Pipeline | VC-51A | 19 | 27 | 35 | 18 | Silty Sand / Gravel |
| Pictou Harbour | Pipeline | VC-52A-1 | 13 | 79 | 7.5 | 0.1 | Clay & Sandy Silt |
| Pictou Harbour | Pipeline | VC-53A-1 | 16 | 79 | 5 | 0.34 | Clay & Sandy Silt |
| Pictou Harbour | Pipeline | VC-54A-1 | 15 | 76 | 7.3 | 2.3 | Clay & Sandy Silt |

## Appendix C-2: Exceedance of Benchmark "CCME ISQG"

| Site Name | Media Name | Benchmark | Parameter | Exposure Level | Location | Units | Sample Time | Sample Value | Benchmark Maximum |
|---|---|---|---|---|---|---|---|---|---|
| NPNS | Sediment | CCME ISQG | 1,2,3,4,6,7,8-Hepta CDD | Exposure 2 | VC-16-1 | pg/g | 02-May-2019 | 8.55 | 0.85 |
| NPNS | Sediment | CCME ISQG | 1,2,3,4,6,7,8-Hepta CDF | Exposure 2 | VC-16-1 | pg/g | 02-May-2019 | 1.63 | 0.85 |
| NPNS | Sediment | CCME ISQG | 2-Methylnaphthalene | Exposure 2 | VC-50C-1 | mg/kg | 29-Apr-2019 | 1.8 | 0.0202 |
| NPNS | Sediment | CCME ISQG | 2-Methylnaphthalene | Exposure 2 | VC-50C-2 | mg/kg | 29-Apr-2019 | 0.082 | 0.0202 |
| NPNS | Sediment | CCME ISQG | 2-Methylnaphthalene | Exposure 2 | VC-50C-3 | mg/kg | 29-Apr-2019 | 0.15 | 0.0202 |
| NPNS | Sediment | CCME ISQG | Acenaphthene | Exposure 2 | VC-50C-1 | mg/kg | 29-Apr-2019 | 0.69 | 0.007 |
| NPNS | Sediment | CCME ISQG | Acenaphthene | Exposure 2 | VC-50C-2 | mg/kg | 29-Apr-2019 | <0.02 | 0.007 |
| NPNS | Sediment | CCME ISQG | Acenaphthene | Exposure 2 | VC-50C-3 | mg/kg | 29-Apr-2019 | <0.02 | 0.007 |
| NPNS | Sediment | CCME ISQG | Arsenic | Exposure 2 | VC-14-1 | mg/kg | 02-May-2019 | 8.5 | 7.24 |
| NPNS | Sediment | CCME ISQG | Arsenic | Exposure 2 | VC-14-2 | mg/kg | 02-May-2019 | 8.4 | 7.24 |
| NPNS | Sediment | CCME ISQG | Arsenic | Exposure 2 | VC-14-3 | mg/kg | 02-May-2019 | 8.1 | 7.24 |
| NPNS | Sediment | CCME ISQG | Arsenic | Exposure 2 | VC-16-1 | mg/kg | 02-May-2019 | 7.4 | 7.24 |
| NPNS | Sediment | CCME ISQG | Arsenic | Exposure 2 | VC-16-2 | mg/kg | 02-May-2019 | 9 | 7.24 |
| NPNS | Sediment | CCME ISQG | Arsenic | Exposure 2 | VC-16-3 | mg/kg | 02-May-2019 | 12 | 7.24 |
| NPNS | Sediment | CCME ISQG | Arsenic | Exposure 2 | VC-19-3 | mg/kg | 05-May-2019 | 9.9 | 7.24 |
| NPNS | Sediment | CCME ISQG | Arsenic | Exposure 2 | VC-20-3 | mg/kg | 05-May-2019 | 11 | 7.24 |
| NPNS | Sediment | CCME ISQG | Arsenic | Exposure 2 | VC-21-1 | mg/kg | 05-May-2019 | <7.3 | 7.24 |
| NPNS | Sediment | CCME ISQG | Arsenic | Exposure 2 | VC-50C-1 | mg/kg | 29-Apr-2019 | 11 | 7.24 |
| NPNS | Sediment | CCME ISQG | Arsenic | Exposure 2 | VC-50C-2 | mg/kg | 29-Apr-2019 | 9.1 | 7.24 |
| NPNS | Sediment | CCME ISQG | Arsenic | Exposure 2 | VC-50C-3 | mg/kg | 29-Apr-2019 | 9.6 | 7.24 |
| NPNS | Sediment | CCME ISQG | Arsenic | Exposure 2 | VC-51 | mg/kg | 29-Apr-2019 | 8.3 | 7.24 |
| NPNS | Sediment | CCME ISQG | Arsenic | Exposure 2 | VC-52-1 | mg/kg | 29-Apr-2019 | 11 | 7.24 |
| NPNS | Sediment | CCME ISQG | Arsenic | Exposure 2 | VC-52-2 | mg/kg | 29-Apr-2019 | 11 | 7.24 |
| NPNS | Sediment | CCME ISQG | Arsenic | Exposure 2 | VC-52-3 | mg/kg | 29-Apr-2019 | 12 | 7.24 |
| NPNS | Sediment | CCME ISQG | Arsenic | Exposure 2 | VC-53-1 | mg/kg | 29-Apr-2019 | 12 | 7.24 |
| NPNS | Sediment | CCME ISQG | Arsenic | Exposure 2 | VC-53-2 | mg/kg | 29-Apr-2019 | 11 | 7.24 |
| NPNS | Sediment | CCME ISQG | Arsenic | Exposure 2 | VC-53-3 | mg/kg | 29-Apr-2019 | 12 | 7.24 |
| NPNS | Sediment | CCME ISQG | Arsenic | Exposure 2 | VC-54-1 | mg/kg | 29-Apr-2019 | 12 | 7.24 |
| NPNS | Sediment | CCME ISQG | Copper | Exposure 2 | VC-12-2 | mg/kg | 02-May-2019 | 41 | 18.7 |
| NPNS | Sediment | CCME ISQG | Copper | Exposure 2 | VC-16-3 | mg/kg | 02-May-2019 | 19 | 18.7 |
| NPNS | Sediment | CCME ISQG | Copper | Exposure 2 | VC-50C-1 | mg/kg | 29-Apr-2019 | 19 | 18.7 |
| NPNS | Sediment | CCME ISQG | Copper | Exposure 2 | VC-50C-3 | mg/kg | 29-Apr-2019 | 20 | 18.7 |
| NPNS | Sediment | CCME ISQG | Copper | Exposure 2 | VC-52-3 | mg/kg | 29-Apr-2019 | 19 | 18.7 |
| NPNS | Sediment | CCME ISQG | Copper | Exposure 2 | VC-53-3 | mg/kg | 29-Apr-2019 | 20 | 18.7 |
| NPNS | Sediment | CCME ISQG | Copper | Exposure 2 | VC-54-1 | mg/kg | 29-Apr-2019 | 19 | 18.7 |
| NPNS | Sediment | CCME ISQG | Fluoranthene | Exposure 2 | VC-19-1 | mg/kg | 05-May-2019 | <0.12 | 0.113 |
| NPNS | Sediment | CCME ISQG | Fluoranthene | Exposure 2 | VC-50C-1 | mg/kg | 29-Apr-2019 | 0.13 | 0.113 |
| NPNS | Sediment | CCME ISQG | Fluoranthene | Exposure 2 | VC-50C-2 | mg/kg | 29-Apr-2019 | 0.15 | 0.113 |
| NPNS | Sediment | CCME ISQG | Fluoranthene | Exposure 2 | VC-50C-3 | mg/kg | 29-Apr-2019 | 0.14 | 0.113 |
| NPNS | Sediment | CCME ISQG | Fluorene | Exposure 2 | VC-50C-1 | mg/kg | 29-Apr-2019 | 0.36 | 0.0212 |
| NPNS | Sediment | CCME ISQG | Fluorene | Exposure 2 | VC-50C-3 | mg/kg | 29-Apr-2019 | 0.03 | 0.0212 |
| NPNS | Sediment | CCME ISQG | Lead | Exposure 2 | VC-50C-1 | mg/kg | 29-Apr-2019 | 33 | 30.2 |
| NPNS | Sediment | CCME ISQG | Lead | Exposure 2 | VC-50C-3 | mg/kg | 29-Apr-2019 | 33 | 30.2 |
| NPNS | Sediment | CCME ISQG | Naphthalene | Exposure 2 | VC-50C-1 | mg/kg | 29-Apr-2019 | 6.8 | 0.0346 |
| NPNS | Sediment | CCME ISQG | Naphthalene | Exposure 2 | VC-50C-2 | mg/kg | 29-Apr-2019 | 0.039 | 0.0346 |
| NPNS | Sediment | CCME ISQG | Naphthalene | Exposure 2 | VC-50C-3 | mg/kg | 29-Apr-2019 | 0.081 | 0.0346 |
| NPNS | Sediment | CCME ISQG | Phenanthrene | Exposure 2 | VC-50C-1 | mg/kg | 29-Apr-2019 | 0.24 | 0.0867 |
| NPNS | Sediment | CCME ISQG | Phenanthrene | Exposure 2 | VC-50C-2 | mg/kg | 29-Apr-2019 | 0.11 | 0.0867 |
| NPNS | Sediment | CCME ISQG | Phenanthrene | Exposure 2 | VC-50C-3 | mg/kg | 29-Apr-2019 | 0.11 | 0.0867 |
| NPNS | Sediment | CCME ISQG | Pyrene | Exposure 2 | VC-50C-3 | mg/kg | 29-Apr-2019 | 0.21 | 0.153 |

**Notes:**

1. The summary time is between 01-Jan-1900 and 13-Aug-2019.

CCME ISQG - Canadian Council of Ministers of the Environment Interim Sediment Quality Guideline

## Appendix C-3: Exceedance of Benchmark "CCME PEL"

| Site Name | Media Name | Benchmark | Parameter | Exposure Level | Location | Units | Sample Time | Sample Value | Benchmark Maximum |
|---|---|---|---|---|---|---|---|---|---|
| NPNS | Sediment | CCME PEL | 2-Methylnaphthalene | Exposure 2 | VC-50C-1 | mg/kg | 29-Apr-2019 | 1.8 | 0.201 |
| NPNS | Sediment | CCME PEL | Acenaphthene | Exposure 2 | VC-50C-1 | mg/kg | 29-Apr-2019 | 0.69 | 0.089 |
| NPNS | Sediment | CCME PEL | Fluorene | Exposure 2 | VC-50C-1 | mg/kg | 29-Apr-2019 | 0.36 | 0.144 |
| NPNS | Sediment | CCME PEL | Naphthalene | Exposure 2 | VC-50C-1 | mg/kg | 29-Apr-2019 | 6.8 | 0.391 |

**Notes:**

1. The summary time is between 01-Jan-1900 and 13-Aug-2019.

CCME PEL - Canadian Council of Ministers of the Environment Probable Effect Level

# Appendix D Fish Species and Fish Habitat Presence Screening

## Appendix D: Marine Fin-Fish Species Status, Occurrence, Habitat and Resource Use

| Occurrence | Group | Common Name | Scientific Name | Status | | | Habitat Affinity[1] | Reference | Probability of Capture (trawl)** (%) | Likely Occurrence in LAA[2] | Notes | CRA Fishery? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SARA | COSEWIC | IUCN Red List Status | | | | | | |
| Coastal | Migratory | American Eel | *Anguilla rostrata* | No Status | Threatened | Endangered | Migratory, shallow coastal, rock, sand, mud, eelgrass and interstitial spaces. | COSEWIC Assessment and Status Report (2012) | | Medium-low | Migratory and passing through the LAA to spawning areas | Yes |
| Coastal | Forage | Atlantic Silverside | *Menidia menidia* | No Status | No Status | Least Concern | 0-3 m brackish water | Fishbase (2019) | | Low-medium | LAA outside the general influence of brackish water | No |
| Coastal | Migratory | Atlantic Striped Bass | *Morone saxatilis* | No Status | Threatened | Least Concern | Migratory, nearshore in summer, resident Feeding/nursery | COSEWIC Assessment and Status Report (1996), Rondeau et al. (2016) | | Medium-low | Migratory and passing through the LAA to spawning areas | Yes |
| Coastal | Forage | Banded Killifish | *Fundulus diaphanous* | No Status | No Status | Least Concern | Freshwater/Estuaries | Fishbase (2019) | | Low | LAA outside the general influence of brackish water | No |
| Coastal | Forage | Blackspotted Stickleback | *Gasterosteus wheatlandi* | No Status | No Status | Least Concern | Marine; brackish; benthopelagic, vegetation | Fishbase (2019) | | Low | LAA outside the general influence of brackish water | No |
| Coastal | Migratory | Brook Trout | *Salvelinus fontinalis* | No Status | No Status | Not Evaluated | Sand and clay flats in estuaries; sand, cobble in bays | Morinville & Rasmussen (2006) | | Low-medium | Possible movement into LAA from river habitats | Yes |
| Coastal | Forage | Cunner | *Tautogolabrus adspersus* | No Status | No Status | Least Concern | Shallow nearshore, near bottom, structure (docks and piers) and seeweed beds, winter inshore under rocks | Fishbase (2019) | 40 - 60 | Medium | Limited nearshore structure available near ferry terminal and Pictou causeway | No |
| Coastal | Forage | Ninespine Stickleback | *Pungitius pungitius* | No Status | No Status | Least Concern | Marine populations found near shore, move into fresh water to spawn. Seasonal movements inshore to shallow water in the spring for spawning, and, in the fall, offshore to deep water, or even to the less saline parts of the sea, by the young and adults that survive spawning | Fishbase (2019) | | Medium-low | Possible movement into LAA from river habitats | No |
| Coastal | Forage | Northern Pipefish | *Syngnathus fuscus* | No Status | No Status | Least Concern | Seagrass beds in bays and estuaries. Resident in estuaries during spring through fall, migrates into near shore continental shelf waters during winter. | Fishbase (2019) | | Low-medium | LAA outside the general influence of brackish water | No |
| Coastal | Migratory-Forage | Rainbow Smelt | *Osmerus mordax* | No Status | No Status | Least Concern | Schooling, inshore coastal | Fishbase (2019), Rondeau et al. (2016) | | High | Resident Feeding/nursery | Yes |
| Coastal | Migratory | Rainbow Trout | *Salmo gairdneri* | No Status | No Status | Not Evaluated | Sand and clay flats in estuaries; sand, cobble in bays, non-native species | Fishbase (2019), NB aquatic invasives (2019) (http://www.nbaquaticinvasives.ca/index.php?option=com_content&view=article&id=58&Itemid=61) | | Low | Introduced/invasive, not considered to be self-sustaining in Northumberland Strait | Yes |
| Coastal | Forage | Threespine Stickleback | *Gasterosteus aculeatus* | No Status | No Status | Least Concern | Shallow coastal vegetated areas, anadromous, resident, probably ubiquitous in SGSL | Fishbase (2019), Rondeau et al. (2016) | 40 - 60 | Medium-high | Possible habitat available in LAA | No |
| Demersal | Benthic | Alligatorfish | *Aspidophoroides monopterygius* | No Status | No Status | Not Evaluated | Primarily lower sections of the shelf all year (depths of 80-200 m), sand and mud bottoms, | Fishbase (2019) | | Low | Inhabits depths greater than LAA | No |
| Demersal | Benthic | Arctic Rockling | *Gaidropsarus argentatus* | No Status | No Status | Not Evaluated | Found offshore in deep water, always on soft bottoms of gravel, sand, mud, shells, and stones. | Fishbase (2019) | | Low | Inhabits depths greater than LAA | No |
| Demersal | Migratory | Atlantic Cod | *Gadus morhua* | No Status | Endangered | Vulnerable | Juveniles prefer shallow (less than 10-30 m depth) sublittoral waters, complex habitats, such as seagrass beds, areas with gravel, rocks, or boulder. Adults are usually found in deeper, colder waters (absent from Northumberland Strait) | Fishbase (2019) | | Medium | LAA possible mitragtory route and juvenile habitat | No |
| Demersal | Benthic | Atlantic Plaice | *Hippoglossoides platessoides* | No Status | Threatened | Not Evaluated | Live on soft bottom, Eggs and Larvae are pelagic. Juvenile and adults commonly burrow in the sediment. They prefer depths of 50 to 200 meters and water temperatures ranging from 0 to 1.5ºC. | Fishbase (2019), DFO Species Account (online) | 0 - 20 | Low | Inhabits depths greater than LAA | Yes |
| Demersal | Benthic | Atlantic Halibut | *Hippoglossus hippoglossus* | No Status | No Status | Endangered | Adults 200 m or greater in the GSL, larval stages in depths from 10 to 100m, rare species in SGSL, absent from central part of Northumberland Strait | DFO Stock Status Report (1999), Rondeau et al. (2016) | | Low | Potential use of LAA by larval stages | Yes |

## Appendix D: Marine Fin-Fish Species Status, Occurrence, Habitat and Resource Use

| Occurrence | Group | Common Name | Scientific Name | Status | | | Habitat Affinity[1] | Reference | Probability of Capture (trawl)** (%) | Likely Occurrence in LAA[2] | Notes | CRA Fishery? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SARA | COSEWIC | IUCN Red List Status | | | | | | |
| Demersal | Benthic | Atlantic Tomcod | *Microgadus tomcod* | No Status | No Status | Least Concern | Coastal and brackish waters | Fishbase (2019) | < 10 | Medium-low | LAA outside the general influence of brackish water | No |
| Demersal | Forage | Butterfish | *Peprilus tricanthus* | No Status | No Status | Not Evaluated | Large schools over the continental shelf, except during the winter months when may descend to deeper water. Juveniles are generally found under floating weeds and jellyfish, transient species in SGSL | Fishbase (2019), Rondeau et al. (2016) | | Low | Generally inhabits depths greater than LAA | No |
| Demersal | Benthic | Common Ocean Pout | *Zoarces americanus* | No Status | No Status | Not Evaluated | shallow coastal waters around rocks and attached algae (14-40m - juveniles), adults move between habitats for optimal temp (sand and gravel, rock and hard substrates - 25 - 200 m), rare in Northumberland Strait | NOAA Technical Memorandum NMFS-NE-129, Rondeau et al. (2016) | < 10 | Low-medium | Generally inhabits depths greater than LAA | No |
| Demersal | Benthic | Eelpout | *Lycodes sp.* | No Status | No Status | Least Concern | Rocky shores under stones, among algae and tide pools to 40 m | Fishbase (2019) | | Low-medium | Potential use of habitats in LAA, but limited availability in LAA of rocky substrates | No |
| Demersal | Benthic | Fourbeard Rockling | *Enchelyopus cimbrius* | No Status | No Status | Least Concern | Sedentary, benthic, muddy sand between patches of hard substrate of deep sinks of continental slopes | Fishbase (2019) | < 10 | Low | Generally inhabits depths greater than LAA | No |
| Demersal | Benthic | Fourline Snakeblenny | *Eumesogrammus praecisus* | No Status | No Status | Not Evaluated | Occurs over sand to gravel-and-stone bottoms at depths of 16-400 meters, typically shallower than 70 meters | Fishbase (2019) | 0 - 30 | Low-medium | Generally inhabits depths greater than LAA | No |
| Demersal | Benthic | Fourspine Stickleback | *Apeltes quadracus* | No Status | No Status | Least Concern | Adults occur mainly along weedy bays and backwaters | Fishbase (2019) | | Low | Possible habitat available in LAA | No |
| Demersal | Migratory | Greenland Cod | *Gadus ogac* | No Status | No Status | Not Evaluated | Juveniles prefer shallow (less than 10-30 m depth) sublittoral waters, complex habitats, such as seagrass beds, areas with gravel, rocks, or boulder. Adults are usually found in deeper, colder waters. | Fishbase (2019) | 0 - 20 | Medium | LAA possible mitragtory route and juvenile habitat | No |
| Demersal | Benthic | Greenland Halibut | *Reinhardtius hippoglossoides* | No Status | No Status | Not Evaluated | They prefer cold temperatures and softer substrates consisting of mud and sandy mud. | DFO Species Account (online) | | Low-medium | Generally inhabits depths greater than LAA | Yes |
| Demersal | Benthic | Longhorn Sculpin | *Myoxocephalus octodecemspinsosus* | No Status | No Status | Not Evaluated | Commonly found in harbors and shallow coastal waters. Move to deeper water in winter. | Fishbase (2019), Rondeau et al. (2016) | 40 - 60 | High | Possible habitat available in LAA | No |
| Demersal | Benthic | Mailed Sculpin | *Triglops murrayi* | No Status | No Status | Not Evaluated | Prefers sandy bottoms between 100 to 200 m | Fishbase (2019) | | Low | Generally inhabits depths greater than LAA | No |
| Demersal | Benthic | Northern Sand Lance | *Ammodytes dubius* | No Status | No Status | Not Evaluated | Shallow water with fine gravel or sandy bottoms, yet generally considered an offshore species | Fishbase (2019) | 0 - 20 | Medium-low | Possible habitat available in LAA | No |
| Demersal | Benthic | Sand Lance | *Ammodytes americanus* | No Status | No Status | Not Evaluated | Found in shallow coastal waters as well as in protected bays and estuaries. Occurs in large schools and burrows in the sand at times to a depth of several inches. | Fishbase (2019) | | High | Possible habitat available in LAA | No |
| Demersal | Benthic | Sea Raven | *Hemitripterus americanus* | No Status | No Status | Not Evaluated | Inhabit rocky or hard bottom between 30 and 100 m | Fishbase (2019), Rondeau et al. (2016) | 0 - 40 | Low | Generally inhabits depths greater than LAA | No |
| Demersal | Benthic | Shorhorn Sculpin | *Myoxocephalus scorpius* | No Status | No Status | Not Evaluated | Found on rocky bottoms with sand or mud, or among seaweed | Fishbase (2019) | 0 - 20 | Medium-high | Possible habitat available in LAA | No |
| Demersal | Benthic | Silver Hake | *Merluccius bilinearis* | No Status | No Status | Near Threatened | depth range 55 - 914 m, Abundant on sandy grounds and strays into shallower waters, Abundant on sandy grounds and strays into shallower waters | Fishbase (2019), DFO Species Account (online) | | Low | Generally inhabits depths greater than LAA | No |
| Demersal | Benthic | Snakblenny | *Lumpenus lampretaeformis* | No Status | No Status | Not Evaluated | Depth range 30 - 373 m, Inhabits deep, cold, dark waters where seasonal weather changes probably have little impact. | Fishbase (2019) | | Low | Generally inhabits depths greater than LAA | No |
| Demersal | Benthic | White Hake | *Urophycis tenuis* | No Status | Endangered | Not Evaluated | found near the sea floor and they prefer areas with sandy or muddy bottoms. They seek depths with water temperatures ranging from 4-8º C. Larger fish generally inhabit deeper waters while small juveniles typically occupy shallow areas close to shore or over shallow offshore banks. In the SGSL, all sizes tend to move shoreward in summer and swim to deeper water in winter. Currently, "high" juvenile numbers in Northumberland Strait, only spawning in St. George's Bay. | DFO Species Account (online), Rondeau et al. (2016) | | High | Habitat available in the LAA for multiple life stages | No - Moratorium |

## Appendix D: Marine Fin-Fish Species Status, Occurrence, Habitat and Resource Use

| Occurrence | Group | Common Name | Scientific Name | Status | | | Habitat Affinity[1] | Reference | Probability of Capture (trawl)** (%) | Likely Occurrence in LAA[2] | Notes | CRA Fishery? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SARA | COSEWIC | IUCN Red List Status | | | | | | |
| Demersal | Benthic | Windowpane | *Scophthalmus aquosus* | No Status | No Status | Not Evaluated | Occurs from shore to 45 m depth, occasionally in deeper water, they prefer sandy and mud bottoms in open areas, but can be also found near areas of structure. | Fishbase (2019) | | Medium-high | Possible habitat available in LAA | No |
| Demersal | Benthic | Winter Flounder | *Pseudopleuronectes americanus* | No Status | No Status | Not Evaluated | Adults inhabit soft muddy to moderately hard bottoms, does not leave the Gulf in winter or migrate to deep water; it overwinters in estuaries or coastal areas | Fishbase (2019), DFO Stock Assessment (2017), Rondeau et al. (2016) | 80 - 90 | High | Habitat available in the LAA for multiple life stages | Yes |
| Demersal | Benthic | Winter Skate | *Leucoraja ocellata* | No Status | Endangered | Endangered | benthic species living over sand or gravel bottoms, usually in depths less than 111m, seasonal inshore and offshore movements, Formerly ubiquitous Now almost exclusively in Northumberland Strait (the only known breeding area) in SGSL | DFO Species Account (online), COSEWIC Assessmetn and Status Report (2015) | | High | Possible habitat available in LAA | No |
| Demersal | Benthic | Wrymouth | *Cryptacanthodes maculatus* | No Status | No Status | Not Evaluated | Burrows in soft muddy bottoms from shallow water to 110 m depth. | Fishbase (2019) | < 20 | Low | Limited soft muddy substrates avaiable within the LAA | No |
| Demersal | Benthic | Yellowtail Flounder | *Limanda ferruginea* | No Status | No Status | Vulnerable | Adults inhabit sandy to muddy bottoms. Prefer depths of 37 to 82 m at temperatures of 3-5°C. Warm waters to transition waters Rare < 15 m depths | Fishbase (2019), DFO Species Account (online), Rondeau et al. (2016) | 20 - 50 | Low | Generally inhabits depths greater than LAA | Yes |
| Pelagic | Migratory | Atlantic Bluefin Tuna | *Thunnus thynnus* | No Status | Endangered | Endangered | Highly migratory across the Atlantic Ocean, The western Atlantic Bluefin Tuna population feed during the summer in Atlantic Canadian water, transient and feeding only in SGSL | DFO Species Account (online), Rondeau et al. (2016) | | Low | Migratory and passing through the LAA to feed | Yes |
| Pelagic | Migratory | Atlantic Herring | *Clupea harengus* | No Status | No Status | Least Concern | 0 to 200 m, schooling behaviour, move from coastal areas to feeding grounds (offshore), adults in deeper water by day but move shallower at night. Spawning on gravel or rock substrates | DFO Species Account (online), Rondeau et al. (2016) | 70 - 80 | High | Migratory and passing through the LAA to spawning areas, limited spawning habitat within the LAA | Yes |
| Pelagic | Migratory | Atlantic Mackerel | *Scomber scombrus* | No Status | No Status | Least Concern | schooling fish, usually spending their time close to shore, larvae distributed in depths 10-130m, newly hatched larvae between 5-10m during the day, adults summer range closer to shore and often in 20-50 m. Ubiquitous, leaves SGSL for winter. | NOAA Technical Memorandum NMFS-NE-141, Rondeau et al. (2016) | 50 - 70 | High | Habitat available in the LAA for multiple life stages | Yes |
| Pelagic | Migratory | Atlantic Salmon | *Salmo salar* | No Status | Special Concern | Lower Risk | migratory using rivers discharging to the Northumberland Strait. Juvenile smolts use estuaries and nearshore habitats prior to moving to open water, Juveniles and adults leave sGSL to feed. | DFO Species Account (online), COSEWIC Assessmetn and Status Report (2010), Rondeau et al. (2016) | | Low-medium | Migratory and passing through the LAA to access spawning rivers and/or to feed as juveniles or adults during at sea stage | Yes |
| Pelagic | Forage | Capelin | *Mallotus villosus* | No Status | No Status | Not Evaluated | Offshore species that move inshore to spawn on beaches or demersal sites (20-30 m on gravel, sand or cobble), Deepest margins, not in Northumberland Strait | DFO Species Account (online), Ings et al. (2005), Rondeau et al. (2016) | < 10 | Low | Not in Northumberland Strait | Yes |
| Pelagic | Forage | Gaspereau / Alewife | *Alosa pseudoharengus* | No Status | No Status | Least Concern | Long-distance migrant Feeding/nursery Leaves sGSL for winter, Shallow warm waters, High concentration in Northumberland Strait | Rondeau (2016) | | High | Available habitat in LAA | Yes |
| Pelagic | Forage | Mummichog | *Fundulus heteroclitus* | No Status | No Status | Least Concern | common fish in coastal habitats such as salt marshes, muddy creeks, tidal channels, brackish estuaries, eelgrass or cordgrass beds, and sheltered shorelines. | DFO Species Account (online) | | Low | LAA outside the general influence of brackish water, limited sheltered shoreline habitat available in the LAA | No |

**Notes**

1 = based on information provided in refernces listed

2 = based on the presence or proportional amount of available preferred habitat in the LAA as described by Caribou Harbour and Pictour Harbour Bathymetry and/or Stantec (2019b), Rondeau et al. (2016)

SARA and COSEWIC Status specific to Souther Gulf of St. Lawrence designatable unit where applicable

IUCN Red List Status - International Union of Conservatio Red List of Threatened Species

GSL - Gulf of St. Lawrence

** - Based on Rondeau et al. (2016) *Identification and Characterization of Important Areas based on Fish and Invertebrate Species in the Coastal Waters of the Southern Gulf of St. Lawrence.* Fisheries and Oceans Canada Research Document 2016/044

# Appendix E Effluent Water Quality Assessment Data

**Appendix E-1 : Step 1 in Screening Process: Comparison of Concentrations in Treated Effluent (represented by current treated effluent concentrations) to Background Concentations (represented by concentrations at the location of the proposed diffuser).**

| Group | Parameter | Unit | Median Background Concentrations (Proposed Diffuser Location) | Total Count | Count (<RDL) | Max Treated Effluent Concentrations (Point C) | Total Count | Count (<RDL) | Are Concentrations in Treated Effluent (Point C) > Background Concentrations (Proposed Diffuser Location)? |
|---|---|---|---|---|---|---|---|---|---|
| Anions and Nutrients | Total Alkalinity (Total as CaCO3) | mg/L | 92.5 | 14 | 0 | 420 | 2 | 0 | Yes |
| Anions and Nutrients | Bicarb. Alkalinity (calc. as CaCO3) | mg/L | 92 | 14 | 0 | 420 | 2 | 0 | Yes |
| Anions and Nutrients | Carb. Alkalinity (calc. as CaCO3) | mg/L | 1 | 14 | 14 | 1.4 | 2 | 0 | Yes |
| Anions and Nutrients | Total Residual Chlorine | mg/L | 0.1 | 1 | 1 | 0.11 | 1 | 0 | Yes |
| Anions and Nutrients | Dissolved Chlorite (CLO2-) | mg/L | 1 | 14 | 14 | 2.1 | 2 | 1 | Yes |
| Anions and Nutrients | Total Phosphorus | mg/L | 0.02 | 14 | 13 | 11 | 1972 | 0 | Yes |
| Anions and Nutrients | Orthophosphate (P) | mg/L | 0.01 | 14 | 14 | 1.5 | 285 | 0 | Yes |
| Anions and Nutrients | Total Nitrogen (N) | mg/L | 0.1475 | 14 | 0 | 7.4 | 1 | 0 | Yes |
| Anions and Nutrients | Nitrogen (Ammonia Nitrogen) | mg/L | 0.05 | 14 | 13 | 6.8 | 1968 | 118 | Yes |
| Anions and Nutrients | Nitrogen (Ammonia Nitrogen) | mg/L | 0.05 | 14 | 13 | 6.8 | 1968 | 118 | Yes |
| Anions and Nutrients | Nitrite (N) | mg/L | 0.01 | 14 | 14 | 3.15 | 1986 | 1754 | Yes |
| Anions and Nutrients | Nitrate (N) | mg/L | 0.05 | 14 | 13 | 4.21 | 1986 | 1776 | Yes |
| Anions and Nutrients | Total Kjeldahl Nitrogen (TKN) | mg/L | 0.155 | 14 | 0 | 31 | 1970 | 13 | Yes |
| Anions and Nutrients | Sulphide (as H2S) | mg/L | 0.011 | 4 | 4 | 1.9 | 1 | 0 | Yes |
| Anions and Nutrients | Sulphide | mg/L | 0.1 | 5 | 5 | 3.2 | 285 | 0 | Yes |
| Anions and Nutrients | Reactive Silica (SiO2) | mg/L | 0.5 | 14 | 13 | 9.6 | 2 | 0 | Yes |
| AOX | Adsorbable Organic Halogen | mg/L | 0.25 | 5 | 5 | 4.94 | 95 | 0 | Yes |
| Dioxins & Furans | Total Dioxins | pg/L | 14.3 | 13 | 4 | 42.4 | 4 | 0 | Yes |
| Dioxins & Furans | Total Furans | pg/L | 0 | 13 | 13 | 13 | 4 | 0 | Yes |
| Dioxins & Furans | 2,3,7,8-Tetra CDD | pg/L | 1.11 | 13 | 13 | 1.9 | 7 | 7 | Yes |
| Dioxins & Furans | 1,2,3,7,8-Penta CDD | pg/L | 1.08 | 13 | 13 | 2.5 | 7 | 7 | Yes |
| Dioxins & Furans | 1,2,3,4,7,8-Hexa CDD | pg/L | 1.18 | 13 | 13 | 1.5 | 7 | 7 | Yes |
| Dioxins & Furans | 1,2,3,6,7,8-Hexa CDD | pg/L | 1.05 | 13 | 13 | 1.8 | 7 | 7 | Yes |
| Dioxins & Furans | 1,2,3,7,8,9-Hexa CDD | pg/L | 1.07 | 13 | 13 | 1.8 | 7 | 7 | Yes |
| Dioxins & Furans | 1,2,3,4,6,7,8-Hepta CDD | pg/L | 1.57 | 13 | 13 | 10.4 | 7 | 3 | Yes |
| Dioxins & Furans | Octa CDD | pg/L | 11.3 | 13 | 5 | 28.9 | 7 | 1 | Yes |
| Dioxins & Furans | Total Tetra CDD | pg/L | 1.11 | 13 | 13 | 1.9 | 7 | 7 | Yes |
| Dioxins & Furans | Total Penta CDD | pg/L | 1.11 | 13 | 13 | 2.5 | 7 | 7 | Yes |
| Dioxins & Furans | Total Hexa CDD | pg/L | 1.11 | 13 | 13 | 2.34 | 7 | 6 | Yes |
| Dioxins & Furans | Total Hepta CDD | pg/L | 2.68 | 13 | 10 | 21.6 | 7 | 2 | Yes |
| Dioxins & Furans | 2,3,7,8-Tetra CDF | pg/L | 1.02 | 13 | 13 | 4.6 | 7 | 4 | Yes |
| Dioxins & Furans | 1,2,3,7,8-Penta CDF | pg/L | 1.08 | 13 | 13 | 1.34 | 7 | 6 | Yes |
| Dioxins & Furans | 2,3,4,7,8-Penta CDF | pg/L | 1.09 | 13 | 13 | 1.36 | 7 | 7 | Yes |
| Dioxins & Furans | 1,2,3,4,7,8-Hexa CDF | pg/L | 1.02 | 13 | 13 | 2.1 | 7 | 6 | Yes |
| Dioxins & Furans | 1,2,3,6,7,8-Hexa CDF | pg/L | 0.938 | 13 | 13 | 2.2 | 7 | 6 | Yes |
| Dioxins & Furans | 2,3,4,6,7,8-Hexa CDF | pg/L | 1.14 | 13 | 13 | 1.9 | 7 | 7 | Yes |
| Dioxins & Furans | 1,2,3,7,8,9-Hexa CDF | pg/L | 1.3 | 13 | 13 | 2.7 | 7 | 6 | Yes |
| Dioxins & Furans | 1,2,3,4,6,7,8-Hepta CDF | pg/L | 1.42 | 13 | 13 | 3.1 | 7 | 6 | Yes |
| Dioxins & Furans | 1,2,3,4,7,8,9-Hepta CDF | pg/L | 1.92 | 13 | 13 | 4.4 | 7 | 7 | Yes |
| Dioxins & Furans | Octa CDF | pg/L | 2.48 | 13 | 13 | 3.5 | 7 | 4 | Yes |
| Dioxins & Furans | Total Tetra CDF | pg/L | 1.05 | 13 | 13 | 7.1 | 7 | 4 | Yes |
| Dioxins & Furans | Total Penta CDF | pg/L | 1.09 | 13 | 13 | 1.35 | 7 | 6 | Yes |

## Appendix E-1 : Step 1 in Screening Process: Comparison of Concentrations in Treated Effluent (represented by current treated effluent concentrations) to Background Concentations (represented by concentrations at the location of the proposed diffuser).

| Group | Parameter | Unit | Median Background Concentrations (Proposed Diffuser Location) | Total Count | Count (<RDL) | Max Treated Effluent Concentrations (Point C) | Total Count | Count (<RDL) | Are Concentrations in Treated Effluent (Point C) > Background Concentrations (Proposed Diffuser Location)? |
|---|---|---|---|---|---|---|---|---|---|
| Dioxins & Furans | Total Hexa CDF | pg/L | 1.08 | 13 | 13 | 2.2 | 7 | 6 | Yes |
| Dioxins & Furans | Total Hepta CDF | pg/L | 1.84 | 13 | 13 | 4.3 | 7 | 4 | Yes |
| Fatty Acids | Total Fatty Acids | mg/L | 0.072 | 13 | 13 | 0.49 | 1 | 0 | Yes |
| Fatty Acids | 9,10-Dichlorostearic acid | mg/L | 0.006 | 13 | 13 | 0.0094 | 1 | 0 | Yes |
| Fatty Acids | Docosanoic acid (C22) | mg/L | 0.006 | 13 | 13 | 0.24 | 1 | 0 | Yes |
| Fatty Acids | Eicosanoic acid (C20) | mg/L | 0.006 | 13 | 13 | 0.081 | 1 | 0 | Yes |
| Fatty Acids | Hexadecanoic acid (C16) | mg/L | 0.006 | 13 | 13 | 0.039 | 1 | 0 | Yes |
| Fatty Acids | Linoleic acid (C18:2) | mg/L | 0.006 | 13 | 13 | 0.02 | 1 | 0 | Yes |
| Fatty Acids | Octadecanoic acid (C18) | mg/L | 0.006 | 13 | 13 | 0.047 | 1 | 0 | Yes |
| Fatty Acids | Oleic acid (C18:1) | mg/L | 0.006 | 13 | 13 | 0.05 | 1 | 0 | Yes |
| General Chemistry & Physical Parameters | pH | pH | 7.675 | 14 | 0 | 8.33 | 285 | 0 | Yes |
| General Chemistry & Physical Parameters | Saturation pH (@ 20C) | N/A | 7.37 | 14 | 0 | 7.48 | 2 | 0 | Yes |
| General Chemistry & Physical Parameters | Saturation pH (@ 4C) | N/A | 7.61 | 14 | 0 | 7.73 | 2 | 0 | Yes |
| General Chemistry & Physical Parameters | Colour | TCU | 5 | 14 | 13 | 9200 | 1965 | 0 | Yes |
| General Chemistry & Physical Parameters | Ion Balance (% Difference) | % | 2.765 | 14 | 0 | 3.25 | 2 | 0 | Yes |
| General Chemistry & Physical Parameters | Total Organic Carbon (C) | mg/L | 5 | 14 | 9 | 316 | 285 | 4 | Yes |
| General Chemistry & Physical Parameters | Dissolved Organic Carbon (C) | mg/L | 5 | 13 | 9 | 15 | 1 | 0 | Yes |
| General Chemistry & Physical Parameters | Total Suspended Solids | mg/L | 2.1 | 14 | 0 | 228 | 1969 | 19 | Yes |
| General Chemistry & Physical Parameters | Turbidity | NTU | 0.77 | 14 | 0 | 45 | 2 | 0 | Yes |
| Metals | Total Aluminum (Al) | µg/L | 50 | 14 | 13 | 2330 | 5 | 0 | Yes |
| Metals | Total Barium (Ba) | µg/L | 10 | 14 | 5 | 450 | 5 | 0 | Yes |
| Metals | Total Cadmium (Cd) | µg/L | 0.1 | 14 | 13 | 1.4 | 5 | 0 | Yes |
| Metals | Total Copper (Cu) | µg/L | 5 | 14 | 14 | 7.5 | 5 | 0 | Yes |
| Metals | Total Iron (Fe) | µg/L | 500 | 14 | 14 | 718 | 5 | 0 | Yes |
| Metals | Total Manganese (Mn) | µg/L | 20 | 14 | 14 | 2800 | 5 | 0 | Yes |
| Metals | Total Mercury (Hg) | µg/L | 0.00225 | 14 | 12 | 0.028 | 3 | 0 | Yes |
| Metals | Total Phosphorus (P) | µg/L | 1000 | 14 | 14 | 1600 | 2 | 0 | Yes |
| Metals | Total Zinc (Zn) | µg/L | 50 | 14 | 14 | 160 | 5 | 0 | Yes |
| Oxygen Demand | Biochemical Oxygen Demand | mg/L | 12 | 1 | 1 | 16 | 1 | 0 | Yes |
| Oxygen Demand | Carbonaceous BOD | mg/L | 5 | 13 | 13 | 253 | 838 | 5 | Yes |
| Oxygen Demand | Total Chemical Oxygen Demand | mg/L | 935 | 14 | 0 | 2580 | 856 | 0 | Yes |
| Oxygen Demand | Dissolved Chemical Oxygen Demand | mg/L | 20 | 1 | 1 | 220 | 1 | 0 | Yes |
| Petroleum Hydrocarbons | >C10-C16 Hydrocarbons | mg/L | 0.05 | 14 | 14 | 0.13 | 2 | 0 | Yes |
| Petroleum Hydrocarbons | >C16-C21 Hydrocarbons | mg/L | 0.05 | 14 | 14 | 0.13 | 2 | 0 | Yes |
| Petroleum Hydrocarbons | >C21-<C32 Hydrocarbons | mg/L | 0.1 | 14 | 13 | 0.26 | 2 | 0 | Yes |
| Petroleum Hydrocarbons | Modified TPH (Tier1) | mg/L | 0.1 | 14 | 13 | 0.53 | 2 | 0 | Yes |
| Phenols | Total of Reg.P&P phenols | µg/L | 1.5 | 14 | 12 | 9.6 | 2 | 1 | Yes |
| Phenols | Catechol | µg/L | 1 | 4 | 4 | 3.7 | 1 | 0 | Yes |
| Phenols | 2-Chlrophenol | µg/L | 1 | 5 | 5 | 1.2 | 2 | 1 | Yes |
| Phenols | o-Cresol | µg/L | 0.5 | 5 | 5 | 3 | 2 | 1 | Yes |
| Phenols | 4,6 Dichloroguaiacol | µg/L | 1 | 4 | 4 | 5.6 | 1 | 1 | Yes |
| Phenols | 2,3 Dichlorophenol | µg/L | 1 | 5 | 5 | 2 | 2 | 2 | Yes |

**Appendix E-1 : Step 1 in Screening Process: Comparison of Concentrations in Treated Effluent (represented by current treated effluent concentrations) to Background Concentations (represented by concentrations at the location of the proposed diffuser).**

| Group | Parameter | Unit | Median Background Concentrations (Proposed Diffuser Location) | Total Count | Count (<RDL) | Max Treated Effluent Concentrations (Point C) | Total Count | Count (<RDL) | Are Concentrations in Treated Effluent (Point C) > Background Concentrations (Proposed Diffuser Location)? |
|---|---|---|---|---|---|---|---|---|---|
| Phenols | 2,6 Dichlorophenol | µg/L | 1 | 5 | 5 | 2 | 2 | 2 | Yes |
| Phenols | 3,4 Dichlorophenol | µg/L | 1 | 5 | 5 | 2 | 2 | 2 | Yes |
| Phenols | 3,5 Dichlorophenol | µg/L | 1 | 5 | 5 | 2 | 2 | 2 | Yes |
| Phenols | 2,4 Dimethylphenol | µg/L | 1 | 5 | 5 | 2 | 2 | 1 | Yes |
| Phenols | Guaiacol | µg/L | 1 | 4 | 4 | 1.2 | 1 | 0 | Yes |
| Phenols | Pentachlorophenol | µg/L | 1 | 5 | 5 | 4 | 2 | 2 | Yes |
| Phenols | Tetrachloroguaiacol | µg/L | 1 | 5 | 5 | 2 | 2 | 2 | Yes |
| Phenols | 2,3,4,5 Tetrachlorophenol | µg/L | 1 | 5 | 5 | 1.6 | 2 | 2 | Yes |
| Phenols | 2,3,4,6 Tetrachlorophenol | µg/L | 1 | 5 | 5 | 2 | 2 | 2 | Yes |
| Phenols | 2,3,5,6 Tetrachlorophenol | µg/L | 1 | 5 | 5 | 2 | 2 | 2 | Yes |
| Phenols | 2,3,4 Trichlorophenol | µg/L | 1 | 5 | 5 | 2 | 2 | 2 | Yes |
| Phenols | 2,3,5 Trichlorophenol | µg/L | 1 | 5 | 5 | 2 | 2 | 2 | Yes |
| Phenols | 2,3,6 Trichlorophenol | µg/L | 1 | 5 | 5 | 2 | 2 | 2 | Yes |
| Phenols | 2,4,5 Trichlorophenol | µg/L | 1 | 5 | 5 | 2 | 2 | 2 | Yes |
| Phenols | 2,4,6-Trichlorophenol | µg/L | 1 | 5 | 5 | 2 | 2 | 2 | Yes |
| Phenols | 3,4,5 Trichlorophenol | µg/L | 1 | 5 | 5 | 2 | 2 | 2 | Yes |
| Polycyclic Aromatic Hydrocarbons | Acenaphthylene | µg/L | 0.01 | 14 | 14 | 0.03 | 2 | 2 | Yes |
| Polycyclic Aromatic Hydrocarbons | Anthracene | µg/L | 0.01 | 14 | 14 | 0.02 | 2 | 2 | Yes |
| Polycyclic Aromatic Hydrocarbons | Fluoranthene | µg/L | 0.01 | 14 | 14 | 0.037 | 2 | 0 | Yes |
| Polycyclic Aromatic Hydrocarbons | Fluorene | µg/L | 0.01 | 14 | 14 | 0.1 | 2 | 2 | Yes |
| Polycyclic Aromatic Hydrocarbons | Phenanthrene | µg/L | 0.01 | 14 | 14 | 0.049 | 2 | 0 | Yes |
| Polycyclic Aromatic Hydrocarbons | Pyrene | µg/L | 0.01 | 14 | 14 | 0.02 | 2 | 1 | Yes |
| Resin Acids | Total Resin Acids | mg/L | 0.06 | 13 | 13 | 1 | 1 | 0 | Yes |
| Resin Acids | Abietic acid | mg/L | 0.006 | 13 | 13 | 0.25 | 1 | 0 | Yes |
| Resin Acids | Dehydroabietic acid | mg/L | 0.006 | 13 | 13 | 0.2 | 1 | 0 | Yes |
| Resin Acids | Isopimaric acid | mg/L | 0.006 | 13 | 13 | 0.34 | 1 | 0 | Yes |
| Resin Acids | Neoabietic acid | mg/L | 0.006 | 13 | 13 | 0.022 | 1 | 0 | Yes |
| Resin Acids | Pimaric acid | mg/L | 0.006 | 13 | 13 | 0.14 | 1 | 0 | Yes |
| Resin Acids | Sandaracopimaric acid | mg/L | 0.006 | 13 | 13 | 0.061 | 1 | 0 | Yes |
| Volatile Organic Compounds | 1,1-Dichloroethylene | µg/L | 0.5 | 14 | 14 | 71 | 2 | 2 | Yes |
| Volatile Organic Compounds | Ethylene Dibromide | µg/L | 0.2 | 14 | 14 | 1 | 2 | 2 | Yes |
| Volatile Organic Compounds | Toluene | mg/L | 0.0002 | 1 | 1 | 0.00024 | 1 | 0 | Yes |

## Appendix E-2: Point C Effluent Water Quality - Exceedance of Benchmarks

| Site Name | Media Name | Benchmark | Parameter | Location | Units | Sample Time | Sample Value | Benchmark Value |
|---|---|---|---|---|---|---|---|---|
| NPNS | Surface Water | CCME Long Term | Total Cadmium (Cd) | Point C | µg/L | 17-Jul-2019 | 0.73 | 0.12 |
| NPNS | Surface Water | CCME Long Term | Total Cadmium (Cd) | Point C | µg/L | 14-May-2019 | 1.4 | 0.12 |
| NPNS | Surface Water | CCME Long Term | Total Cadmium (Cd) | Point C | µg/L | 29-May-2018 | 0.66 | 0.12 |
| NPNS | Surface Water | CCME Long Term | Total Cadmium (Cd) | Point C | µg/L | 23-Feb-2017 | 1.4 | 0.12 |
| NPNS | Surface Water | CCME Long Term | Total Cadmium (Cd) | Point C | µg/L | 02-Oct-2016 | 0.898 | 0.12 |
| NPNS | Surface Water | CCME Long Term | Total Cadmium (Cd) | Point C | µg/L | 25-Feb-2015 | 1.11 | 0.12 |
| NPNS | Surface Water | CCME Long Term | Total Mercury (Hg) | Point C | µg/L | 17-Jul-2019 | 0.027 | 0.016 |
| NPNS | Surface Water | CCME Long Term | Total Mercury (Hg) | Point C | µg/L | 29-May-2018 | 0.028 | 0.016 |
| NPNS | Surface Water | CCME Long Term | Total Mercury (Hg) | Point C | µg/L | 23-Feb-2017 | 0.028 | 0.016 |
| NPNS | Surface Water | CCME Clear Flow* | Turbidity | Point C | NTU | 17-Jul-2019 | 27 | 2 |
| NPNS | Surface Water | CCME Clear Flow* | Turbidity | Point C | NTU | 14-May-2019 | 45 | 2 |
| NPNS | Surface Water | CCME Clear Flow* | Turbidity | Point C | NTU | 29-May-2018 | 12 | 2 |
| NPNS | Surface Water | CCME High Flow or Turbid Waters** | Turbidity | Point C | NTU | 17-Jul-2019 | 27 | 8 |
| NPNS | Surface Water | CCME High Flow or Turbid Waters** | Turbidity | Point C | NTU | 14-May-2019 | 45 | 8 |
| NPNS | Surface Water | CCME High Flow or Turbid Waters** | Turbidity | Point C | NTU | 29-May-2018 | 12 | 8 |

Notes:

1. The summary time is between 01-Jan-1900 and 10-Sep-2019.
2. The comparison historical time is between 01-Jan-1900 and 31-Dec-1899.
3. The reporting locations are: "Point C".

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*clear flow - Maximum increase of 8 NTUs from background levels for a short-term exposure (e.g., 24-h period). Maximum average increase of 2 NTUs from background

**high flow or turbid waters - Maximum increase 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.