ENVIRONMENTAL ASSESSMENT
REALIGNMENT OF MARINE DRIVE
HIGHWAY 316
ENVIRONMENTAL ASSESSMENT REGISTRATION

Goldboro LNG Project

Pieridae Energy (Canada) Limited

MARCH 2021

GOLDBORO LNG

ENVIRONMENTAL ASSESSMENT
REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

Environmental Assessment Registration

Submitted to:
Nova Scotia Environment
1894 Barrington Street, Suite 1800
Halifax, Nova Scotia, B3J 2P8

Submitted by:
Pieridae Energy (Canada) Limited
1718 Argyle Street
Halifax, Nova Scotia, B3J 3N6

Prepared by:
Wood Environment & Infrastructure Solutions
a Division of Wood Canada Limited
50 Troop Avenue, Suite 300
Dartmouth, Nova Scotia, B3B 1Z1

March 2021

TE201007

EXECUTIVE SUMMARY

GOLDBORO LNG

Executive Summary

Background

Pieridae Energy (Canada) Limited (Pieridae) is the Proponent of the realignment of approximately 3.5 km of the existing Marine Drive (Highway 316) in Goldboro, Nova Scotia (the Realignment; the Project). The Realignment will convey traffic along an approximately 5.6 km new road segment around the site for the planned Goldboro LNG facility.

Initially, the Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR) had proposed the Realignment. However, for schedule and practical reasons, Pieridae has agreed to design and construct the Realignment to NSTIR standards. It was further agreed that NSTIR will review and approve the design and, once completed, will take ownership of the Realignment and its operation and maintenance.

Pieridae is also the proponent of the Goldboro LNG facility and requires the Realignment for the implementation of its proposed Goldboro LNG facility. That proposal underwent a Class II Environmental Assessment (EA) process and received approval from Nova Scotia Environment (NSE) on the 21st of March, 2014.

While the EA for the Goldboro LNG Project did mention a realignment of Marine Drive (Highway 316), it did not assess a specific route. The Realignment has now been delineated and NSE has determined that the proposed road work requires a separate Class I EA under the *Nova Scotia Environment Act* and the Environmental Assessment Regulations (NSE, 18 January 2021; and 27 January 2021).

Realignment Proposal

The proposed Realignment of Marine Drive will redirect traffic around the north side of the Goldboro LNG Facility and temporary laydown areas. The new route will be approximately 5.6 km long, connecting the local communities of Goldboro and Drum Head, along Marine Drive. The Realignment includes the construction of three intersections including one to Sable Road (access road to the former ExxonMobil Gas Plant) and one at each end of the Realignment, connecting to the abandoned sections of the existing Marine Drive, which will be maintained up to boundaries of the LNG Facility. The Realignment will be 2-lanes with posted speed limit and signage in accordance with NSTIR requirements. In some segments a third lane (climbing lane) may be added.

Existing Environment

Pieridae conducted extensive environmental studies to supplement the Goldboro LNG environmental base with up-to-date information on baseline conditions within and adjacent to the Realignment right-of-way (ROW). The information gathered established and addresses the following Valued Environmental Components (VECs)

- Groundwater Resources
- Surface Water Resources
- Atmospheric Environment
- Acoustic Environment
- Avifauna
- Terrestrial Wildlife
- Terrestrial Habitat and Flora
- Wetlands
- Aquatic Environment
- Species at Risk (SAR)
- Land Use
- Traditional Use of Land and Resources
- Cultural and Archaeological Resources

The proposed ROW is routed primarily through a mosaic of wetlands and wooded habitat ranging from shrubby pioneer stages to mid-age mixed forests patches. A total of 32 wetlands (WLs) were identified within or adjacent to the ROW - most of them representing swamps. One Wetland of Special Significance (WSS) was identified based upon the presence of Blue Felt Lichen within the wetland habitat.

The Realignment crosses eight (8) small watercourses (Crusher Brook, Betty's Cove Brook and 6 unnamed tributaries). The width of the watercourses measured from approximately 0.2 m to 1.4 m (Unnamed Watercourse #3 and Betty's Cove, respectively); water depths ranged between 0.04 m and 0.6 m (Betty's Cove Brook and Unnamed Watercourse #4). All watercourses showed low pH levels. Electrofishing documented presence of Brook Trout and American Eel in Betty's Cove Brook and Unnamed Watercourse #5.

Several Species and Risk (SAR) and Species of Conservation Interest (SOCI) from several taxonomic groups were found in the study area including lichens, vascular plants, molluscs, odonates, butterflies, fish, amphibians, reptiles, mammals, and birds. The only plant SAR identified was the Blue Felt Lichen; listed as "Special Concern" by the *Canadian Species at Risk Act* (SARA) and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as well as "Vulnerable" by the NS *Endangered Species Act* (NSESA).

Contamination in surface soils and sediments was investigated and identified in some sample exceedances of NSE Tier 1 Environmental Quality Standards (EQS) for arsenic. Tier 1 EQS criteria were also exceeded by some of the surface water samples that were collected from the watercourses that will be crossed by the Realignment. These exceedances related to aluminum, arsenic, and iron concentrations.

There are very few residences near the Realignment, all of which are located near the start and end points of the proposed Realignment. Upon completion of the Project, five residences along Marine Drive segments will be situated along cul-de-sacs (i.e., segments of "old" Marine Drive). The western segment of the Realignment together with the lands for the Goldboro LNG facility are located within the Municipality's designated Goldboro Industrial Park. Currently, the only existing industrial land is the recently decommissioned Exxon Mobil gas plant site north of the Realignment.

Based on a desktop review no registered heritage / archaeological resources were identified within the Realignment ROW. Eight (8) areas with moderate potential for undiscovered archaeological resources are within the proposed ROW, being associated with the mapped watercourses. The remainder of the ROW exhibits low archaeological potential for Indigenous and historic archaeological resources.

Environmental Effects

The effects assessment considered all works and activities associated with construction, operation and maintenance of the Project. The assessment also included Project-environment interactions from planned activities and infrastructure as well as potential effects of unplanned events and accidents. Further, the assessment considered potential effects that environmental conditions (severe weather, climate change) could have on the Project as well as potential effects that may arise from the realization of other projects. Subsequently, mitigation and environmental management measures were developed to avoid and/or minimize adverse effects.

Mitigation, Environmental Management, Monitoring

Careful planning and design measures along with accepted construction techniques will minimize adverse environmental effects from activities such as road construction near residents, watercourses and wetlands and disruption of highly erodible materials. This includes clearing of the ROW outside of the breeding bird season, and the appropriate design of all watercourse crossings for fish passage.

Pieridae will require its contractor to construct the new road under the guidance of NSTIR's Standard Specification Highway Construction and Maintenance (NSTIR, 1997; revised annually) and in compliance with NSTIR's Environmental Protection Plan (EPP) for the Construction of 100 Series Highways (NSTIR, 2007). The EPP was developed to convey NSTIR's commitment to construction and maintenance of highways in a manner that minimizes adverse effects to the environment, including preservation of water quality through erosion and sediment control as well as minimizing disturbance to land use, wildlife, habitat, and biodiversity in general. The EPP measures have been successfully applied and proven to be effective in numerous road development projects in NS.

Conclusion

Unavoidable impacts on wetlands and watercourses will be minimized based on best management practices as well as compensation and offset measures, where required. With the successful implementation of environmental management and mitigation measures, no significant adverse environmental effects are likely to occur. Comprehensive environmental monitoring and environmental site inspections will be conducted to evaluate the effectiveness of the mitigation measures, verify the effects predictions of the EA, and ensure compliance with regulatory requirements. Positive effects are expected from the Realignment in that it will facilitate the implementation of the Goldboro LNG development proposal, providing significant short- and long-term economic stimulus and job opportunities to Guysborough County. In addition, the Goldboro LNG development will manage the onsite contaminants from legacy mining activities in full compliance with the NS Contaminated Sites Regulations to reduce current contaminant levels in site surfaces and eliminate onsite exposure risks.

Consultation and Engagement

Since the inception of the Goldboro LNG Project, the Realignment of Marine Drive (Hwy 316) around the LNG Project site has been included in Pieridae's consultation and engagement activities. To facilitate discussion and solicit public input specifically on the Realignment, Pieridae held two community engagement sessions: one in 2019 and another in 2020. Both sessions were very well attended. Based on feedback received during the first session, Pieridae made several adjustments to the Realignment. The preferred and final route is presented in this EA Report and was discussed in the second information session. It was widely accepted by the participants. Issues and concerns raised did not question the alignment and focussed on the road design, property access, schedule, and temporary traffic disruptions.

As part of its ongoing communication with the Mi'kmaq community, Pieridae made direct contact with KMKNO to solicit feedback on the Realignment planning. Pieridae remains committed to engage with the Mi'kmaq of Nova Scotia, including the Assembly of Nova Scotia Mi'kmaq Chiefs, which includes Sipekne'katik and Millbrook, throughout the Project implementation and is determined to provide economic and educational benefits to the Mi'kmaq community through the signed Collaborative Benefits Agreement (CBA).

Pieridae will continue with the consultation and engagement process through a variety of communication methods and meeting formats. This includes continued communication with the Community Liaison Committee (CLC) and Fisheries Advisory Committee (FAC) as well as direct dialogue with representatives of the Mi'kmaq community. These Committees were established to assist Pieridae in the implementation of the Goldboro LNG facility and will also serve as forum for discussions of Pieridae's Realignment activities.

Table of Contents

List of Figures

List of Tables

List of Appendices

List of Acronyms

AADT	Annual Average Daily Traffic
AASHTO	American Association of State and Transportation Officials
ACCDC	Atlantic Canada Conservation Data Centre
AMO	Abandoned mine openings
AO	Aesthetic Objective
AQMS	Air Quality Management System
ARD	acid rock drainage
ARIA	Archaeological Resources Impact Assessment
AZMF	Air Zone Management Framework
BMP	Best Management Practices
BTEX/TPH	Benzene, Toluene, Ethylbenzene and Xylene / Total Petroleum Hydrocarbons
°C	degrees Celsius
CAAQO	Canada Ambient Air Quality Objectives
CALA	Canadian Association for Laboratory Accreditation
CAO	Chief Administrative Officer
CBA	Collaborative Benefits Agreement
CCME	Canadian Council of Ministers of the Environment
CEPA	Canadian Environmental Protection Act
CLC	Community Liaison Committee
cm	centimetre
CMM	Confederation of Mainland Mi'kmaq
CO	Carbon monoxide
CoA	Conditions of Approval
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
dBA	A-weighted decibels
DFO	Fisheries and Oceans Canada
DHV	Design Hourly Volume
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
ECM	Environmental Compliance Monitoring
EEM	Environmental Effects Monitoring
EGSPA	Environmental Goals and Sustainable Prosperity Act
ELC	Ecological Land Classification
EPA	Elevated Potential Areas
EPP	Environmental Protection Plan
EQS	Environmental Quality Standards
ESC	Erosion and Sedimentation Control
FAC	Fisheries Advisory Committee
FAL	Freshwater Aquatic Life
GCDWQ	Guidelines for Canadian Drinking Water Quality
GHG	Greenhouse Gas

GLO	Ground-level ozone
GSC	Geological Survey of Canada
ha	hectare
HADD	Harmful Alteration, Disruption or Destruction
hr	hour
Hwy	highway
IBA	Important Bird Area
IMHO	Imperfectly drained, medium textured and hummocky
IRVM	Integrated Roadside Vegetation Maintenance
ISO	International Standards Organization
km	kilometre
KMKNO	Kwilmu'kw Maw-klusuaqn Negotiation Office
Leq	equivalent continuous sound levels
LNG	Liquid Natural Gas
LSA	Local Study Area
m	metre
m^3	cubic metre
MAC	Maximum Acceptable Concentration
MBBA	Maritime Breeding Bird Atlas
MBCA	Migratory Birds Convention Act
MDGC	Municipality of the District of Guysborough County
MEKS	Mi'kmaq Ecological Knowledge Study
mg	milligram
mL	millilitres
mm	millimetres
NAAQO	United States National Ambient Air Quality Objectives
NAPS	National Air Pollution Surveillance
NO	nitrogen oxides
NO_2	Nitrogen dioxide
NRCan	Natural Resources Canada
NS	Nova Scotia
NSCCH	NS Communities, Culture & Heritage
NSDLF	Nova Scotia Department of Lands and Forestry
NSDNR	Nova Scotia Department of Natural Resources *(partial transitioning to Energy and Mines)*
NSDTPW	Nova Scotia Department of Transportation and Public Works (now NSTIR)
NSE	Nova Scotia Department of Environment (*transitioning to Environment and Climate Change)*
NSESA	Nova Scotia Endangered Species Act
NSMNH	Nova Scotia Museum of Natural History
NSTIR	Nova Scotia Department of Transportation and Infrastructure Renewal (*transitioning to Transportation and Active Transit*)
OG	Operational Guideline
PAH	Polycyclic aromatic hydrocarbons

PC	Point Count Survey Location
PDA	Project Development Area
PM	Particulate Matter
PM_{10}	PM with aerodynamic diameter less than a nominal 10 micrometres
$PM_{2.5}$	PM with aerodynamic diameter less than a nominal 2.5 micrometres
PoE	Pathways of Effects
POL	petroleum-oil-lubricant
ppb	parts per billion
ppm	parts per million
ROW	right-of-way
RSA	Regional Study Area
SAR	Species at Risk
SARA	Species at Risk Act
SARPR	Species at Risk Public Registry
SO_2	Sulphur dioxide
SOCI	Species of Conservation Interest
SOEI	Sable Offshore Energy Inc.
TAC	Transportation Association of Canada
TDG	Transportation of Dangerous Goods
TDS	Total dissolved solids
TSP	Total suspended particulates
TSS	Total suspended solids
µg	micrograms
µm	micrometres
µS	microSiemens
US	United States
VEC	Valued Environmental Component
VOC	Volatile Organic Compound
WC	Watercourse Field Identifier
WCHO	Well drained, coarse textured and hummocky
WESP-AC	Wetland Ecosystem Services Protocol – Atlantic Canada
WL	Wetland Field Identifier
WMRD	Well drained, medium textured with ridges
WSS	Wetland of Special Significance

SECTION 1.0
INTRODUCTION

GOLDBORO LNG

1.0 Introduction

1.1 Background, Project History

Pieridae Energy (Canada) Limited (Pieridae), as general partner of Goldboro LNG Limited Partnership, is the Proponent of the Goldboro LNG Project, which entails the development and operation of a natural gas liquefaction plant, Liquefied Natural Gas (LNG) tanker terminal, marine facilities and a power plant in Goldboro, Guysborough County, Nova Scotia (NS).

On the 21st of March, 2014, Nova Scotia Environment (NSE) approved the Class II Environmental Assessment (EA) for the proposed Goldboro LNG facility (NSE, 2014). While the EA for the Goldboro LNG Project did mention a realignment of Marine Drive (Highway 316), the EA did not define the alignment and the road engineering and design.

Initially, the Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR) had proposed the road realignment. However, for schedule and practical reasons, Pieridae has agreed to design and construct the realignment to NSTIR standards. No commitments for public funding of the Project have been made. It has been further agreed that NSTIR will review and approve the design and, once completed, will take ownership of the realigned highway and be responsible for its operation and maintenance.

Since the realignment of Marine Drive was not part of the approved EA for the Goldboro LNG Project, NSE determined that the proposed undertaking is subject to a Class I EA based on the requirements under the *Nova Scotia Environment Act* and the Environmental Assessment Regulations (NSE, 18 January 2021; and 27 January 2021).

1.2 Project Name, Proponent, Contact Information

The proposed undertaking is referred to as the "Realignment of Marine Drive (Hwy 316)" (the Project, the Realignment). Proponent and Environmental Assessment contacts are provided in Table 1.2-1 below.

Table 1.2-1 Proponent and EA Contacts

Party	Contact	Telephone, Email
Proponent	Pieridae Energy (Canada) Ltd. 1718 Argyle Street Suite 730 Halifax Nova Scotia B3J 3N6	902-492-4044
Pieridae Environmental Assessment Contact	Barb Bryden Environmental Manager Pieridae Energy (Canada) Ltd. (address same as above)	902-492-4044 barb.bryden@pieridaeenergy.com
Consultant	Uwe Wittkugel, Project Manager Wood Environment and Infrastructure Solutions Dartmouth, Nova Scotia B3B 1Z1	902-480-5445 uwe.wittkugel@woodplc.com

Pieridae Executive

Name: Bart Bryden

Official Title: Environmental Manager

Signature: [signature] **Date:** 1 March 2021

1.3 Purpose and Need of the Undertaking

The proposed Realignment of Marine Drive is shown in Figure 1.3-1. The realigned highway will convey traffic around the Goldboro LNG site both during construction and operation. Upon completion, the Realignment will provide the Goldboro LNG site with uninterrupted access to the waterfront, the planned marginal wharf and LNG Jetty. This will promote public safety during the LNG Facility construction and operation.

1.4 Project Components

The Project will consist of the following components:

- a 5.6 kilometre (km) road with two travel lanes; and
- three (3) intersections to provide access to the existing Marine Drive west and east of the LNG Project Site, the Goldboro LNG site, temporary work camp, and laydown areas.

1.5 Alternatives

The selected proposed route minimizes interaction with environmentally sensitive features and community concerns, adhering to NSTIR road design and operational standards. The selected route also ensures minimal effects on residents along Marine Drive. The Realignment alternatives are shown in Figure 1.5-1. A brief tabulated review and rationale for the overall preferred alignment is presented in Appendix A and Realignment Detailed Design Drawings are shown in Appendix B.

LEGEND:

- Highway 316 Realignment ROW
- Highway 316 Realignment
- Roads
- Watercourse
- LNG Wharf and Jetty
- LNG Facility Footprint
- Proposed Temporary Work Camp/Laydown

0 125 250 500 750 1,000

Metres

The map shown here has been created with all due and reasonable care and is strictly for use with Wood. Project Number: TE201007. This map has not been certified by a licensed land surveyor, and any third party use of this map comes without warranties of any kind. Wood. assumes no liability, direct or indirect, whatsoever for any such third party or unintended use.

CLIENT:

PIERIDAE ENERGY (CANADA) LIMITED

wood.

PROJECT:

ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

GOLDBORO LNG

TITLE:

PROPOSED REALIGNMENT

DATUM:	DWN BY:	DATE:
NAD 83	CM	FEB 2021
PROJECTION:	CHK'D BY:	SCALE:
UTM Zone 20 North	BM	1:15,000
PROJECT NO:	REV NO:	FIGURE NO:
TE201007	1	FIGURE 1.3-1

Path: G:\5290 PROJECTS\2020\TE201007_Pieridae_Energy_Goldboro_LNG\GIS\MXD\500_100 EA REPORT\TE201007_FIGURE_1_3-1_ProposedRoadRealignment.mxd User: candace.macdonald Date: 2/25/2021

LEGEND:

- Alternative Alignment 1
- Alternative Alignment 2
- Alternative Alignment 3 (Preferred Alignment)
- Roads
- Watercourse
- LNG Wharf and Jetty
- LNG Facility Footprint
- Proposed Temporary Work Camp/Laydown

0 125 250 500 750 1,000

Metres

CLIENT:

PIERIDAE ENERGY (CANADA) LIMITED

wood.

PROJECT:

ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

GOLDBORO LNG

TITLE:

ALTERNATIVE ROUTES CONSIDERED

DATUM:	DWN BY:	DATE:
NAD 83	CM	FEB 2021
PROJECTION:	CHK'D BY:	SCALE:
UTM Zone 20 North	BM	1:20,000
PROJECT NO:	REV NO:	FIGURE NO:
TE201007	1	FIGURE 1.5-1

Path: G:\5290 PROJECTS\2020\TE201007_Pieridae_Energy_Goldboro_LNG\GIS\MXD\500_100 EA REPORT\TE201007_FIGURE_1_5-1_AlternativeRoutesConsidered.mxd User: candace.macdonald Date: 2/25/2021

1.6 Schedule

Provided all necessary permits and approvals can be obtained and applicable EA Conditions of Approval (CoA) are met, the implementation of the Realignment is expected to continue following these tentative timelines:

- Environmental investigations Q2 to Q4 2020
- Engineering and Design Q2 2020 to Q2 2021
- Permitting and Approvals Q1 to Q2 2021
- Clearing of Right of Way (ROW) Q3 2021
- Start of Construction Q3 2021
- Operation Q4 2022

1.7 Concordance – Environmental Assessment Regulations

Minimum requirements for the Registration of the Project under the NS EA Regulations are listed in Table 1.7-1, together with a reference where the information is provided in the Registration document.

Table 1.7-1 Concordance – Environmental Assessment Regulations

Requirement (as per NS EA Regulations)		Section in Registration Report
i.	the name of the proposed undertaking,	Section 1.2 Project Name, Proponent, and Contact Information
ii.	the location of the proposed undertaking,	Section 1.3 Purpose and Need of the Undertaking
iii.	the name, address and identification of the proponent,	Section 1.2 Project Name, Proponent, and Contact Information
iv.	a list of contact persons for the proposed undertaking and their contact information,	Section 1.2 Project Name, Proponent, and Contact Information
v.	the name and signature of the Chief Executive Officer or a person with signing authority, if the proponent is a corporation;	Section 1.2 Project Name, Proponent, and Contact Information
vi.	details of the nature and sensitivity of the area surrounding the proposed undertaking,	Section 5.0 Description of the Existing Environment (and Appendices with Project specific study reports)
vii.	the purpose and need for the proposed undertaking,	Section 1.3 Purpose and Need of the Undertaking
viii.	the proposed construction and operation schedules for the undertaking,	Section 1.6 Schedule
ix.	a description of the proposed undertaking,	Section 2.0 Description of the Realignment
x.	environmental baseline information,	Section 5.0 Environmental Conditions
xi.	a list of licences, certificates, permits, approvals and other forms of authorization that will be required for the proposed undertaking,	Section 4.0 Regulatory Requirements
xii.	all sources of any public funding for the proposed undertaking,	Section 1.1 Background, Project History
xiii.	all steps taken by the proponent to identify the concerns of the public and aboriginal people about the adverse effects or the environmental effects of the proposed undertaking,	Section 7.0 Consultation and Engagement
xiv.	a list of all concerns expressed by the public and aboriginal people about the adverse effects or the environmental effects of the proposed undertaking,	Section 7.0 Consultation and Engagement
xv.	all steps taken or proposed to be taken by the proponent to address concerns of the public and aboriginal people identified under subclause (xiv).	Section 7.0 Consultation and Engagement Programs

SECTION 2.0
DESCRIPTION OF THE REALIGNMENT

GOLDBORO LNG

2.0 Description of the Realignment

2.1 Location

The Project is situated in Municipality of the District of Guysborough County (MDGC), along Marine Drive (Hwy 316) between the communities of Goldboro and Drum Head. The proposed Realignment of Marine Drive begins immediately west of the proposed Goldboro LNG facility and ends just east of the Site, where it converges with the existing Marine Drive.

2.2 The Roadway, Intersections

The proposed Realignment of Marine Drive will redirect traffic around the north side of the Goldboro LNG Facility and temporary laydown areas (Figure 1.3-1). The new route will be approximately 5.6 km long, connecting the local communities of Goldboro and Drum Head along Marine Drive. The Realignment includes construction of three intersections; comprised of:

- one (1) to Sable Road (access road to the former ExxonMobil Gas Plant); and
- one (1) at each end of the Realignment, connecting to the abandoned sections of the existing Marine Drive, which will be maintained up to boundaries of the LNG Facility.

The 2-lane roadway will be built to the NSTIR standard Major Collector "E" (Figure 2.2-1) with posted speed limit and signage in accordance with NSTIR requirements. In some segments a third lane (climbing lane) may be added.

The detailed road design (plan and profile) is presented in Appendix B (Figure B-2). The approximate cut and fill areas along the route are presented in Appendix B (Figure B-3).

2.3 Existing Roadway

Within the LNG Facility footprint, the existing roadway will be completely removed to establish the final site contours. The sections of Marine Drive outside the Project footprint and up to the intersections with the proposed Realignment will remain unaltered and accessible as cul-de-sacs.

2.4 Watercourse and Wetland Crossings, Drainage

Eight (8) watercourse crossings (i.e., Crusher Brook, Betty's Cove Brook and 6 unnamed small tributaries) are located along the Realignment. Each of these will be crossed by the ROW with an appropriately sized culvert to maintain fish passage.

Approximately 7.3 hectares (ha) of wetland are located within the area inventoried along the proposed ROW. A portion of these wetlands will be filled in during construction. Drainage between contiguous wetlands separated by the road will be maintained by cross-culverts.

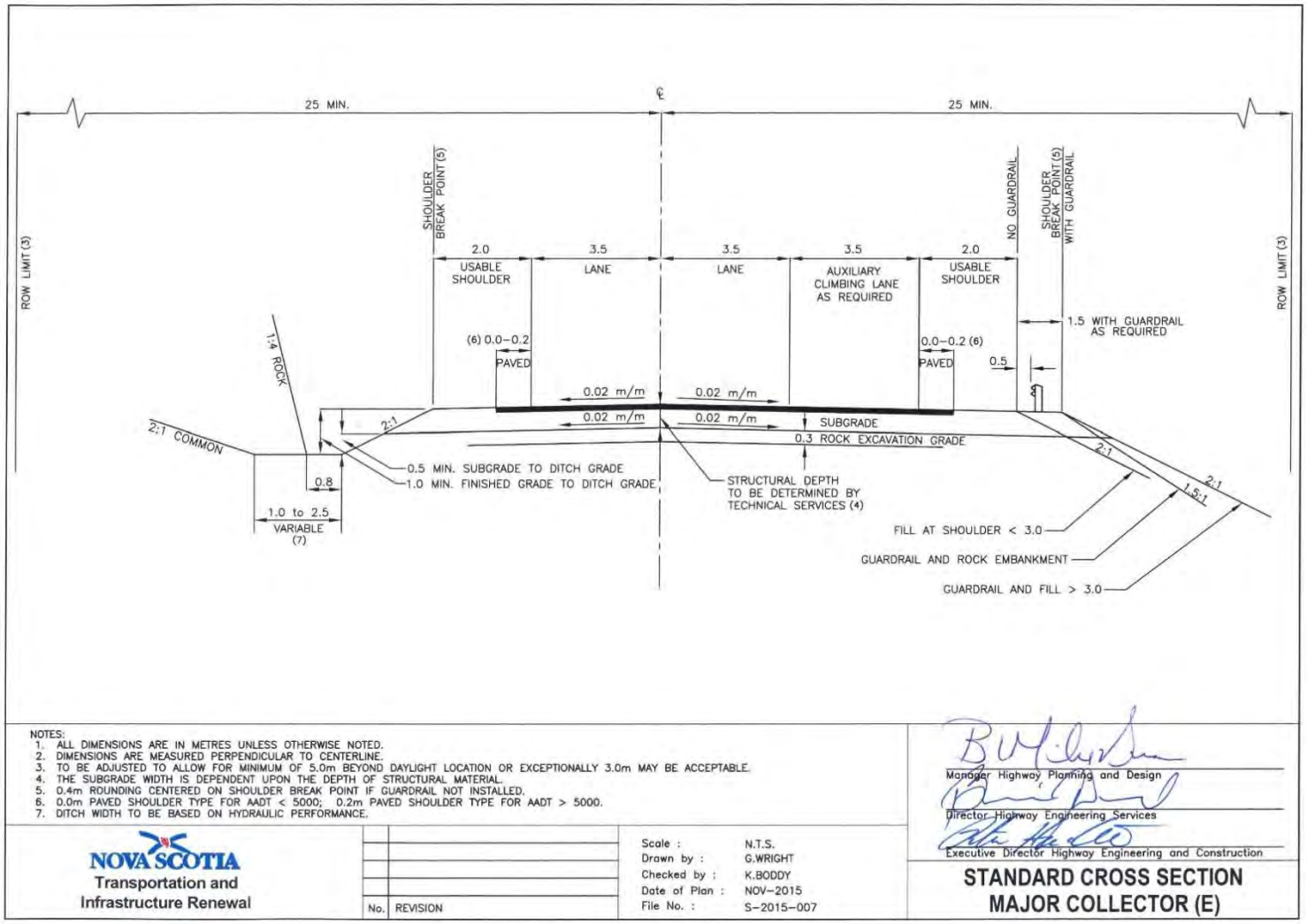
Standard methods for watercourse crossings and work in or near wetlands will be implemented and will follow the NSTIR Generic Environmental Protection Plan (EPP) (NSTIR, 2007) and NSE guidance documents (NSE 2015a, 2015b).

2.5 Temporary Access Roads and Laydown Areas

The development of temporary ancillary features that may be required for the construction of the Project would typically occur within the Project ROW and could potentially include:

- access roads;
- laydown areas for materials and equipment storage;
- mobile offices;
- crushing operations;
- borrow sites; and
- a waste disposal site.

Figure 2.2-1 Proposed Road Realignment – Standard Cross Section



2.6 Emissions and Waste Management

The monitoring of emissions and air quality at the Project site is guided by NSTIR's Generic EPP Section 2.6.2. The contractor is responsible for monitoring the equipment used during construction to maintain good operating condition. The contractor is encouraged to establish vehicle non-idling policies during construction to help minimize adverse effects on local air quality and greenhouse gas (GHG) emissions.

Dust management will be practiced during construction, and monitoring may be conducted in response to dust complaints in accordance with NSE and Environment and Climate Change Canada (ECCC) guidelines. The EPP Section 3.15 also provides guidelines for waste management as well as the handling and storage of petroleum, oils and lubricants (POLs).

2.7 Construction Activities

The Realignment will be constructed to meet NSTIR highway construction standards: "*Standard Specification: Highway Construction and Maintenance*" (NSTIR, 1997). Construction activities associated with roadbed preparation include:

- clearing and grubbing;
- installation of erosion and sedimentation control measures and structures;
- blasting and excavation;
- placement of fill material;
- installation of drainage and watercourse crossing structures; and
- surfacing and finishing.

Pieridae will require its road contractor to implement environmental protection and management measures based on NSTIR's EPP and Best Management Practices (BMP). Principal construction activities and associated environmental measures are detailed in Table 2.7-1.

Table 2.7-1 Construction Activities

Activity	Description	Key features of EPP or BMP
Site Preparation		
Erosion and Sediment Control	Implementation of Erosion and Sedimentation Control (ESC) methods where there is exposed soil and potential for erosion.	Erosion control techniques outlined in NSTIR's Standard Specifications and EPP and carried out according to the "*NS Watercourse Alterations Standard*" (NSE, 2015a). ESC measures will be integrated with the design tendered for construction.
Clearing and Grubbing	Clearing involves the removal of trees and shrubs found within the proposed Realignment Road footprint and ROW to the extent necessary. It will be conducted using conventional harvesting techniques and equipment. Grubbing involves the removal of all organic material and unsuitable soil above the underlying soil.	Activities carried out in accordance with NSTIR's Standard Specifications and EPP (EPP Sections 3.3 & 3.6). • Where possible, conducted during the winter months to limit erosion and sedimentation. • Hand clearing implemented within buffer zones surrounding wetlands and watercourses. • Work outside breeding bird season in compliance with the *Migratory Bird Convention Act* (MBCA).
Roadbed Development		
Excavation	Removal of material (e.g., till, small boulders, topsoil) for the construction of subgrade layer, including excavation methods such as common excavation; rock excavation (by ripper blades on heavy equipment); and swamp excavation, where soil is peat or water saturated, soil is either excavated and replaced with a competent fill or floated over, using geogrids or berm construction.	• Proper ESC methods are to be implemented throughout this process. • Excavated soils that are unsuitable for use as fill or dressing slopes are disposed at a site approved by the Project Engineer (no disposal to wetlands or sensitive areas). • If not disposed, may be salvaged for other projects such as wetland restoration efforts.
Blasting	Blasting is necessary where bedrock cannot be ripped.	Blasting activities will be conducted in accordance with all applicable provincial and federal guidelines and regulations. • Pre-blast surveys are to be completed prior to blasting. • Blasting will be performed by a certified and competent contractor.

Activity	Description	Key features of EPP or BMP
Grading		
Subgrade Construction	Grading of the highway including rock and overburden cut and fills, ditch excavation and sloping and shaping of embankments.	Excavating, transporting, disposing and placement of fill material will be carried out in accordance with NSTIR's Standard Specifications and EPP. • Design based on slope stability, ESC, location, availability, and suitability of fill material/borrow sources and impacts of surface water and groundwater.
Subbase and Base Construction	After completion of the subgrade, coarse granular subbase material consisting of several graded gravel layers to contribute to the structural integrity and drainage beneath the asphalt concrete pavement surfacing.	Grading according to NSTIR's Standard Specifications and EPP.
Watercourse Crossings		
Culverts	The installation of concrete pipe or box culverts and development of a drainage system conducted during the earthworks for the Realignment Road ROW, following NSTIR's Standard Specifications and EPP, and in accordance with all applicable government approvals, permitting and authorizations.	All work conducted in accordance with the "*NS Watercourse Alterations Standard* (NSE, 2015a)" • In-stream work timed between June 1 and September 30, and in isolation from flowing water (plus appropriate ESC). • Culverts designed to address potential climate change impacts on stream flow. • Designed to meet the Fisheries and Oceans Canada (DFO) fish passage requirements and an authorization and fisheries productivity offsetting plan under Section 35 (2) of the *Fisheries Act*, where necessary.
Surfacing and Finishing		
Paving	Paving with black asphalt concrete, using heavy trucks, graders and asphalt concrete pavers. • Mixed at an offsite asphalt plant or onsite in an approved mobile plant. • Hot mix transported, spread and rolled to pave the surface on site.	Paving methods and procedures are detailed in NSTIR's Standard Specifications. Where applicable, mobile asphalt plants are to be in accordance with NSTIR's Standard Specifications and EPP.
Shouldering and Topsoil	Addition of gravels by a shouldering machine to the pavement edge and subsequently compacted to grade. Topsoil, the surface layer of soil that has been processed and potentially applied to cover medians and side slopes.	Shoulders should be constructed as outlined in the NSTIR Standard Specifications. Topsoil may be retained from the clearing and grubbing process and re-used for this purpose. The source and placement of topsoil is guided by NSTIR's Standard Specifications and EPP (EPP Section 2.6.1).

Activity	Description	Key features of EPP or BMP
Hydroseeding	The application of a mixture of seed, fertilizer, mulch, binder and water to re-vegetate and stabilize the Project footprint that has been cleared outside of the surfaced areas.	Conducted in accordance with NSTIR's Standard Specifications as soon as practicable after surfacing preparation activities.
Finishing	Line painting, installation of signage, lighting, guide rails, fencing and barriers requiring a small amount of excavation.	Signage and barrier installation procedures included in NSTIR's Standard Specifications and EPP.

2.8 Operation and Maintenance Activities

Once the Realignment is constructed to NS highway construction standards, NSTIR will obtain ownership and maintain the Realignment as part of Hwy 316 in accordance with the Provincial "*Standard Specification: Highway Construction and Maintenance*" (NSTIR, 1997). The operation phase encompasses operation of the highway, maintenance of the road infrastructure, winter maintenance and vegetation control. It also includes maintenance of portions of Marine Drive that will become cul-de-sacs.

2.8.1 Operational Traffic

Traffic on the completed Road Realignment will experience increased volumes during Goldboro LNG Project construction, then decline to near pre-construction volumes during LNG Facility operation. Pieridae's final traffic impact study (Amec Foster Wheeler, 2018) determined that the road will be able to accommodate peak construction traffic generated by the Goldboro LNG Project.

2.8.2 Maintenance Activities

NSTIR will conduct regularly scheduled maintenance and repairs on an as-needed basis. As a result, disruption to the public would be temporary and infrequent.

Operations and maintenance activities are outlined in the NSTIR Standard Specifications on Highway Construction and Maintenance as well as the Generic EPP. These activities are outlined in Table 2.8-1.

Table 2.8-1 Key Activities During Operations

Activity	Description	Key features of EPP or BMP
Maintenance		
Pavement repair	Maintenance can include minor crack filling and pothole repair, resurfacing every 10-15 years and repaving every 20-25 years.	Paving methods and procedures are detailed in NSTIR's Standard Specifications.
Manual and mechanical vegetation management	Roadside vegetation growth is cut periodically to maintain lines of sight required for highway safety.	Guided by NSTIR's vegetation management techniques.
Shoulder & ditch maintenance	The roadway shoulder is maintained using a grader and ditch shape is maintained by re-ditching.	Maintenance activities in accordance with NSTIR EPP/Standard Specifications and "*NS Watercourse Alterations Standard*".
Culvert maintenance	Removal of debris blockages and small repairs to complete culvert replacements as needed.	All work conducted in accordance with the "*NS Watercourse Alterations Standard*".
Winter Maintenance		
Snow removal	Snow is ploughed using graders, light trucks and four-wheel drive vehicles.	Snow removal is managed by NSTIR.
Ice control	Sanding and salting by snow removal equipment. Rate of application depends on the severity of winter conditions.	The management of ice control methods are described by the Road Salt Management Plan in NSTIR's EPP (sanding conducted in places where salt could adversely affect a nearby surface water body or other sensitive feature).

2.9 Accidents and Unplanned Events

Potential accidents and unplanned events that may arise during construction or operation of the Road Realignment include:

- Spills of chemicals and POLs.
- Failure of ESC measures.
- Fires.
- Vehicular collisions.

Potential adverse effects during construction and specific avoidance and contingency measures are discussed in Section 6. Contingency plans for operational activities are provided in NSTIR's EPP and plans will be tailored by NSTIR to accommodate any sensitive features within the ROW.

2.10 Environmental Management

2.10.1 Environmental Protection Plan

Careful planning and design measures along with accepted construction techniques will minimize adverse environmental effects from activities such as road construction near residents, watercourses and wetlands and disruption of highly erodible materials. Pieridae will require its contractor to construct the new road under the guidance of NSTIR's Standard Specification Highway Construction and Maintenance (NSTIR, 1997; revised annually) and in compliance with NSTIR's EPP for the Construction of 100 Series Highways (NSTIR, 2007). The EPP was developed to convey NSTIR's commitment to construction and maintenance of highways in a manner that minimizes adverse effects to the environment, including preservation of water quality through erosion and sediment control as well as minimizing disturbance to land use, wildlife, habitat and biodiversity in general.

The Generic EPP is continually referred to throughout this document and all parties involved with the construction of this Project are expected to understand and comply with it. On this basis, Pieridae's selected construction contractor will develop a Project EPP and implement BMPs to ensure environmental protection and compliance with provincial and federal regulatory approvals and authorizations.

2.10.2 Standard/Best Management Practices

In addition to the EPP, numerous guidance documents are directly applicable to the various works associated with construction and operation of the Realignment. These documents will be followed where applicable:

- Canadian Council of Ministers of the Environment (CCME) guidance on water quality.
- Environmental Stewardship Practices, Procedures and Policies for Highway Construction and Maintenance (American Association of State and Transportation Officials (AASHTO), 2007).
- Guidelines for the design of fish passage for culverts in NS (DFO, 2015).
- Guidelines for Use of Explosives in or Near Canadian Fisheries Waters (Wright and Hokpy, 1998).
- Highway Drainage Guidelines, Transport Association of Canada (TAC).
- Integrated Roadside Vegetation Management Manual (NSDTPW, undated).
- NS Generic Environmental Protection Plan (EPP) for the Construction of 100 Series Highways.

- NS Watercourse Alterations Standard (NSE, 2015a).
- Guide to Altering Watercourses (NSE, 2015b).
- Beaverdam Removal Code of Practice (NSE and the NS Department of Natural Resources (NSDNR)).
- TAC's National Guide to Erosion and Sediment Control on Roadway Projects.
- TAC's Synthesis of Environmental Management Practices for Road Construction, Operation and Maintenance.

2.10.3 Inspection and Monitoring

Regular inspection and monitoring will be conducted to ensure compliance with environmental standards, regulations and commitments established in this EA Report. Pieridae's construction contractors will be responsible for designing and implementing an environmental compliance monitoring program to meet the regulatory requirements.

Inspection and monitoring will be conducted in accordance with the EPP, the EA, and conditions of regulatory approvals and authorizations. A summary of the Project-specific commitments to mitigation and monitoring are presented in Section 8 of this EA Registration Document.

SECTION 3.0
ASSESSMENT METHODOLOGY

GOLDBORO LNG

3.0 Assessment Methodology

3.1 Scope of the Project

The scope of the Project addressed by the EA includes those components and activities described in Sections 2.7 and 2.8; i.e., the assessment encompasses the construction / operation / maintenance phases of the Project. It does not include an assessment of decommissioning / abandonment, and no plans have yet been developed for that stage of the Project. Specific decommissioning / abandonment plans and related environmental management and mitigation measures will be generated by NSTIR in accordance with all applicable regulatory requirements at the time of decommissioning.

3.2 Valued Environmental Components (VECs), Project Interactions

Potential Project interactions with Valued Environmental Components (VECs) are presented in Table 3.2-1. These VECs were assessed in the EA for the Goldboro LNG Project and have been confirmed to also represent the relevant VECs for the proposed Road Realignment. The interactions were identified based on professional judgment, an understanding of the preliminary road design and the EA Team's familiarity with the environmental setting and other road-related development projects. These VECs also reflect interactions of concern indicated by regulators, the general public, stakeholders and the Mi'kmaq of NS.

Table 3.2-1 Valued Environmental Components (VECs)

Valued Environmental Components (VECs) / Works and Activities	Groundwater Resources	Surface Water Resources	Atmospheric Environment	Acoustic Environment	Avifauna	Terrestrial Wildlife	Terrestrial Habitat and Flora	Wetlands	Aquatic Environment	Species at Risk	Land Use	Traditional Use of Lands and Resources	Cultural and Archaeological Resources
Construction, Operation, Maintenance													
Site Preparation	●	●	●	●	●	●	●	●	●	●	●	●	●
Roadbed Preparation	●	●	●	●	●	●	●	●	●	●	●	●	●
Watercourse Alteration (Crossings)		●	●	●	●	●	●	●	●	●	●	●	●
Highway Operation	●	●			●	●	●			●			
Road and ROW / Infrastructure Maintenance	●	●	●	●	●	●	●	●	●	●	●		
Winter Maintenance	●	●						●					
Vegetation Maintenance					●	●	●			●			
Accidents and Unplanned Events													
Spills	●	●			●	●	●	●	●	●	●	●	
Erosion and Sediment Control Failures		●			●		●	●	●		●		
Fire	●	●	●		●	●	●	●	●	●	●	●	●
Vehicular Collisions		●			●	●	●	●	●	●	●		

The VECs address several diverse environmental factors outlined in Table 3.2-2. The effects assessment focusses on the VECs and associated environmental factors.

Table 3.2-2 Valued Environmental Components (VECs)

VEC	Factors Considered
Physical Environment	
Groundwater Resources	Quantity and Quality
Surface Water	Quantity and Quality
Atmospheric Environment	Air Quality Climate Change and GHG Emissions
Acoustic Environment	Noise
Biological Environment	
Avifauna	Migratory Birds Breeding Birds Raptors
Terrestrial Wildlife	Moose Bats Other
Terrestrial Habitat and Flora	Habitat, Vegetation, Flora
Wetlands	Wetland Functions Wetland Types, Protective Status
Aquatic Environment	Fish Fish Habitat
Species at Risk (SAR)	Bird SAR Plant SAR Wildlife SAR Aquatic SAR
Socio-Economic Environment	
Land Use	Existing Land Use Planned Land Use Traffic
Traditional Use of Land and Resources	Traditional Use of Resources (e.g., Hunting, Country Foods) Traditional Use of Land (e.g., Burial Grounds, Hunting Camps)
Cultural and Archaeological Resources	Features and Artifacts of Scientific, Historical and / or Heritage Significance

3.3 Temporal and Spatial Boundaries

The effects assessment addresses the timeframes associated with the construction and the operation / maintenance phases of the Project. For natural features, the assessment considers the ecological variability, sensitivities, and interactions over the course of a full year (e.g., sensitivities associated with migratory time periods, bird nesting or fish spawning time periods). The following spatial boundaries have been established for the effects assessment:

- Project Development Area (PDA);
- Local Study Area (LSA); and
- Regional Study Area (RSA).

The Project footprint and ROW represent the PDA. The PDA has been delineated to extend 2x50 m from the proposed centreline. The potential for adverse effects on natural environmental components is the highest concern within the PDA; it was, therefore, the focus for field survey work.

The LSA encompasses potential Project-related effects that may be experienced beyond the PDA, such as adverse effects resulting from increased noise levels or changes in drainage patterns. The LSA extends to an area of approximately 1 km from the planned centre line.

Socioeconomic VECs evaluated potential effects at a local and regional level, such as those related to land use and traffic. The RSA encompasses the communities along Highway 102 and Highway 2, extending approximately 3 km northwest and southeast of the respective start- and endpoints of the Realignment.

Table 3.3-1 lists the VECs and the applicable study areas.

Table 3.3-1 VECs and Study Areas

Category	VEC	PDA	LSA	RSA
Biophysical Environment	**Groundwater**	✓	✓	
	Surface Water	✓	✓	
	Atmospheric Environment	✓	✓	✓
	Acoustic Environment	✓	✓	
	Avifauna	✓	✓	
	Terrestrial Wildlife	✓	✓	
	Terrestrial Habitat and Flora	✓	✓	
	Wetlands	✓	✓	
	Aquatic Environment	✓	✓	
	Species at Risk	✓	✓	
Socioeconomic and Cultural	**Land Use**	✓	✓	✓
	Traditional Use of Land and Resources	✓	✓	✓
	Cultural and Archaeological Resources	✓	✓	

3.4 Effects Assessment

The environmental effects assessment was conducted in a stepwise fashion involving:

- prediction and assessment of Project-related environmental effects;
- identification of mitigation measures (avoidance, mitigation, compensation, offsetting; and
- determination of residual effects and their significance.

3.4.1 Potential Project-VEC Interactions and Effects

The potential effects resulting from interactions with the Project, either directly or indirectly, were described for each VEC. This effects assessment involved qualitative and quantitative analyses using existing knowledge, professional judgment, and computer modelling where appropriate and feasible.

3.4.2 Significance Definition

To determine whether an environmental effect is significant, significance thresholds were defined per VEC. These thresholds constitute a measure or standard beyond which residual environmental effects (those remaining after implementation of mitigation and controls) would be significant. Thresholds are quantitative, where possible, and based on applicable regulatory criteria or standards, policies and guidelines, stakeholder input and / or professional judgement.

3.4.3 Mitigation Measures

Where an adverse environmental effect was identified, mitigation was proposed. Where possible, mitigation measures were incorporated into the Project design and implementation to eliminate or reduce potential adverse effects. Where avoidance and mitigation at the source of the effect was deemed not feasible or not sufficiently effective, mitigation at the receptor was considered.

In those instances where an adverse effect is unavoidable and cannot be mitigated to insignificant levels, options for compensation / offsetting were investigated.

For interactions where positive effects are anticipated, opportunities were considered for maximizing those positive effects.

3.4.4 Residual Effects and Determination of Significance

Residual effects refer to those environmental effects predicted to remain after the successful application of all proposed mitigation measures. The predicted residual effects were evaluated for the Project construction and operation phases as well as for potential accidents and unplanned events.

In accordance with the Provincial EA regulations, the significance of the residual effects was evaluated for each VEC. For adverse impacts, significance was determined based upon:

- magnitude;
- geographic extent;
- timing, duration and frequency;
- reversibility; and
- ecological and sociocultural context.

For magnitude, a relative rating was established as defined Table 3.4-1. Absolute values were applied for geographic extent, frequency and duration. Reversibility was considered as the ability of a VEC to return to

an equal or improved condition once the interaction with the Project has ended. Reversibility was assessed as "reversible" or "irreversible," based on previous experience and research.

Upon determination of the significance of the adverse residual effects, the need for monitoring and follow-up programs was established. The purpose of these programs is to monitor the effectiveness of the mitigation measures and to verify the effects predictions.

Table 3.4-1 Definitions for Levels of Magnitude

Rating	Magnitude*
High	Affecting a whole stock, population or definable group of people; or where a specific parameter is outside the range of natural variability based on professional judgement and determined from local knowledge over many seasons.
Medium	Affecting a portion of a population, or one or two generations; or where there are rapid and unpredictable changes in a specific parameter so that it is temporarily outside the range of natural variability based on professional judgement and determined from local knowledge over many seasons.
Low	Affecting a specific group of individuals in a population within a localized area, one generation or less; or where there are distinguishable changes in a specific parameter. The parameter, however, is within the range of natural variability based on professional judgement and determined from local knowledge over many seasons.
Nil	No environmental effect.
Unknown	Affecting an unknown portion of a population or group or where the changes in a specific parameter are unknown.

*Note: Magnitude criteria for noise and water quality are VEC-specific and defined in the respective subsections of the effects assessment.

For adverse residual effects, the evaluation for the individual criteria was combined into an overall effects rating as follows:

- **Major effect:** Potential adverse effect could jeopardize the long-term sustainability of the resource, such that the effect is substantial in magnitude, aerial extent, duration and frequency, and is considered irreversible. Additional research, monitoring, and/or recovery initiatives should be considered.
- **Moderate effect:** Potential adverse effect could result in a decline of a resource in terms of quality / quantity, such that the effect is moderate in its combination of magnitude, aerial extent, duration and frequency, but is considered reversible. Additional research, monitoring, and / or recovery initiatives may be considered.
- **Minor effect:** Potential adverse effect may result in a localized or short-term decline in a resource during the life of the Project. Typically, no additional research, monitoring, and / or recovery initiatives are considered.
- **No effect:** No potential effect, or potential effect results in no measurable change to the overall baseline status of the VEC.

An adverse effect was considered "significant" where its residual effects were classified as major; while they were considered "not significant" where residual effects were classified as moderate, negligible or no effect.

The likelihood of occurrence and level of confidence underlying the effects prediction would be determined for significant (i.e., "major") effects.

3.5 Accidents and Unplanned Events

The effects assessment as described addresses potential effects associated with routine, planned Project activities. The potential for adverse effects on VECs that could be caused by unplanned, accidental events is evaluated separately. Plausible accidental events were formulated as part of the Project Description. The effects assessment of these events involves the same principal components as the assessment of planned Project activities in that it considers standard and site-specific mitigation measures but also considers contingency and emergency response plans and related infrastructure and services. The criteria for evaluating the significance of residual adverse effects are the same as those for planned activities.

3.6 Effects of the Environment on the Project

In accordance with the NS EA Regulations, the effects assessment also considers how the proposed Project could be affected by meteorological factors. This involves a discussion of extreme weather events, the potential consequences for the Project and environmental components, and the identification of mitigation requirements. The determination of significance follows the same general approach as applied in the assessment of effects associated with planned activities.

3.7 Other Undertakings

The effects assessment identifies other planned and reasonably foreseeable activities that could overlap in time and space with the proposed Realignment construction and operation. Where such overlap is recognized, the potential for cumulative effects and requirements for mitigation measures is discussed. The significance levels of the residual adverse effects, if any, is determined applying the criteria presented above.

SECTION 4.0
REGULATORY REQUIREMENTS

GOLDBORO LNG

4.0 Regulatory Requirements

Any required permits, approvals or authorizations will be obtained by Pieridae prior to construction. Relevant policies that frame legislation, such as the NS Wetland Conservation Policy, will also be followed. Pieridae will work with the Municipality of the District of Guysborough to meet any applicable permitting requirements. In addition, Pieridae has, and will continue to, align with the Mi'kmaq-Nova Scotia-Canada Framework Agreement for the Made-in-Nova Scotia Process.

Table 4.1-1 provides a preliminary list of federal and provincial environmental legislation relevant to the Realignment of Hwy 316, as well as anticipated permits, approvals or authorizations. Several acts and regulations have ongoing compliance commitments, but do not have associated authorization processes.

Table 4.1-1 Relevant Environmental Regulatory Requirements

Legislation	Requirement	Permit / Approval / Authorization Required
Federal		
***Species at Risk Act* (SARA)**	Protection of federally-listed species at risk in Canada and their critical habitat.	None expected, as no adverse effects to species at risk or their habitats are anticipated.
***Migratory Birds Convention Act* (MBCA) and Regulations**	Protection of migratory bird species (not listed as game birds), as well as their eggs and young.	Compliance requirements. Clearing planned to occur outside of nesting season.
***Canadian Environmental Protection Act* (CEPA)**	Provision for pollution prevention requirements and list of priority and deleterious substances.	Compliance requirements.
***Transportation of Dangerous Goods Act* and Regulations**	Requirement for documentation and handling procedures for transportation of dangerous goods (TDG).	Compliance requirements.
Provincial and Municipal		
Environmental Assessment Regulations	Goldboro LNG Project required Ministerial Approval.	No. Road Realignment is considered a Project modification subject to the EA Conditions of Approval and all other applicable post-EA regulatory requirements.
Activities Designation Regulations	Culvert and bridge installation, including compliance with Watercourse Alteration Standard. Wetland Alteration, including compliance with the Wetland Conservation Policy.	Yes, culvert installations planned for water crossings. Yes, wetland alteration approvals will be required.
Sulphide Bearing Material Disposal Regulations	Regulation of acid draining rock, including approval for disposal of sulphide bearing material as defined by legislation over 50 m^3 *in situ* or 1300 tonnes.	No. No acid generating rock material is expected within the Road Realignment Corridor (to be confirmed)

Legislation	Requirement	Permit / Approval / Authorization Required
Contaminated Sites Regulations	Specific requirements should contaminated sites be identified / managed as part of Project.	No. No contaminated soils identified (to be confirmed)
Petroleum Management Regulations	Definition of petroleum storage requirements.	Compliance requirements.
Environmental Emergency Regulations	Requirement to be met in an environmental emergency or release of substances into the environment.	Compliance requirements.
Nova Scotia *Endangered Species Act* (NSESA) and Regulations	Protection of NS-listed SAR.	None expected.
Special Places Protection Act	Heritage Research Permit and associated follow up to clear the site of requirement for additional archaeological investigation.	Yes, a program for an archaeological visual inspection and possibly subsurface testing will be conducted before construction.
***Environmental Goals and Sustainable Prosperity Act* (EGSPA)**	Specified goals associated with air quality, water quality, renewable energy, ecosystem protection, contaminated sites, solid waste reduction, sustainable purchasing and energy efficiency building.	Compliance requirements.
***Crown Lands Act* and Regulations**	Crown land construction permit, easements, leases and licences.	Location-specific requirements; to be determined.
***Forests Act* and Regulations**	Requirements for fire suppression equipment for operations in forests.	Compliance requirements.
***Dangerous Goods Transportation Act* and Regulations**	Requirements for safe transport of dangerous goods.	Compliance requirements.
Labour Standards Codes	Labour requirements.	Compliance requirements.
***Occupational Health and Safety Act* and Regulations**	Workplace health and safety requirements to be met including General Blasting Regulations.	Activity-specific compliance requirements to be met.
Municipality of the District of Guysborough Noise Control By-Law	Comply with specified noise levels within timeframes.	Exceptions include construction activities under municipal permit, activities of public agencies including the Province of NS or exemption resulting from application to the Chief Administrative Officer (CAO). Contravention subject to fine.

SECTION 5.0
ENVIRONMENTAL CONDITIONS

GOLDBORO LNG

5.0 Environmental Conditions

The biophysical environment of the Goldboro LNG Facility site area, the Road Realignment ROW in particular, have been studied extensively through numerous field programs for various project proposals such as the Keltic Petrochemical Project, the MapleLNG Project and the Goldboro LNG Project.

Environmental conditions at the Goldboro site and surrounding lands are comprehensively documented in the Goldboro EA Report (AMEC, 2013). Pieridae has updated the information base with a series of ROW-specific field surveys during 2019 and 2020 (Table 5.1-1).

Table 5.1-1 Pieridae Field Studies for Road Realignment ROW

VEC	Field Studies	Date
Groundwater Resources	• Well water survey	2019 / 2020
Surface Water Resources	• Water quality • Sediment quality • Fish habitat • Fish community • Benthic invertebrates	2019/2020
Avifauna	• Spring Survey • Breeding Bird Survey 1 and 2	
Terrestrial Wildlife	• Moose survey • Bat surveys • Wildlife observations in context of other surveys	2020
Terrestrial Habitat and Flora	• Plants / Vegetation	2020
Wetlands	• Wetland delineation and functional assessment	2020
Aquatic Environment	• Habitat characterization • Fish community • Benthic invertebrates	2020
Species at Risk (SAR)	• Avifauna • Wildlife • Plants	2020
Human Health and Safety	• Well water survey	2019 / 2020
Archaeological Resources	• Desktop review	2020

5.1 Physical Environment

The area surrounding the Project has been studied extensively over the past 15 years for previous other projects. These projects have been comprised of the Keltic Petrochemicals project, its partial successor MapleLNG and most recently the Goldboro LNG project. Information related to the physical environment has been obtained from reports generated for these projects. The sources are referenced in the following sections, where applicable. Sampling for soils and sediments have been completed within the PDA and are further described in Section 5.1.3.

5.1.1 Topography and Geomorphology

The Project is located within the Southern Upland physiographic region (Figure 5.1-1). The topography in this region is somewhat varied, with low ridges and intervening hollows that are swampy flats. The soil is generally thin and acidic. Drainage is poor due to deposits of glacial drift. Peat bogs are common, and in

some areas there are wide level expanses of heath and meadow. Chains of lakes, streams, and still-water occur. River channels are shallow. The area is mainly forest country; the terrain in the Project area generally inclined in a southerly and westerly direction towards the ocean. The topography is characterized by two low ridges that run in a roughly east to west direction with an elevation of 50 to 65 m (AMEC, 2013).

Goldboro is located in the Meguma Zone on the Atlantic Coast of NS (Figure 5.1-2). This zone occupies the southern mainland of NS, extending seaward beneath younger sedimentary rocks. It is a good example of a terrane (i.e., a fault-bounded rock body of regional extent) characterized by a geologic history different from that of adjoining terrane. It is an exotic fragment of continental material added to ancestral North America by continental collision (NS Museum of Natural History (NSMNH), 1996). The sedimentary rocks of the Meguma Zone consist almost entirely of fine-grained sandstones and shales with minor amounts of volcaniclastic, conglomeratic and carbonate rocks (NSMNH, 1996).

The Meguma stratigraphic succession consists of three major groups of sandstone (Goldenville Formation) that alternate vertically with two thick groups of shale (Halifax Formation). The Goldenville Formation contains alternating layers of sandstone and finer grained beds and is interpreted as a submarine mid-fan deposit (NSMNH, 1996). The Halifax Formation consists of slate, siltstone, minor sandstone. Faribault (1914, in Keppie, 1977) recorded a thickness of at least 5,600 m for the Goldenville Formation, and approximately 500 to 4,400 m has been recorded for the Halifax Formation.

5.1.2 Bedrock Geology

The nature of the bedrock geology of the Project area is a direct result of complex tectonic events. There has been a significant amount of folding and faulting resulting in complex structural geology. Figure 5.1-3 depicts the structural and bedrock geology in the Project area.

Steeply dipping rocks of the Goldenville Formation underlie the entire LSA. Halifax Formation slates are present, generally as narrow bands at major syncline axis (Fletcher and Faribault, 1893) to the north of the LSA (AMEC, 2013). Certain rocks of the Goldenville Formation may also be a source of acid rock drainage (ARD), particularly (in small areas) where highly mineralized zones are present.

Borehole logs documented during the installation of monitoring wells in the LSA (Keltic Project footprint) indicate that much of the Project site is underlain by bedrock consisting of greywacke with some occurrences of argillite. Argillite with pyrite and arsenopyrite associated with the Halifax Formation was identified in the RSA along the southern edge of Meadow Lake.

Twenty-four test pits were excavated to depths between 1.2 to 4.5 m as part of the geotechnical investigation required for MapleLNG's Permit to Construct. While the test pits were completed outside the PDA, the bedrock samples were analysed for the presence of sulphide mineralization. Sulphur measurements ranged from 0.008% to 0.085%, well below the 0.4% sulphur limit established by NSE with respect to mineralized rock (MapleLNG, 2008).

Previous site investigations between 2005 and 2013 have revealed multiple "unmapped" abandoned mine openings (AMOs) (Figure 5.1-4).

As a result of the folding and faulting and associated mineralization, the greater Goldboro area, including the Local Study Area, has been the subject of gold mining activities for well over 100 years. Several mines were established in the region. Figure 5.1-5 shows the distribution of exploration licenses in the immediate area as of March 2013.

5.1.3 Surficial Geology and Soils

About 94% of the soils in Guysborough County have developed from glacial till consisting of quartzite till and / or stony plain deposits. For the most part, these soils reflect the geology of the underlying bedrock. Onshore glacial deposits in NS were classified into till and glaciofluvial units by Stea and Fowler (1979). The surficial geology of the Project area and surrounding region were mapped by Cann and Hilchey (1954), Hilchey et al. (1964), Stea and Fowler (1979) and Stea et al. (1992). Riverport, Thom, Halifax, Danesville and Aspotogan series soils and peat are present at and near the Project area.

A and B Horizons

Figure 5.1-6 depicts the A and B soil horizons within the RSA. The Aspotogan, Halifax, and Danesville series soils overlay the LSA. The PDA overlays Aspotogan and Halifax series soils. The Aspotogan series is comprised of medium and moderately coarse-textured glacial tills derived from granite or quartzitic materials and is poorly draining. Halifax series soils are comprised of medium and moderately coarse-textured glacial tills that have developed from sandy loam quartzitic till with some slate and granite material present (Hilchey et al., 1964).

C Horizon

The C horizon materials (or "mineral soil") consists generally of quartzite till and/or stony till plain deposits in Guysborough County. Glacial-age kame fields and esker systems, and post - glaciation alluvial deposits are also present at various locations in the LSA (AMEC, 2013).

The ground moraine till material is comprised of a mixture of gravel, sand, and mud of direct glacial origin. It is variable in thickness from 2 to 25 m and forms local ridges, depressions or pits (kettles). The stony till unit consists of material released at the base of ice sheets and is described by Stea (1979) as a bluish-greenish-grey, loose, cobbly, silt-sand till, which will grade into a sandier, coarser till, sometimes with red clay inclusions. It is generally thin (less than 10 m) with a matrix made up of 80% sand, 15% silt, and 5% clay. It is derived of locally eroded quartzite and slate bedrock (AMEC, 2013).

Quartzite till is shown by Stea (1979) and Stea et al. (1992) to extend northward along the eastern half of the Isaac's Harbour River watershed, west of the PDA. Granite ablation till, or silty till plain deposits, are present along the western periphery in the upper reaches of the Isaac's watershed. These deposits are described by Stea (1979) as yellow-grey, bouldery sand till. A total of 24 test pits were completed in the LSA in 2007 by MapleLNG as part of the geotechnical investigation required for their Permit to Construct. The subsurface conditions were described as 1 to 4 m of overburden overlying Goldenville Formation bedrock (MapleLNG, 2008). The results indicate that the average thicknesses of the topsoil, silty sand/sandy silt layer, and the glacial till are 0.28 m, 0.34 m, and 1.96 m, respectively; and the average depth to bedrock is 2.72 m.

Soil and Sediment Sampling

The Site is a former gold mining district where mining and processing activities occurred. Wood conducted surface soil sampling within the PDA on the 9th and 10th of June, 2020 (Figure 5.1-7); sediment sampling on the 11th and 12th of June, 2020 (Figure 5.1-8) along the proposed ROW. Additional surface soil and sediment samples were collected on the 26th and 27th of September, 2020.

Sample collection methods included a trowel and a hand auger. Surface soil samples were collected at a discrete depth of 0.30 m. In the event of refusal before that point samples were collected at a depth of 0.10 m. Sediment samples were collected at a depth of 0.10 m where substrate composition allowed. All samples were transported to AGAT Laboratories Ltd., Dartmouth, NS (AGAT) on ice for preservation and submitted

within approved sample holding times. AGAT is accredited to International Standards Organization (ISO) 17025 standards by the Canadian Association for Laboratory Accreditation (CALA) at the Dartmouth, NS location.

For classification purposes, the Site is considered industrial use, potable groundwater and coarse-grained soil. Analytical chemistry data were assessed and evaluated using the following regulatory guidelines:

- NSE Tier 1 Environmental Quality Standards (Tier 1 EQS) for Soil.
- NSE Tier 1 EQS for Freshwater Sediment.

Soil Sampling Results

A total of 30 surface soil samples plus two duplicates were collected and analyzed for metals, including mercury. A subset of five samples were analyzed for a standard suite of benzene, toluene, ethylbenzene and xylene / total petroleum hydrocarbons (BTEX/TPH).

The sampling program identified exceedances of NSE Tier 1 EQS criteria. Two surface soil samples (SS19 and DUP2 (duplicate of SS13) exceeded for arsenic.

Sediment Sampling Results

A total of five sediment samples (SED1, SED2, SED4, SED5 and SED7) were collected from Crusher Brook, Betty's Cove Brook and several Unnamed Watercourses within the PDA to evaluate potential impacts from former gold mining activities (Figure 5.1-8). Sediment samples were submitted for analysis of metals, including mercury and BTEX/TPH.

Two sediment samples (SED2 and SED5) exceeded for arsenic. Four sediment samples (SED1, SED2, SED4, AND SED5) exceeded criteria for Modified TPH. The detection of BTEX/TPH in the four sediment samples are assumed to be either the result of aliphatic compounds synthesized by living plants that resemble hydrocarbons found in petroleum mixtures, or biological molecules from decaying matter that resemble the breakdown products of petroleum hydrocarbons and are generally referred to as biogenic hydrocarbons. Refer to Appendix C for sample analysis results and comparison with guidelines.

5.1.4 Groundwater

Groundwater has a dynamic relationship with surface water and provides a potable water supply to non-serviced residences at the start and end points of the Realignment. Influences on groundwater flow direction may include water table hydraulic gradient (piezometric), hydraulic conductivity, and fracture orientation. Groundwater is expected to follow relief on a regional scale; however, this may not always be the case (AMEC, 2013).

The predominance of secondary permeability within the bedrock of the Goldenville Formation, the large number of shear zones known to be present in the LSA, and the large number of possibly extensive abandoned underground workings can be expected to have a significant influence on groundwater flow pathways and on overall groundwater flow velocity within and beyond the Site.

A monitoring well network was installed in 2008 for baseline and construction monitoring purposes for a previous project located south of the Realignment, at the site of the proposed Goldboro LNG facility. There were ten wells in total, constructed as five shallow / deep water couplets ranging in depth from 7.6 to 8.8 m for the shallow water wells; to 15.4 to 42.7 m for the deep water wells (AMEC, 2013). Assessment of the data indicated that hydraulic communication was found to exist between many of the monitoring well pairs during hydraulic testing, suggesting both vertical and lateral bedrock fracturing. Groundwater is expected

to flow from higher elevations northwest of the Site, in a southeast direction across the site towards Betty's Cove Brook to the east, southeast and south; Dung Cove to the southwest; and Stormont Bay to the south. However, possible groundwater flow paths of potential least resistance are indicated from the current knowledge of faults, shear zones and abandoned underground workings on the Site. These are expected to have an influence on the actual routes groundwater would flow.

Groundwater Sampling

The previous Keltic project identified up to forty wells in the community of Goldboro, most of which were dug wells. There were only thirteen drilled wells in the community of Goldboro (AMEC, 2013).

The dug wells generally produce water classed as soft, sodium-chloride type waters with low total dissolved solids (TDS), low alkalinity and low pH. The relative proportions of sodium and chloride appear to increase with increased TDS concentration, suggesting a possible road salt (less likely) and/or sea spray (more likely) influence on these wells. The values for pH and aluminum are generally outside of acceptable guideline limits. Nearly all the dug wells showed positive for total coliform; likely a function of well construction and maintenance (AMEC, 2013).

To satisfy conditions of the Class II EA approval for the proposed Goldboro LNG facility (NSE, 2014) Wood conducted a pre-blast well survey (Wood, 2020a) that encompassed all wells situated within at least an 800 m radius of a point of blast initiation (Figure 5.1-9). Homeowner permission was given to sample ten of the thirteen drilled wells identified in the area. Wood held interviews either in person or via telephone from the 12th to 15th of November and the 10th of December, 2018 as well as on the 25th of February, 2019. A well water sampling program was conducted on the 12th and 13th of November as well as the 5th of December, 2018. Three locations were resampled on the 9th of December, 2018. A total of ten samples were submitted with the accompanying chain of custody documentation to AGAT for analysis, within 24 hours of collection.

Well water samples were analyzed for:

- general chemistry;
- total metals;
- mercury; and
- total coliform and *E.coli* most probable number analysis (MPN).

Samples had been compared to the most current version of the Guidelines for Canadian Drinking Water Quality (GCDWQ) at that time (Health Canada, 2017).

All ten samples exceeded GCDWQs Operational Guidelines (OG) and/or Aesthetic Objectives (AO) for pH, true colour, and turbidity. Metals were reported above laboratory detection limits at all sample locations. Concentrations of aluminum, arsenic, iron, lead, and manganese exceeded the GCDWQ AO, OG, and/or Maximum Allowable Concentrations (MAC) at one or more locations. Nine samples were submitted for microbial (total coliform and *E.coli*) analysis. Exceedances of the GCDWQ for total coliform were noted in eight samples; two samples of which had *E.coli.*

Pump tests were conducted at five sites to collect baseline conditions.

5.1.5 Surface Water

Two named watercourses (Crusher Brook and Betty's Cove Brook) and 6 other unnamed watercourses (WCs) were identified in the PDA (Figure 5.1-10). Wood collected *in-situ* water quality parameters and water samples on the 11th and 12th of June; the 26th and 27th of September; and the 26th and 27th of November, 2020.

The *in-situ* parameters (Table 5.1-2) showed generally low conductivity and total dissolved solids values. All pH results were below the lower CCME Freshwater Aquatic Life (FAL) guideline value of 6.5 (CCME, 2007).

Table 5.1-2 In-situ Water Quality Parameters (Field Survey Results)

Watercourse Field Identifier	Date (2020)	Temperature (°C)	Conductivity (µS/cm)[1]	Total Dissolved Solids (ppm)[2]	pH
Crusher Brook (WC1)	11 June	8.5	64	32	4.59
Betty's Cove Brook (WC2)	12 June	7.3	38	19	4.84
Unnamed Watercourse (WC3)	12 June	10.3	39	19	4.96
Unnamed Watercourse (WC4)	26 September	15.2	112	56	4.06
Unnamed Watercourse (WC5)	27 September	12.5	54	27	5.44
Unnamed Watercourse (WC6)	27 September	14.1	56	28	4.46
Unnamed Watercourse (WC7)	26 November	7.4	131	55	5.92
Betty's Cove Brook (WC8)	27 November	7.7	62	29	4.37

Note: 1. µS/cm = microSiemens per centimetre
Note 2: ppm = parts per million

Surface Water Sampling

Surface water samples were collected at a depth of 5-10 centimetres (cm) below surface using a 250 millilitre (mL) sample bottle for decanting. All samples were submitted to AGAT on ice for preservation within approved sample holding times. Samples were analysed for dissolved and total metals, including mercury, as well as BTEX/TPH. Results were compared to NSE Tier 1 EQS for water.

The sampling program identified exceedances of NSE Tier 1 EQS criteria. Three samples (SW1, SW2, and SW3) exceeded for aluminium; three samples (SW3, SW5, and SW6) exceeded for arsenic and six samples (SW1, SW2, SW3, SW4, SW5, and SW6) exceeded for iron.

Refer to Appendix D for sample analysis results and comparison with guidelines.

5.1.6 Climate and Weather

NS has a "temperate continental" climate (Rudloff, 1981) marked by relatively large daily and day-to-day ranges of temperature, especially during the spring and fall, and moderate rainfall. NS lies in the "prevailing westerlies" characteristic of mid-latitudes in the northern hemisphere. Within this general circulation are

embedded air masses originating at higher or lower latitudes that interact to produce storm systems. NS experiences a relatively large number of storm systems that contribute to a roughly twice-weekly shift between fair and cloudy and stormy weather.

The climate of the Project area is best characterized by long-term meteorological data collected by ECCC at Stillwater-Sherbrooke. Stillwater-Sherbrooke is at an elevation of 14 m with latitude 45° 09′ N and longitude 61° 59′ W, located approximately 25 km northeast of the Project area (AMEC, 2013).

Precipitation

Precipitation is slightly greater in the late fall and early winter due to more frequent and intense storm activity. In most years there is a good supply of rain during the spring and summer; however, drought is not unknown in NS.

On average, only about 15% of NS's total annual precipitation originates as snow. Snowfall is relatively light near the warm Atlantic shore and near the entrance to the Bay of Fundy, where less than 150 cm may fall per winter. Here, copious rain and freezing rain make up for the scanty snowfalls (AMEC, 2013).

ECCC Climate Normal Data (1981-2010) show an average annual precipitation reported at the Stillwater-Sherbrooke station of 1524.7 mm; 178.0 cm in the form of snow. The extreme daily precipitation recorded was 142.6 mm, which occurred in September 1996. Total monthly precipitation has ranged from 96.3 mm to 165.4 mm (ECCC, 2020).

Fog and Sunshine

Each year there is an average of 115 days with fog at Canso and 101 days with fog at Shearwater. Canso is located approximately 55 km from the proposed Project site. The period from mid-spring to early summer is the foggiest time. Bands of thick, cool fog lie off the coast, produced where the chilled air above the Labrador Current mixes with warm, moisture-laden air moving onshore from the Gulf Stream. With onshore winds, these banks of fog move far inland. Sea fog often affects the headlands by day, moving inland and up the bays and inlets at night. At other times of the year, fog is much more transient and local in nature.

Due to extensive fogs, as well as mists and low cloud, sunshine amounts throughout the province are usually less than half the total possible. Sunshine totals range from 1700 to 1969 hours per year; August being the sunniest month along the coast. Sunless days (days with less than five minutes of bright sunshine) amount to between 75 and 90 a year, with a marked seasonal high from November to February. Sunny days, on which less than 70% of the sky is covered with cloud in the early afternoon, amount to between 130 and 160, with a peak from July through October (AMEC, 2013).

Severe Weather

Storms frequently pass close to the Atlantic coast of NS and cross the southern part of Newfoundland, producing highly changeable and generally stormy weather. This region has more storms over the course of a year than any other region of Canada. With a variety of weather conditions from hurricane-force winds to heavy precipitation, storm systems can pass rapidly through, or stall and batter the region for several days. Other conditions associated with these storms include freezing spray; reduced visibility in snow, rain, or fog; and numbing wind chills, especially in a storm's wake.

In late summer and fall the remnants of a hurricane or tropical storm are felt at least once a year in NS. For example, in September, 2003, Hurricane Juan struck Atlantic Canada with peak winds of 165 kilometres per hour (km/h). Juan resulted in eight fatalities and over 200 million dollars in damage, and was described as the worst storm to hit Halifax since 1893.

Thunderstorms are infrequent in NS and occur about 10 days per year. The most winter lightning in Canada occurs in an area south of Sable Island, in the Atlantic Ocean. Cold air moving down from the Arctic collides with warmer air rising from the Gulf Stream. This collision creates ideal conditions for thunderstorms and lightning.

Tornadoes have been recorded but are rare. Reports of waterspouts over near-shore waters are received annually. Other severe weather phenomena include ice storms and blizzards. Each year one or two 25 cm snowfalls occur in NS. When combined with strong winds, impacts can include property damage and loss of life (AMEC, 2013).

Temperatures

The range of temperatures at the Site is rather broad from winter to summer. Summers are relatively cool; for example, the warmest average daily maximum temperature recorded at the Stillwater-Sherbrooke station from June to August is 24.2°C with a record high temperature of 35°C in June 1976. Winters are cold with an average daily minimum temperature in January at Stillwater-Sherbrooke of -11.2°C with the lowest recorded temperature at Stillwater-Sherbrooke of -39°C in February 1985 (ECCC, 2020).

Winds

The wind at any given location is often quite different from the wind conditions which prevail even a short distance away. Wind direction and speed varies with natural and man-made obstructions, topography, and surface cover. Along the coast, an onshore sea breeze circulation often develops, particularly during a warm, sunny afternoon in the spring or early summer (AMEC, 2013).

Unfortunately, wind data is not available from the Stillwater-Sherbrooke Station, but it is available from the Halifax-Shearwater station. Winds at Halifax-Shearwater are fairly light with the highest speeds occurring in the winter at an average of 18.1 km/h for those months. A peak gust of 132 km/h was recorded in December 1976. The lightest winds occur in summer with a monthly average wind speed of 13.2 km/h in August. The mean wind speed for the year is 15.5 km/h. The prevailing wind direction at Halifax-Shearwater is from the south from May through September and from the west, northwest, or north from October through April. Monthly wind roses (Figure 5.1-11) show the predominance of winds from the northwest and west in the winter; from the southwest in the summer.

Climate Update and Predicted Future Trends

Both DFO and ECCC report that climate change will result in a sea level rise of 50 to 80 cm along the Atlantic coast over the next century. Rising sea levels will contribute to an increase in coastal flooding, reduced ice cover, intensified storm events and possibly increased tidal ranges. Air temperatures in the Scotian Shelf Region are expected to rise in annual averages by 2 to 3.5°C over the next 50 years (DFO, 2013). Disruptions to transportation (including road damage during storm events), electrical transmission and communications will become more commonplace (Natural Resources Canada (NRCan), 2008).

5.1.7 Air Quality

NS air quality is routinely monitored by the provincial and federal governments at various stations, usually located in or near population centres. The Air Quality Management System (AQMS) was designed to address the challenges of air quality management, including cross-jurisdictional issues, and deliver a Canada-wide approach that provides flexibility to account for regional differences in air quality issues while, at the same time, ensuring a level of consistency so that Canadians can rely on good air quality outcomes. As part of this approach, CCME has also created an Air Zone Management Framework (AZMF) which categorizes provincial regions by existing air quality and management goals. The Project Study Area lies

within the Northern Air Zone of NS, which is considered "yellow".

Since the Canadian Ambient Air Quality Objective (CAAQO) are still under development for some parameters, NS Air Quality Regulations have been adopted from the United States (US) National Ambient Air Quality Objectives (NAAQOs); however, values are based on "maximum ground level concentration" rather than "maximum acceptable level" of the NAAQOs. NS Air Quality Regulations are listed for six compounds, including Total Suspended Particulate (TSP) and carbon monoxide (CO). Table 5.1-3 lists the Regulations established under the provincial EGSPA enacted in 2007.

Table 5.1-3 In-situ Water Quality Parameters (Field Survey Results)

Pollutant	Averaging Time	Standards (numerical values)		Metric
		2015	2020	
$PM_{2.5}$	24-hour (calendar day)	28 µg/m^3	28 µg/m^3	The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations
$PM_{2.5}$	Annual (calendar year)	10 µg/m^3	28 µg/m^3	The 3-year average of the annual average concentrations
Ozone	8-hour	63 ppb	62 ppb	The 3-year average of the annual 4th highest daily maximum 8-hour average concentrations
Sulphur dioxide (SO_2)	Annual (calendar year)		5 ppb	The 1-year average of the 1 hour average concentrations
Nitrogen dioxide (NO_2)	Annual (calendar year)		17 ppb	The 1-year average of the 1 hour average concentrations

$PM_{2.5}$: Particulate matter less than 2.5 micrometres (µm) in diameter
µg/m^3: micrograms per cubic metre
ppb: parts per billion

Monitoring and Emissions

The Port Hawkesbury Ambient Air Quality monitoring station operated by NSE is the nearest station to the Project Study Area. This station records fine particulate matter, SO_2, nitric oxide (NO) and NO_2 (NSE, 2021). ECCC manages National Air Pollution Surveillance Program (NAPS), whose database provides annual summaries for weather stations in Canada, including Port Hawkesbury (ECCC, 2018a). Introduced in 2012, the ozone CAAQ is based on the fourth highest daily 8-hour average of the year. In all cases, the calculated annual statistic is averaged over a three-year period. At the Port Hawkesbury station, the recorded annual metric of ground-level ozone (GLO) was 29 ppb in 2019; below the 63 ppb CAAQO standard for 2015 and the 62-ppb goal for 2020 (NSE, 2018).

Particulate Matter

Particulate matter (PM) refers to those particulates in the air that do not settle readily and thereby remain suspended (e.g., smoke, soot and dust). PM is a broad class of chemically and physically diverse substances that can occur in either a solid or liquid state, or a combination of these. PM greater than 10 µm in diameter creates problems such as visibility reduction and soiling as well as material and vegetation damage. PM becomes a potential human health hazard when the particle size is equal to, or less than, 10 µm in diameter (PM_{10}) (NBDELG, 2001). These particles are typical of dust granules that are invisible to the naked eye as

individual specks. Such particles are commonly generated from building materials, combustion, human activities and outdoor sources; including atmospheric dust and combustion emissions from mobile and stationary sources. Particles of 2.5 µm or less ($PM_{2.5}$) are small enough to inhale and are believed to cause respiratory and cardiovascular problems. These particles are visible as clouds of smoke and are typically high in sulphates, nitrates, carbon and heavy metals - being produced by fossil fuel combustion, vehicle exhaust and industrial emissions (NBDELG, 2001).

At Port Hawkesbury, the average daily metric value in 2020 was recorded as 5 µg/m^3 (below the 28 µg/m^3 standard).

Combustion Gases

These gases are produced by the combustion of fossil fuels. Note that neither ECCC nor NSE report carbon monoxide levels from the Port Hawkesbury Station.

Nitrogen oxides (NO and NO_2)

Nitric oxide (NO) is released in the exhaust of internal combustion engines and furnaces. NO is an unstable compound, readily converted to NO_2, which contributes to the formation of acid rain and is a primary precursor pollutant in the formation of smog. NSE has set an air quality guideline for NO_2 of 210 ppb for a 1-hour averaging period. The mean 1-hr averaging period for NO_2 in 2020 was 2.3 ppb.

Sulphur dioxide (SO_2)

Sulphur dioxide is produced by burning oil and coal for energy production and space heating; these contain sulphur as an impurity in various concentrations. Other potential sources of SO_2 include oil refineries, pulp and paper mills, and vehicles. NSE has set an air quality guideline for SO_2 of 340 ppb for a 1-hour averaging period. The mean 1-hr averaging period for SO_2 in 2020 was 0.6 ppb.

5.1.8 Acoustic Environment

A Provincial Guideline was developed to facilitate the evaluation of noise pollution in the environment and establish acceptable sound levels. Noise levels are frequently presented in A- weighted decibels (dBA) which measures relative loudness of sounds in air as perceived by the human ear. The guidelines for acceptable equivalent continuous sound levels (Leq) are:

- Leq of 65 dBA between 0700 to 1900 hours;
- Leq of 60 dBA between 1900 to 2300 hours; and
- Leq of 55 dBA between 2300 to 0700 hours.

Typical noise guidelines are usually related to time of day, since noise impacts are generally perceived as being of the nuisance variety in terms of human activity, which also varies by time of day. To ensure that a representative sample is collected during any one period, a minimum of two continuous representative hours of data per period is required, unless the sound being generated is reasonably steady and the Leq is not expected to change drastically.

Goldboro and surrounding area is governed by the MDGC. The Municipality's Noise By-Law #29, Prevention of Excessive Noise, provides sections that refer to the governance of noise during the operation of combustion engines, such as gas turbines. The following provides pertinent excerpts from the By-Law:

- The discharge into open air of the exhaust of any steam engine, stationary internal combustion engine, or motor boat, except through a muffler or other device which will effectively prevent loud or explosive noises.

- The operation of any noise-creating blower, power fan or any internal combustion engine, the operation of which causes noise due to the explosion of gases or fluids, unless the noise from such blower or fan is muffled and such engine is equipped with a muffler device sufficient to deaden such noise.
- The sounding of any signaling device for a period longer than would be reasonable under the circumstances.

In addition, the By-Law states the following that applies to the operation of machinery during the construction phase:

- No person shall, in the Municipality, make any noise which disturbs or tends to disturb the peace and tranquility of the Municipality or any portion thereof, and in particular, between the hours of 11:00 pm and 6:00 am.

Baseline Noise Sampling

The general locale of the Realignment corridor is semi-rural in nature. Its actual location, however, is within an industrial park which, until recently, was the site of the Sable Offshore Energy Inc. (SOEI) gas plant.

Ambient noise monitoring was performed near the proposed Goldboro LNG Site on two occasions:

- in 2004 at the SOEI gas plant site; and
- in 2007 at the proposed site as part of the EA for the proposed MapleLNG Terminal.

In September 2004, noise monitoring was conducted within the LSA (Figure 5.1-12).

The monitoring was conducted over a period of 24 hours (September 15-16, 2004), with measurements recorded once per minute in dBA. Given the limited noise sources in the area, this sample can be considered representative of typical noise levels in the Project area. The results are reported as Leq; the level of a constant sound which, in a given situation and time period, has the same sound energy as does a time-varying sound. Technically, equivalent sound level is the level of the time-weighted, mean square, A-weighted sound pressure. Typical noise guidelines are usually related to time of day, since noise impacts are generally perceived as being of the nuisance variety in terms of human activity, which also varies by time of day. The results of this monitoring are summarized in Table 5.1-4.

Table 5.1-4 Hourly Leq Range (dBA) SOEI Gas Plant, September 15 - 16, 2004

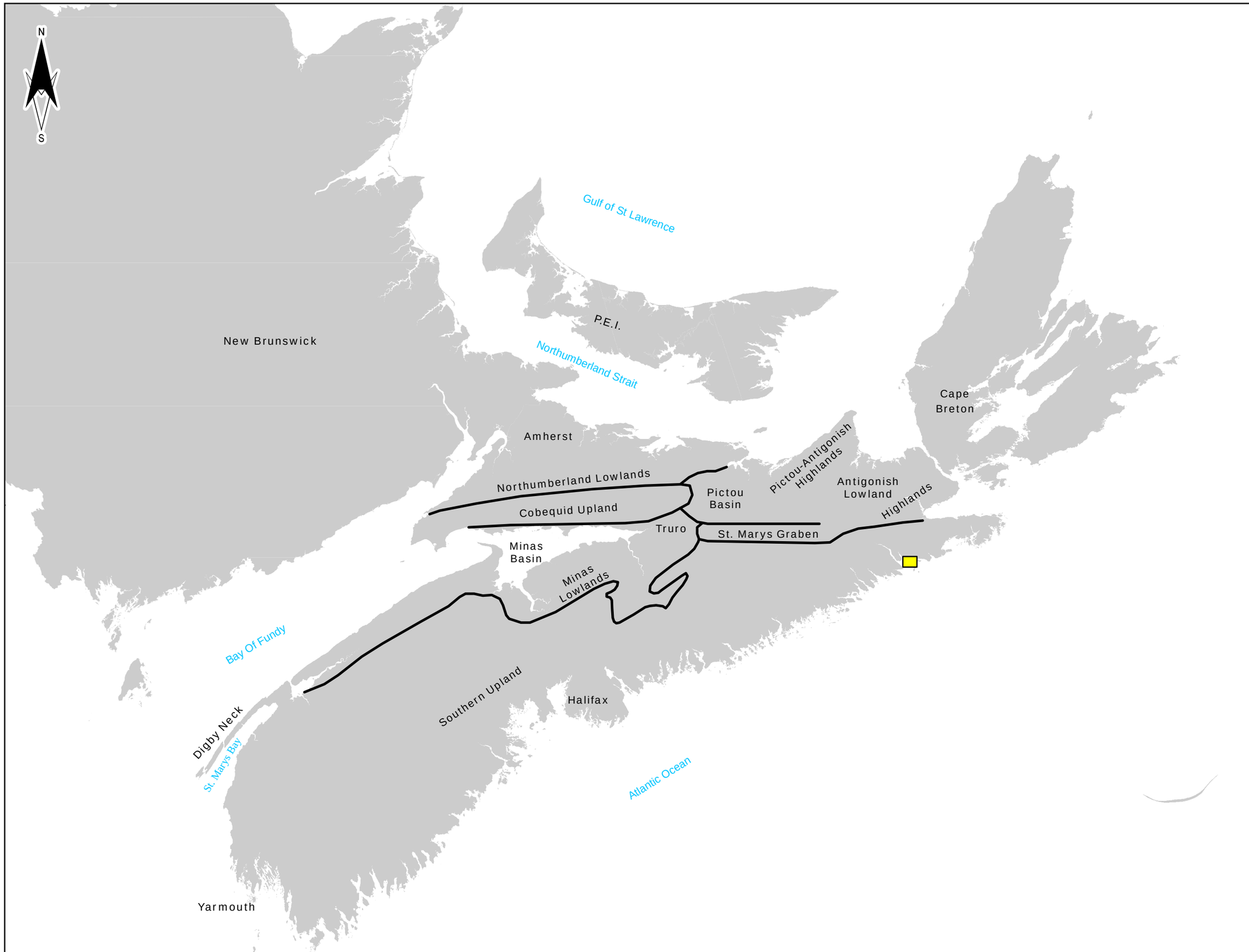
Time Period	Leq Range	Guideline Value
14:00-18:00	45.5 - 63.7	65
18:00-23:00	38.6 - 54.8	60
23:00-07:00	38.5 - 52.7	55
07:00-14:00	39.1 - 61.4	65

In 2007, an ambient noise assessment was conducted by Jacques Whitford Limited for the Keltic Project EA (Jacques Whitford, 2007a). Ambient noise was monitored at the proposed Keltic plant (approximate location of the proposed Pieridae site at three residential receptors over a two day period of the 17th to 19th of October, 2007 (Figure 5.1-12). The onsite Keltic monitoring was located approximately 180 m north from the nearest point on the property boundary of MapleLNG and the only other significant manmade noise source was the operating SOEI gas plant. The residential receptors were located 1.7 to 2.5 km from the proposed MapleLNG site. The results of this monitoring are summarized in Table 5.1-5.

Table 5.1-5 Ambient Noise Levels, October 17 - 19, 2007

Monitoring Location	Approximate Distance from MapleLNG Boundary	October 17, 2007 07:00-19:00 Leq (dBA)	October 18, 2007 07:00-19:00 Leq (dBA)	October 19, 2007 07:00-19:00 Leq (dBA)
Keltic Project	250	47	45	45
Residence - Isaac's Harbour	2480	37	27	26
Residence - Goldboro Public Wharf	2070	51	46	46
Residence - Drum Head	1710	39	37	32
Guideline Value	--	65	60	55

Since the reported noise measurements were taken, the SOEI gas plant has stopped operating and has been decommissioned. This is the only notable change in the land use near the Realignment with implications on the acoustic environment. Today's (2021) ambient noise levels are expected to be lower than what has been reported in 2004 and 2007. To establish a new baseline without the SOEI gas plant, Pieridae has scheduled ambient noise monitoring at and near the Goldboro LNG site for early 2021. The planned baseline measurements are part of Pieridae's Noise Management Plan for the Goldboro LNG facility and its components and will also provide an up-to-date noise baseline for the Realignment Project.



LEGEND:

Project Location

0 12.5 25 50 75 100

Kilometres

The map shown here has been created with all due and reasonable care and is strictly for use with Wood. Project Number: TE201007. This map has not been certified by a licensed land surveyor, and any third party use of this map comes without warranties of any kind. Wood. assumes no liability, direct or indirect, whatsoever for any such third party or unintended use.

CLIENT:

PIERIDAE ENERGY (CANADA) LIMITED

wood.

PROJECT:

ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

GOLDBORO LNG

TITLE:

NOVA SCOTIA'S MAIN PHYSIOGRAPHIC REGIONS

DATUM:	DWN BY:	DATE:
NAD 83	CM	FEB 2021
PROJECTION:	CHK'D BY:	SCALE:
UTM Zone 20 North	BM	1:2,000,000
PROJECT NO:	REV NO:	FIGURE NO:
TE201007	1	FIGURE 5.1-1

Path: G:\5290 PROJECTS\2020\TE201007_Pieridae_Energy_Goldboro_LNG\GIS\MXD\500_100 EA REPORT\TE201007_FIGURE_5_1-1_Physiograhic.mxd User: candace.macdonald Date: 2/25/2021

N

S

Cape Breton Island

AVALON TERRANE

Mabou

Arisaig

Cobequid-Chedabucto Fault System

Bay Of Fundy

Halifax Pluton

MEGUMA TERRANE

Service Layer Credits:

LEGEND:

- Fault Line
- Project Location
- Avalon Terrane Basement; Precambrian-Devonian
- Triassic-Jurassic
- Meguma
- Lower Carboniferous
- Upper Carboniferous
- Meguma Terrane Basement; Percambrian - Devonian

0 12.5 25 50 75 100

Kilometres

The map shown here has been created with all due and reasonable care and is strictly for use with Wood. Project Number: TE201007. This map has not been certified by a licensed land surveyor, and any third party use of this map comes without warranties of any kind. Wood. assumes no liability, direct or indirect, whatsoever for any such third party or unintended use.

CLIENT:

PIERIDAE ENERGY (CANADA) LIMITED

wood.

PROJECT:

ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

GOLDBORO LNG

TITLE:

MEGUMA TERRANE IN NOVA SCOTIA

DATUM:	DWN BY:	DATE:
NAD 83	CM	FEB 2021
PROJECTION:	CHK'D BY:	SCALE:
UTM Zone 20 North	BM	1:1,750,000
PROJECT NO:	REV NO:	FIGURE NO:
TE201007	1	FIGURE 5.1-2

Path: G:\5290 PROJECTS\2020\TE201007_Pieridae_Energy_Goldboro_LNG\GIS\MXD\500_100 EA REPORT\TE201007_FIGURE_5_1-2_Meguma_Terrane.mxd User: candace.macdonald Date: 2/25/2021

LEGEND:

- Fault
- Anticline
- Raw Water Supply Pipeline
- Highway 316 Realignment ROW
- Highway 316 Realignment
- Elevation Contours (5m Intervals)
- Roads
- LNG Wharf and Jetty
- Stream
- Waterbody
- Wetland
- LNG Facility Footprint
- Goldenville Formation
- Halifax Formation
- Devonian Granite
- Proposed Temporary Work Camp/Laydown

0 125 250 500 750 1,000

Metres

The map shown here has been created with all due and reasonable care and is strictly for use with Wood. Project Number: TE201007. This map has not been certified by a licensed land surveyor, and any third party use of this map comes without warranties of any kind. Wood. assumes no liability, direct or indirect, whatsoever for any such third party or unintended use.

CLIENT:

PIERIDAE ENERGY (CANADA) LIMITED

wood.

PROJECT:

ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

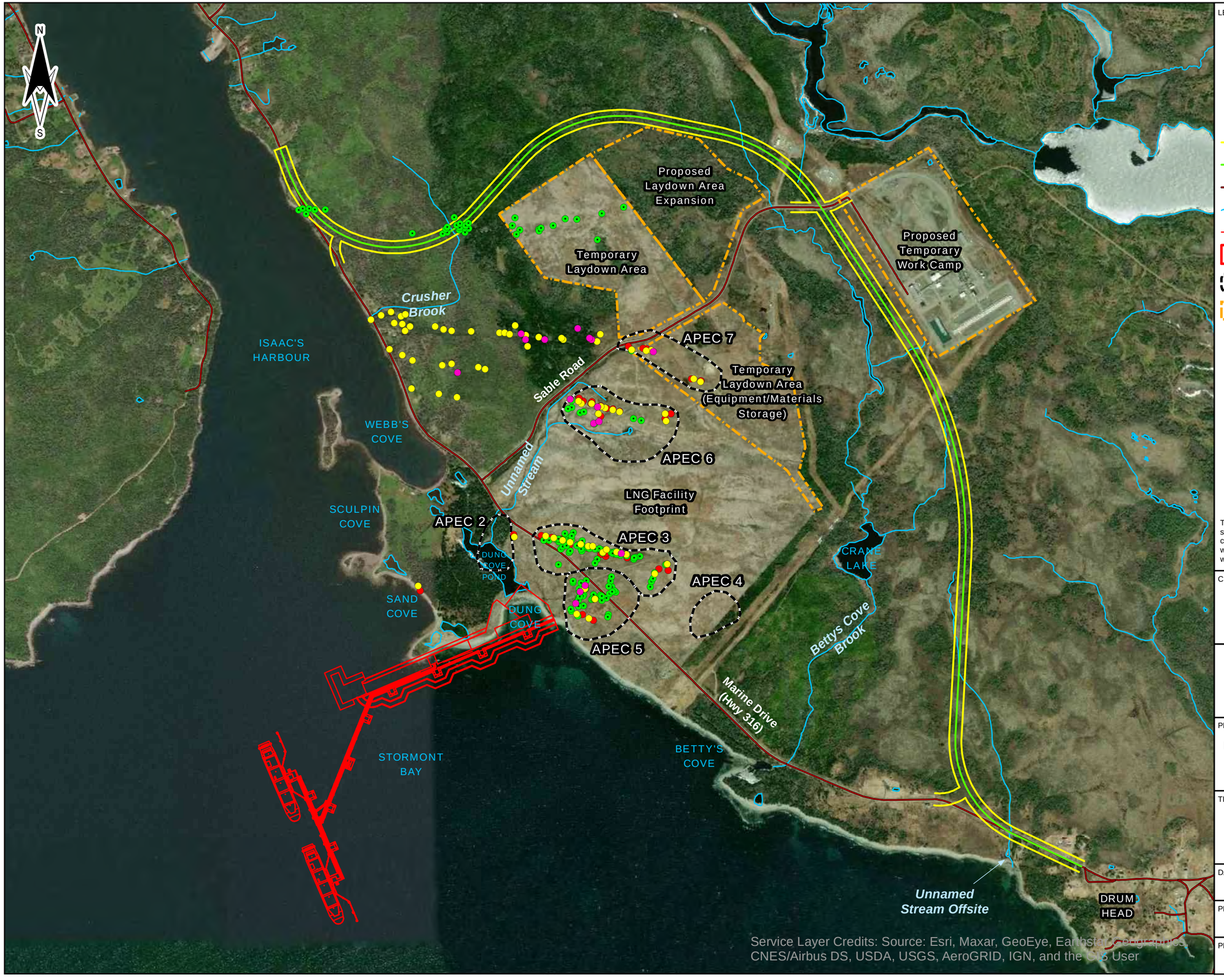
GOLDBORO LNG

TITLE:

BEDROCK AND STRUCTURAL GEOLOGY

DATUM:	DWN BY:	DATE:
NAD 83	CM	FEB 2021
PROJECTION:	CHK'D BY:	SCALE:
UTM Zone 20 North	BM	1:15,000
PROJECT NO:	REV NO:	FIGURE NO:
TE201007	1	FIGURE 5.1-3

Path: G:\5290 PROJECTS\2020\TE201007_Pieridae_Energy_Goldboro_LNG\GIS\MXD\5500_100 EA REPORT\TE201007_FIGURE_5_1-3_Bedrock_Structural_Geography.mxd User: candace.macdonald Date: 2/25/2021



LEGEND:

- Previously Unmapped Abandoned Mine Opening (AMEC,2013)
- Mapped Abandoned Mine Opening (AMEC,2006)
- Golder Identified
- NS DNR Identified AMO (gold
- Highway 316 Realignment ROW
- Highway 316 Realignment
- Roads
- Watercourse
- LNG Wharf and Jetty
- LNG Facility Footprint
- Area of Potential Environmental Concern (APEC)
- Proposed Temporary Work Camp/Laydown

0 125 250 500 750 1,000

Meters

CLIENT:

PIERIDAE ENERGY (CANADA) LIMITED

wood.

PROJECT:

ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

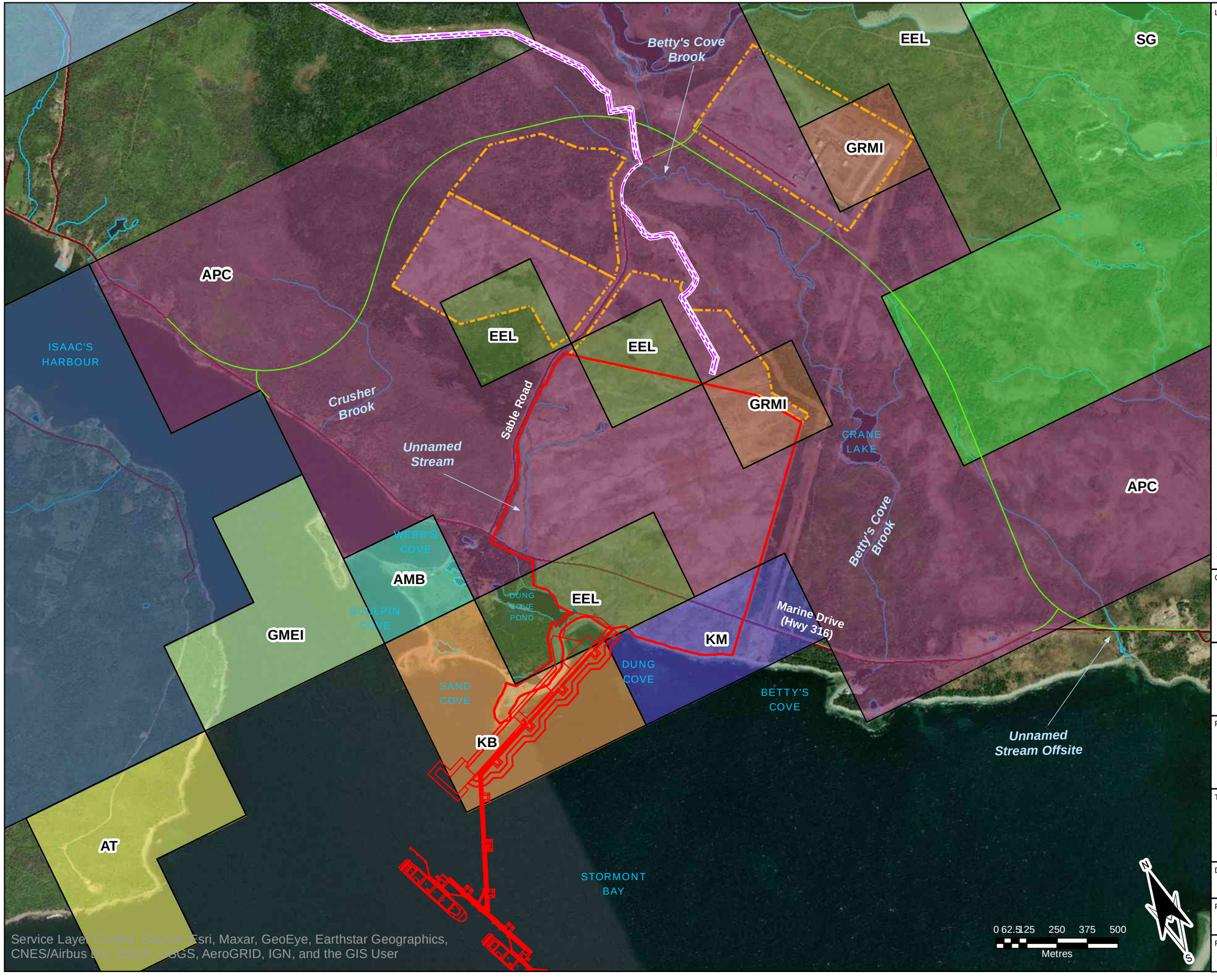
GOLDBORO LNG

TITLE:

ABANDONED MINE OPENINGS (AMOs)

DATUM:	DWN BY:	DATE:
NAD 83	CM	FEB 2021
PROJECTION:	CHK'D BY:	SCALE:
UTM Zone 20 North	BM	1:15,000
PROJECT NO:	REV NO:	FIGURE NO:
TE201007	1	FIGURE 5.1-4

Path: G:\5290 PROJECTS\2020\TE201007_Pieridae_Energy_Goldboro_LNG\GIS\MXD\500_100 EA REPORT\TE201007_FIGURE_5_1-4_AMOs.mxd User: candace.macdonald Date: 2/25/2021



LEGEND:

- Raw Water Supply Pipeline
- Highway 316 Realignment
- Roads
- Watercourse
- LNG Wharf and Jetty
- LNG Facility Footprint
- Proposed Temporary Work Camp/Laydown Areas

MINERAL EXPLORATION LICENSEE

- ANNAPOLIS PROPERTIES CORP.
- BARRETT, ANTHONY M.
- BOBKO, KIM
- D.D.V. GOLD LTD.
- ELK EXPLORATION LTD.
- EXPLORATION OREX INC.
- GLOBEX MINING ENTERPRISES INC.
- GRANT, SCOTT
- GREYHAWK RIDGE MINERALS INC.
- MACKINNON, R. PERRY
- MCALLISTER, KEVIN
- PELLERINE, DOMINIC ALAN JEROME
- THOMSON, ALEX C.

CLIENT:

PIERIDAE ENERGY (CANADA) LIMITED

PROJECT:

ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

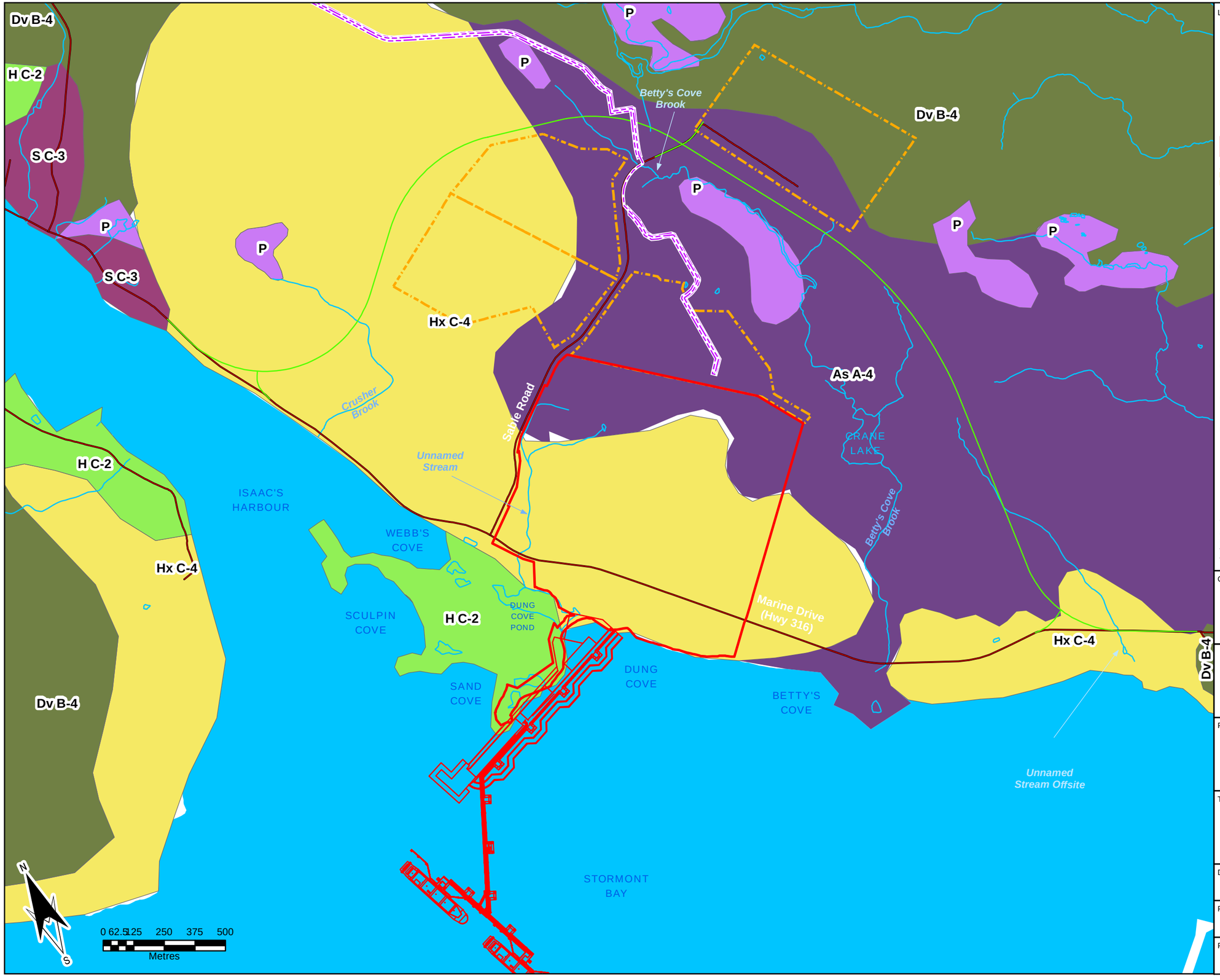
GOLDBORO LNG

TITLE:

THE DISTRIBUTION OF EXPLORATION INTERESTS IN THE IMMEDIATE AREA

DATUM:	DWN BY:	DATE:
NAD 83	CM	FEB 2021
PROJECTION:	CHK'D BY:	SCALE:
UTM ZONE 20 N	BM	1:15,000
PROJECT NO:	REV NO:	FIGURE NO:
TE201007	1	FIGURE 5.1-5

Path: G:\5290 PROJECTS\2020\TE201007_Pieridae_Energy_Goldboro_LNG\GIS\MXD\500_100 EA REPORT\TE201007_FIGURE_5_1-5_MineralExploration.mxd User: candace.macdonald Date: 2/25/2021



LEGEND:

- Raw Water Supply Pipeline
- Highway 316 Realignment
- Roads
- Watercourse
- LNG Wharf and Jetty
- LNG Facility Footprint
- Proposed Temporary Work Camp/Laydown Areas

SOIL TYPE

- As A-4
- Dv B-4
- H C-2
- Hx C-3
- Hx C-4
- P
- S C-3
- Waterbody

CLIENT:

PIERIDAE ENERGY (CANADA) LIMITED

wood.

PROJECT:

ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

GOLDBORO LNG

TITLE:

SOIL TYPE DISTRIBUTION (A AND B HORIZONS)

DATUM:	DWN BY:	DATE:
NAD 83	CM	FEB 2021
PROJECTION:	CHK'D BY:	SCALE:
UTM ZONE 20 N	BM	1:15,000
PROJECT NO:	REV NO:	FIGURE NO:
TE201007	1	FIGURE 5.1-6

Path: G:\5290 PROJECTS\2020\TE201007_Pieridae_Energy_Goldboro_LNG\GIS\MXD\500_100 EA REPORT\TE201007_FIGURE_5_1-6_SoilTypeDistribution.mxd User: candace.macdonald Date: 2/25/2021

LEGEND:

- Soil Sample Location - July 2020
- Soil Sample Location - June 2020
- Soil Sample Location - Sept 2020
- Highway 316 Realignment ROW
- Highway 316 Realignment
- Roads
- Watercourse
- LNG Wharf and Jetty
- LNG Facility Footprint
- Proposed Temporary Work Camp/Laydown

0 125 250 500 750 1,000

Meters

The map shown here has been created with all due and reasonable care and is strictly for use with Wood. Project Number: TE201007 This map has not been certified by a licensed land surveyor, and any third party use of this map comes without warranties of any kind. Wood. assumes no liability, direct or indirect, whatsoever for any such third party or unintended use.

CLIENT:

PIERIDAE ENERGY (CANADA) LIMITED

wood.

PROJECT:

ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

GOLDBORO LNG

TITLE:

SOIL SAMPLING LOCATIONS

DATUM:	DWN BY:	DATE:
NAD 83	CM	FEB 2021
PROJECTION:	CHK'D BY:	SCALE:
UTM Zone 20 North	BM	1:15,000
PROJECT NO:	REV NO:	FIGURE NO:
TE201007	1	FIGURE 5.1-7

Path: G:\5290 PROJECTS\2020\TE201007_Pieridae_Energy_Goldboro_LNG\GIS\MXD\500_100 EA REPORT\TE201007_FIGURE_5.1-7_Soil_Sampling_Locations.mxd User: candace.macdonald Date: 2/26/2021

LEGEND:

- Sediment Sample Location
- Highway 316 Realignment ROW
- Highway 316 Realignment
- Roads
- Watercourse
- LNG Wharf and Jetty
- LNG Facility Footprint
- Proposed Temporary Work Camp/Laydown

0 125 250 500 750 1,000

Meters

The map shown here has been created with all due and reasonable care and is strictly for use with Wood. Project Number: TE201007 This map has not been certified by a licensed land surveyor, and any third party use of this map comes without warranties of any kind. Wood. assumes no liability, direct or indirect, whatsoever for any such third party or unintended use.

CLIENT:

PIERIDAE ENERGY (CANADA) LIMITED

wood.

PROJECT:

ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

GOLDBORO LNG

TITLE:

SEDIMENT SAMPLING LOCATIONS

DATUM:	DWN BY:	DATE:
NAD 83	CM	FEB 2021
PROJECTION:	CHK'D BY:	SCALE:
UTM Zone 20 North	BM	1:15,000
PROJECT NO:	REV NO:	FIGURE NO:
TE201007	1	FIGURE 5.1-8

Path: G:\5290 PROJECTS\2020\TE201007_Pieridae_Energy_Goldboro_LNG\GIS\MXD\500_100 EA REPORT\TE201007_FIGURE_5_1-8_Sediment_Sampling_Locations_AMOs.mxd User: candace.macdonald Date: 2/25/2021

LEGEND:

- Residence/Outbuilding Location
- Water Well (Tested)
- Highway 316 Realignment ROW
- Highway 316 Realignment
- Roads
- Watercourse
- LNG Wharf and Jetty
- LNG Facility Footprint
- Proposed Temporary Work Camp/Laydown

0 125 250 500 750 1,000
Meters

CLIENT:

PIERIDAE ENERGY (CANADA) LIMITED

wood.

PROJECT:

ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

GOLDBORO LNG

TITLE:

DRILLED WATER WELLS

DATUM:	DWN BY:	DATE:
NAD 83	CM	FEB 2021
PROJECTION:	CHK'D BY:	SCALE:
UTM ZONE 20 NORTH	UW	1:15,000
PROJECT NO:	REV NO:	FIGURE NO:
TE201007	0	FIGURE 5.1-9

Path: G:\5290 PROJECTS\2020\TE201007_Pieridae_Energy_Goldboro_LNG\GIS\MXD\500_100 EA REPORT\TE201007_FIGURE_5_1-9_Drilled_Water_Wells.mxd User: candace.macdonald Date: 2/25/2021

LEGEND:

- Surface Water Sample Location
- Highway 316 Realignment ROW
- Highway 316 Realignment
- Roads
- Watercourse
- LNG Wharf and Jetty
- LNG Facility Footprint
- Proposed Temporary Work Camp/Laydown

0 125 250 500 750 1,000

Meters

CLIENT:

PIERIDAE ENERGY (CANADA) LIMITED

wood.

PROJECT:

ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

GOLDBORO LNG

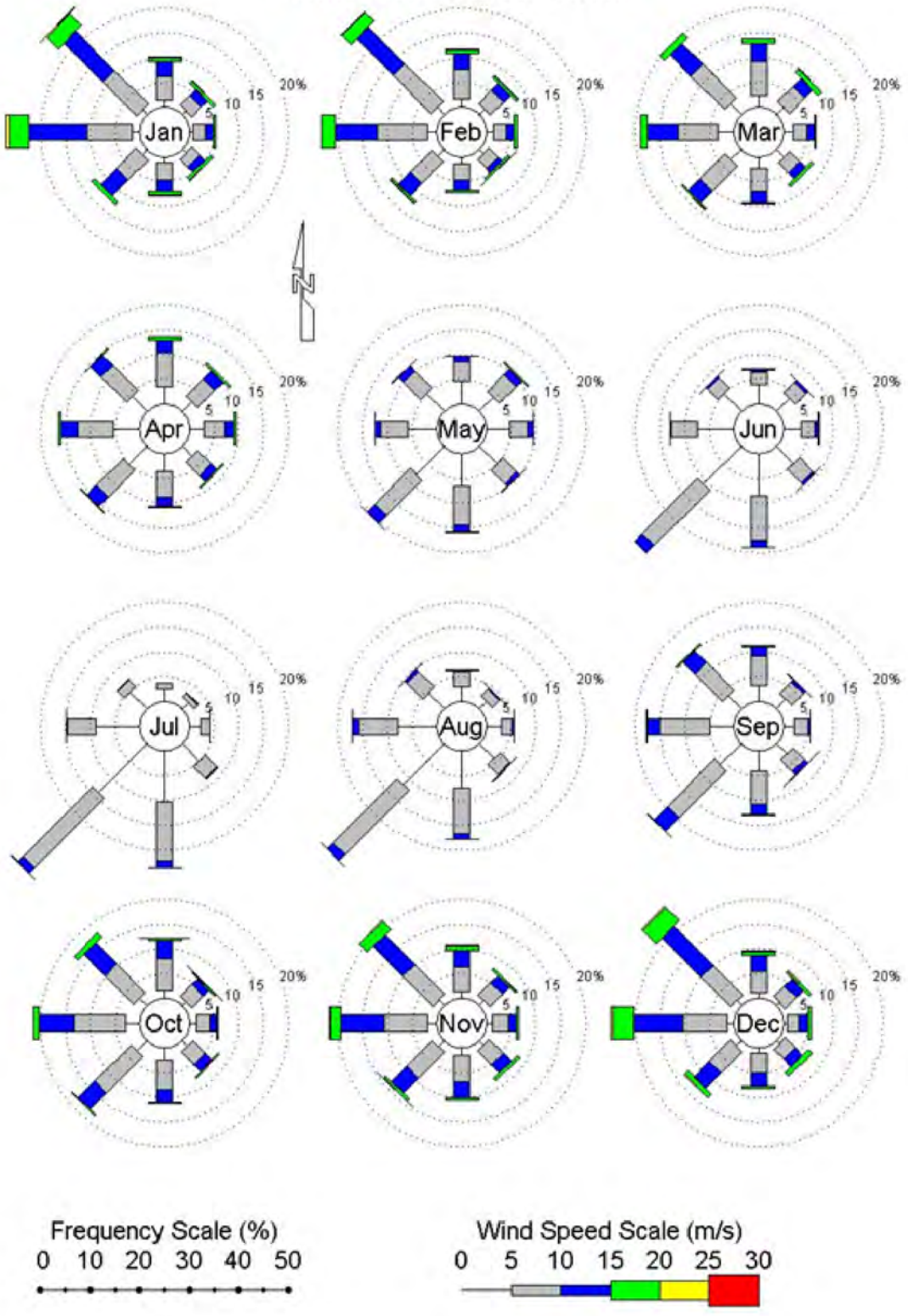
TITLE:

SURFACE WATER SAMPLE LOCATIONS

DATUM:	DWN BY:	DATE:
NAD 83	CM	FEB 2021
PROJECTION:	CHK'D BY:	SCALE:
UTM Zone 20 North	BM	1:15,000
PROJECT NO:	REV NO:	FIGURE NO:
TE201007	1	FIGURE 5.1-10

Path: G:\5290 PROJECTS\2020\TE201007_Pieridae_Energy_Goldboro_LNG\GIS\MXD\500_100 EA REPORT\TE201007_FIGURE_5_1-10_SurfaceWaterSampleLocations.mxd User: candace.macdonald Date: 2/25/2021

MSC50 #8086, 45.1N - -61.6W



CLIENT: **PIERIDAE ENERGY (CANADA) LIMITED**	TITLE: **MONTHLY WIND ROSE FOR MSC50 NODE #8086**		LEGEND:
	PROJECT: **ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)** GOLDBORO LNG		
wood.	PROJECT NO: **TE201007**	DATE: **FEB 2021**	FIGURE: **FIGURE 5.1-11**
	REV NO: **1**	DWN/CHK'D BY: **CM / BM**	SCALE: **NOT TO SCALE**
	DATUM: **N/A**	PROJECTION: **N/A**	

LEGEND:

- Noise Monitoring Location
- Local Receptors (mainly residences)
- Highway 316 Realignment ROW
- Highway 316 Realignment
- Roads
- Watercourse
- LNG Facility Footprint
- Proposed Temporary Work Camp/Laydown

0 125 250 500 750 1,000
Meters

The map shown here has been created with all due and reasonable care and is strictly for use with Wood. Project Number: TE201007. This map has not been certified by a licensed land surveyor, and any third party use of this map comes without warranties of any kind. Wood. assumes no liability, direct or indirect, whatsoever for any such third party or unintended use.

CLIENT:

PIERIDAE ENERGY (CANADA) LIMITED

wood.

PROJECT:

ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

GOLDBORO LNG

TITLE:

NEAREST SENSITIVE RECEPTORS AND NOISE MONITORING LOCATIONS

DATUM:	DWN BY:	DATE:
NAD 83	CM	FEB 2021
PROJECTION:	CHK'D BY:	SCALE:
UTM Zone 20 North	UW	1:15,000
PROJECT NO:	REV NO:	FIGURE NO:
TE201007	0	FIGURE 5.1-12

Path: G:\5290 PROJECTS\2020\TE201007_Pieridae_Energy_Goldboro_LNG\GIS\MXD\500_100 EA REPORT\TE201007_FIGURE_5.1-12_NoiseMonitoringLocations.mxd User: candace.macdonald Date: 2/26/2021

5.2 Biological Environment

5.2.1 Avifauna

The assessment of avian presence within the Local Study Area was focused primarily on priority species (further described in Section 5.2.6) and consisted of a desktop review and field surveys. Important habitat areas for birds that have been federally or provincially designated were identified using available mapping resources, including the Important Bird Areas (IBA) of Canada database (IBA, 2018) for information on areas of particular importance for birds. A search of the Atlantic Canada Conservation Data Centre (ACCDC) database was conducted and the provincial significant habitats database (NS Department of Lands and Forestry (NSDLF), 2018) was reviewed in order to assess potential priority species presence. Additional data was acquired from the Maritimes Breeding Bird Atlas (MBBA) and previous field surveys from the Site. The results of the desktop survey are summarized in Table E1, Appendix E.

Spring Migration Surveys

Wood conducted spring migration surveys on the 29th and 30th of April, 2020. Surveys consisted of fourteen point count survey locations (PCs) in the PDA (PC1 to PC14; Figure 5.2-1) and 4 other locations in the LSA. Additionally, roadside point counts for owls were conducted at three locations on the 29th of April 2020. Observers recorded numbers and species of birds detected at each count location, including breeding evidence if observed.

A total of 20 species (87 individuals) were observed during point counts (Table E-2 and E-3; Appendix E). During night-time surveys, a single Northern Saw-whet Owl (*Aegolius acadicus*) was detected, but the owl was calling from across Isaac's Harbour; therefore, no owls were detected onsite. No federally or provincially listed SAR were observed.

Breeding Bird Surveys

Two rounds of breeding bird surveys were conducted by McCallum Environmental Ltd. during a period from the 8th to the 12th of June, 2020, at the same locations as the spring migration surveys. Observers recorded numbers and species of birds detected at each count location, including breeding evidence if observed.

A total of 58 species (635 individuals) were observed during point counts (Table E-4; Appendix E),

The complete McCallum Environmental Ltd. report has been included in Appendix F.

5.2.2 Terrestrial Wildlife

Terrestrial wildlife surveys have focused on priority species: bat and moose. Incidental observations of non-target fauna species were recorded during avian, freshwater aquatic and wetland field surveys in 2018. In addition, any incidental evidence of non-target species presence was recorded throughout the field program. Information has also been presented for wildlife survey findings from previous EA field work.

Bat Monitoring Summary

Wood deployed three Anabat detectors from the 16th of July through to the 29th of October, 2020; their locations illustrated on Figure 5.2-3. Areas of suitable bat foraging habitat and hibernacula were selected to optimize the probability of detection as follows:

- Site 1, AMO 002;
- Site 2, AMO 026; and
- Site 3, at Dung Cove Pond.

Anabat units were placed in a waterproof housing at the base of a tree along with the power supply and the microphone mounted to the tree at a height of approximately 3 m, oriented along the treeline.

The detectors were programmed to record all ultrasonic sounds between 7 pm and 7 am. The detector sensitivity was set to a manufacturer-recommended level and the sensitivity was tested using a 'chirper' device to ensure that the units were properly detecting signal. The units were periodically checked to download data, check batteries and verify that the system was intact and functioning properly.

Sequences were identified to the lowest possible taxonomic level (species or genus) using Kaleidoscope software (Wildlife Acoustics Inc.) and published information on the calls of bat species native to eastern North America (McBurney and Segers, 2020; Barclay, 1989; Barclay et al., 1999; Betts, 1998; Broders et al., 2001; Fenton and Bell, 1981; Fenton et al., 1983; MacDonald et al., 1994). It should be noted that bats of the genus *Myotis* (including little brown bat and northern long-eared bat) cannot reliably be distinguished using these acoustic survey methods.

Monitoring results for the 2018 program are summarized in Table 5.2-1 and results for the 2020 program are summarized in Table 5.2-2.

Table 5.2-1 Summary of 2018 Bat Monitoring at Goldboro LNG Site, NS

Location	Dates Deployed (2018)	Number of Nights	Observations
LNG Site	24 to 31 August	8	*Myotis* sp. call sequence recorded on 28 August (one event). One Hoary Bat (*Aeorestes cinereus*) sequence recorded on 27 August.
	01 to 30 September	30	*Myotis* sp. call sequences recorded on 10 Sept (one event). Hoary Bat sequences recorded on 12 September (three events).
	01 to 31 October	31	No detections.
	01 to 16 November	16	No detections.

Table 5.2-2 Summary 2020 Bat Monitoring at Goldboro LNG Site, NS

Site ID	Dates Deployed (2020)	Number of Nights	Observations
AMO #2	15 July to 29 Oct	96	*Myotis* sp. call sequences recorded on 10 and 16 August (one sequence on each of these nights).
AMO #26	15 July to 29 Oct	80	Very little activity between 16 July and 31 August. Four *Myotis* sp. detections on 4 August.
Dung Cove Pond	15 July to 29 Oct	87	*Myotis* sp. call sequences recorded on most nights (1-2 calls per night) until 28 August, after which no calls were recorded. The maximum number of *Myotis* calls were recorded on 27 August (five sequences). Hoary Bat sequences were recorded on 8 August (one sequence) and 6 September (five sequences)

Moose Monitoring Summary

A total of five moose surveys were conducted in the LSA over 2018, 2019 and 2020, including spring pellet and winter tracking / pellet surveys. All surveys were conducted by at least one experienced Wood Biologist familiar with the Project area, accompanied by an Environmental Technician, including Technicians from the Confederation of Mainland Mi'kmaq (CMM). Wood field staff walked the survey transects established in 2013 (Figure 5.2-2) looking for evidence of moose including (but not limited to) pellets, tracks, game trails and browse. The survey transects were selected to be representative of probable areas of suitable moose habitat near the Goldboro LNG site and the Realignment corridor (i.e. closed canopy coniferous forest, wetlands and regenerating disturbed areas that provide browsing habitat). The transect running west of the ROW was extended to encompass the Project area.

Observations to date (Table 5.2-3) indicate that Mainland Moose (*Alces alces americanus*) are occasionally present in the Project area.

Table 5.2-3 Moose Survey Transects and Dates

Year	Season / Month	Type	Objective	Location and Outcome	Signs of Moose Observed
2005	Winter (February)	Ground-based and aerial	Pre-Construction (baseline mammalian activity for Keltic Project)	Transects not documented.	No
2005	Summer (no date)	Ground-based and aerial	Pre-Construction (baseline Moose for Keltic Project)	Transects not documented.	No
2013	Spring (April)	Ground-based	Pre-Construction (baseline for Goldboro LNG)	Transects	Yes (scat and tracks)
2016	Spring (April)	Ground-based	Pre-Construction (baseline for Goldboro LNG)	Transects	No
2018	Winter – Pellet Survey (February)	Ground-based	Pre-Construction (baseline for Goldboro LNG)	Transects	No
2018	Winter – Pellet and Track Survey (December)	Ground-based	Pre-Construction (baseline for Goldboro LNG)	Transects	No
2019	Winter - Track Survey (March)	Ground-based	Pre-Construction (baseline for Goldboro LNG)	Transects	No
2019	Spring - Pellet Survey (May)	Ground-based	Pre-Construction (baseline for Goldboro LNG)	Transects	No
2020	Spring - Pellet Survey (May)	Ground-based	Pre-Construction (baseline for Goldboro LNG)	Transects	Yes (scat and tracks)
2020	Winter - Pellet Survey (November)	Ground-based	Pre-Construction (baseline for Goldboro LNG)	Transects	Yes (scat and tracks)

Mammals

At least 20 terrestrial mammals were observed by sight or sign of presence in the LSA (Keltic LNG footprint) (AMEC, 2013). Of these, Coyote (*Canis latrans*), Red Fox (*Vulpes vulpes*), American Black Bear (*Ursus americanus*), White-tailed Deer (*Odocoileus virginianus*), Mainland Moose, Striped Skunk (*Mephitis mephitis*), Raccoon (*Procyon lotor*), Short-tailed Weasel (*Mustela erminea*), River Otter (*Lontra canadensis*), Bobcat (*Lynx rufus*), Woodchuck (*Marmota monax*), Red Squirrel (*Tamiasciurus hudsonicus*), Beaver (*Castor canadensis*), Muskrat (*Ondatra zibethicus*), Meadow Vole (*Microtus pennsylvanicus*), Porcupine (*Erethizon dorsatum*), and Snowshoe Hare (*Lepus americanus*) were observed in or near the Keltic footprint. Red-backed Vole (*Myodes gapperi*), Eastern Chipmunk (*Tamias striatus*) and American Mink (*Neovison vison*) were seen elsewhere in the Keltic Project area (AMEC, 2013). It is plausible that these species could be observed within the Realignment ROW.

Suitable habitat exists in the region for several small mammal species that occur in the province but were not observed during the field surveys. It is plausible that these species could be observed within the Realignment ROW. Potential small mammals that could be observed include:

- Masked Shrew (*Sorex cinereus*);
- Smokey Shrew (*Sorex fumeus*);
- Arctic Shrew (*Sorex arcticus*);
- Maritime Shrew (*Sorex maritimensis*) (often considered conspecific with Arctic Shrew, e.g., Stewart et al., 2002; however, Woodman et al., 2008 considers it a separate species);
- Water Shrew (*Sorex palustris*);
- Pygmy Shrew (*Sorex hoyi*);
- Short-tailed Shrew (*Blarina brevicauda*);
- Northern Long-eared Bat (*Myotis septentrionalis*);
- Little Brown Bat (*Myotis lucifugus*);
- Northern Flying Squirrel (*Glaucomys sabrinus*);
- Deer Mouse (*Peromyscus maniculatus*);
- Southern Bog Lemming (*Synaptomys cooperi*);
- Meadow Jumping Mouse (*Zapus hudsonius*); and
- Woodland Jumping Mouse (*Napaeozapus insignis*).

Amphibians and Reptiles

Field surveys were completed within the LSA (Goldboro LNG facility footprint) in April 2013. Wood Frog (*Lithobates sylvaticus*) and Spring Peeper (*Pseudacris crucifer*) were heard in many of the wet habitats onsite. Green Frog (*Lithobates clamitans*), Wood Frog and American Toad (*Anaxyrus americanus*) were observed in July 2013. In 2005, several species of anurans (frogs and toads) were observed in all permanently wet habitats in the general Keltic Project area, including American Toad, Green Frog, Mink Frog (*Lithobates septentrionalis*), Wood Frog and Pickerel Frog (*Lithobates palustris*) (AMEC, 2013). Other frog species, including Bullfrog (*Lithobates catesbeianus*) and Leopard Frog (*Lithobates pipiens*), have the potential to be present based on their range. Special effort was made during surveys for the Keltic Project to locate salamanders, especially the Four-toed Salamander (*Hemidactylium scutatum*); none, however, were observed. In addition to the Four-toed Salamander, the Eastern Newt (*Notophthalmus viridescens*), Spotted Salamander (*Ambystoma maculatum*), Red-backed Salamander (*Plethodon cinereus*) and Blue Spotted Salamander (*Ambystoma laterale*) have potential to occur in parts of the Keltic LNG footprint area (AMEC, 2013).

Three species of snakes were found in the LSA Keltic LNG footprint in 2005: Eastern Smooth Green Snake (*Opheodrys vernalis*), Red-bellied Snake (*Storeria occipitomaculata*) and Garter Snake (*Thamnophis sirtalis*). The latter two species were observed in the industrial park (AMEC, 2013). No turtles were observed during the field surveys. Other reptile species that could be present based on habitat and range include the Ring-necked Snake (*Diadophis punctatus*), Snapping Turtle (*Chelydra serpentina*), Painted Turtle (*Chrysemys picta*) and Wood Turtle (*Glyptemys insculpta*) (AMEC, 2013).

5.2.3 Terrestrial Habitat and Flora

Ecological Land Classification (ELC) links the abiotic and biotic components of each ecosystem. Climate, landform, and soil influence the distribution of vegetation (NSDNR, 2003). The Realignment is located within the Acadian Forest Ecozone, predominantly in the Atlantic Coastal Ecoregion (#8) and the Eastern Shore Ecodistrict (#820) (NSDLF, 2021). A small portion of the eastern end of the ROW is located within the Eastern Ecoregion (#4) and Eastern Interior Ecodistrict (#440). The presence of the Atlantic Ocean has more influence on the forests in this region than the soils, geology, or landform. The ocean provides a consistent coastal climate, resulting in the absence of Red Spruce (*Picea rubens*), Sugar Maple (*Acer saccharum*), White Pine (*Pinus strobus*) and American Beech (*Fagus grandifolia*) in coastal forests. Coastal forest is typically dominated by Balsam Fir (*Abies balsamea*), Black Spruce (*Picea mariana*) and scattered White Spruce (*Picea glauca*). The coastal forests are short lived, usually existing less than 100 years, but the moist climate is conducive to natural regeneration. Typically, most stands of Balsam Fir and Black Spruce have already developed a layer of regeneration while the overstorey breaks up. The influence of the ocean extends inland until it reaches the 60 m contour. Therefore, the Project site is influenced by the ocean (NSDLF, 2021).

Ecosections describe more permanent physical features such as topographic patterns, soil texture and soil drainage (NSDNR, 2003). Each Ecosection polygon has a four-letter code (e.g., WCHO) that describes the enduring physical features (i.e., soil drainage, soil texture, topographic pattern and sometimes landform) as interpreted for the Land System level in the Bio-physical Land Classification. The first letter in the name represents dominant soil drainage; the second letter represents dominant soil texture; and the final two letters represent the topographic pattern or landform (NSDNR, 2018). The ROW encompasses four Ecosections (NSDLF, 2021); WCHO (well drained, coarse textured and hummocky), WMRD (well drained, medium textured with ridges), IMHO (imperfectly drained, medium textured and hummocky), and WMKK (well drained, medium textured and hilly).

Vegetation Survey

Vegetation community surveys in the PDA were undertaken by McCallum Environmental Ltd. on the 24th to 28th of August; the 3rd to 5th of September; and the 28th of September, 2020. Vegetation community surveys were established in the field by walking meandering transects during the wetland delineation program. The objective of these surveys was to document the key forested and non-forested vegetative plant communities within and adjacent to the ROW.

A full description of the methodology used and detailed information on the vegetation community groups noted have been attached in Appendix F. Vegetation information has been summarized in Table 5.2-4 and Figure 5.2-3.

Table 5.2-4 Habitat Types Within the ROW

Community Type	Vegetation Group	Vegetation Type
Upland Communities	Coastal Forest Group	• CO1 – Black spruce – Balsam fir/Foxberry/Plume moss • CO4 – Balsam fir/Foxberry – Twinflower
	Old Field Forest Group	• OF1 – White spruce/Aster – Goldenrod/Shaggy moss • OF5a – Large-tooth aspen – Grey birch/Rough goldenrod - Strawberry
	Shrubland Group	• SL1 - Alder Shrubland • SL2- Mountain Ash – Wild Raisin Shrubland
	Coastal Barren Group	• CB1– Common Juniper – Black Crowberry wet Coastal Shrubland
Wetland Communities	Wet Coniferous Forest Group	• WC1 – Black spruce / Cinnamon Fern / Sphagnum • WC2 – Black Spruce / Lambkill – Labrador Tea / Sphagnum • WC5 – Red Spruce – Balsam Fir / Cinnamon Fern / sphagnum • WC6 – Balsam Fir / Cinnamon Fern – Three seeded sedge / sphagnum
	Wet Deciduous Forest Group	• WD2 – Red Maple / Cinnamon Fern / Sphagnum
	Peatland Group	• PG1 -Huckleberry – Crowberry Bog • PG2- Sweetgale Mixed Shrub Fen • PG3 - Coastal Sedge Fen • PG4 – Sheep Laurel Dwarf Shrub Bog
	Shrub Swamps Group	• SS1 -Mountain Holly – Alder
	Cut Over Swamps Group	• CS1 – Woolly Bullrush – Three-seeded Sedge – Soft Rush

Flora and Lichen Surveys

Flora and lichen surveys were undertaken in the PDA by McCallum Environmental Ltd. on the 24th to 28th of August; the 3rd to 5th of September; and the 28th of September, 2020. Prior to field surveys, detailed desktop reviews were completed for known observations and potential habitat for rare lichens within the Local Study Area.

Meandering transects were completed on foot and all major habitat types were assessed to create a species list of the general vascular species and communities present within the Study Area. A total of 184 vascular plant species and one priority species – Nova Scotia agalinis (*Agalinis neoscotica*) were identified. For full details refer to the McCallum report in Appendix F.

All habitat types were visited and inspected for lichens; however, efforts were focused on surveying mature trees that are appropriate for hosting priority lichen species. The trunks, and branches were surveyed for lichens. Thirty-one lichens and one priority lichen species, Blue Felt Lichen (*Pectenia plumbea*), were observed within and adjacent to the ROW. The complete McCallum Environmental Ltd. Report, including the list of vascular plants and lichens, has been included in Appendix F.

5.2.4 Wetlands

Wetlands are environmentally significant for several reasons including; flood control, water storage (groundwater recharge), water filtration, shoreline erosion buffering, carbon absorption and their use as fish and/or wildlife habitat. With their unique properties, wetlands may also serve a range of socioeconomic functions; such as natural heritage, recreation (hunting and fishing), and as a valued aesthetic resource (Government of Canada, 1991).

A review, delineation, and functional assessment was completed by McCallum Environmental Ltd. in 2020 to assess wetlands within a 100 m wide corridor (50 m from centreline). A background information review of wetlands was completed using several GIS databases which included the Wet Areas database, NSE Wetlands database and the NSE "Wetlands of Special Significance" (WSS).

Meandering transects were completed within the ROW to confirm the potential presence of wetlands on the 24th to 28th of August; the 3rd to 5th of September; and the 28th of September, 2020. Wetland boundaries were determined as described by the US Army Corps of Engineers, adapted for the Northcentral and Northeast Regions of the US (US Army Corp of Engineers, 2012) based on topography, soil, hydrology, and vegetation. Wetland functional assessment was completed for each wetland using the Wetland Ecosystem Services Protocol - Atlantic Canada (WESP-AC) wetland evaluation technique.

A total of 39 wetlands (WLs) were identified, delineated and characterized (Figure 5.2-4; Table G-1; Appendix G) during the field program; however, seven of those (WLs 1 -7) were within the LSA, but outside the PDA. Within the 100 m wide Realignment PDA, twenty-seven swamps (including complexes with swamp components) were observed; twelve of which were stand-alone softwood tree swamps, eight shrub swamps, three cut-over swamps and four complexes. Six bogs were observed; four of which were stand-alone shrub bogs and two tree swamp – shrub bog – fen complexes. Four fens were observed; one of which was a stand-alone shrub and graminoid fen and two were associated with a tree swamp – shrub bog – fen complex and one was associated with tree swamp – fen complex.

One WSS was identified (WL22) based on the presence of several locations of blue felt lichen within the wetland habitat (Figure 5.2-4). Only portions of the wetlands that had vegetation types belonging to the Wet Deciduous and Wet Coniferous Forest Group provided suitable habitat for this species. Remaining portions (the southern sections of this wetland) were determined to not be suitable habitat for blue felt lichen and therefore is not designated as WSS. These vegetation communities which have not been designation as WSS comprise of the PG1 – Huckleberry – Crowberry Bog; PG3 – Coastal Sedge Fen and the SS1 – Mountain Holly – Alder vegetation type. These vegetation types are either absent of tree cover (i.e., PG3 vegetation type) or support stunted conifer trees which are not suitable substrate for blue felt lichen.

The functional assessment showed that average function and benefit scores of the 32 wetlands was moderate (Table G-2; Appendix G). WESP-AC guidance states that the most vulnerable wetlands are those that possess high function and benefit scores; these wetlands perform well in their physical, chemical and biological processes and have a high importance to societal needs (Adamus and Verble, 2016).

The complete McCallum Environmental Ltd. report is attached in Appendix F.

5.2.5 Aquatic Environment

Two named watercourses (Crusher Brook and Betty's Cove Brook) and 6 other unnamed watercourses were identified to be crossed by the Realignment (Figure 5.2-5). Information on *in-situ* water quality results of laboratory analyses have been discussed in Section 5.1.5.

Aquatic Habitat Survey Results

Site visits were undertaken on the 11th and 12th of June; the 26th and 27th of September; and the 26th and 27th of November, 2020 to characterize watercourse habitat characteristics within the proposed road ROW. Where possible spot-checking electrofishing for fish species presence was performed. In the event that electrofishing could not be completed within the ROW, it was completed as near as practical. Other relevant observations, such as barriers to fish habitat, were recorded during the field assessment.

In general, the watercourses surveyed were cold, clear and had a low conductivity (Table 5.1-2; Section 5.1.5). *In-situ* low pH values were low with only one value above 5. While all were well below the CCME FAL lower limit of 6.5 (CCME, 2007), Guysborough County is known to have depressed pH levels. A 2006 agricultural soil study noted that 70% of the samples collected within the county has pH values below 5.9 (Nova Scotia Federation of Agriculture, 2006).

Habitat characteristics of watercourses within the ROW were collected using a standardized Wood characterization form. If no watercourse was noted within the ROW, the habitat information was collected from the watercourse as near to the ROW as possible. Habitat within the ROW was noted and photographed. Table 5.2-5 presents a summary of the habitat characterization and Table 5.2-6 presents the electrofishing results. Complete habitat data sheets are presented in Appendix H.

Table 5.2-5 Summary of Watercourse Characteristics and Fish Species

ID	Description	Habitat at Crossing	Fish Observed
Crusher Brook (WC1)	Headwaters originate in a wetland channel, approximately 300 m upstream of the ROW and becomes a well-defined channel with predominantly silt and organic substrate with some rock and cobble. Flows southwest into Isaac's Harbour, crossing Highway 316. Average depth 0.14 m, wet width 0.55 m.	No instream vegetation, intermittent channel. Barrier to fish passage (historic waste rock pile) at mouth of watercourse.	None Observed
Betty's Cove Brook (WC2)	Headwaters originate in a braided, ill-defined wetland channel. Approximately 25 m upstream of the ROW, becomes an ill-defined, braided, intermittent channel. No channel present at centreline of ROW for 100 m, subterranean flow through treed/shrub swamp. Channel assessed 25 m downstream of ROW. Predominantly organic substrate with some silt. Flows southeast into Betty's Cove. Average depth 0.04 m, wet width 1.4 m.	Low flow, shallow channel with little instream cover or overhanging vegetation.	American Eel (*Anguilla rostrata*) Brook Trout (*Salvelinus fontinalis*), outside of RoW
Unnamed Watercourse (WC3)	Headwaters originate in wetland channel approximately 250 m upstream of Stormont Bay. Predominantly rock and cobble substrate with some boulder.	Stable channel. Uniformly shallow riffles over flat rocks and boulders	None Observed

ID	Description	Habitat at Crossing	Fish Observed
	Average depth 0.1 m, wet width 0.2 m.	with fast flow.	
Unnamed Watercourse (WC4)	Originates as drainage from the former Gas Plant property. Starts channelized at culvert and becomes braided in a wetland before crossing ROW. Within ROW the channel re-establishes. Mix of rock and silt substrate with organics. Water was clear but watercourse was full of orange flock and a manganese sheen was noted in spots. Average depth 0.6 m, wet width 1 m.	Mainly low flow through a channel with stable banks over a predominantly silt/organics substrate.	None Observed
Unnamed Watercourse (WC5)	Channel running through a wetland. Minimal flow through channel that had a substrate of rock and silt/organics. Riparian zone primarily low shrub. Channel mainly narrow (~0.5 cm) with extensive overhanging vegetation. Average depth 0.18 m, wet width 0.75 m.	Stable, vegetated banks, extensive overhanging vegetation except for one portion that opened up to a wet width of 1.47 m.	Brook Trout and American Eel
Unnamed Watercourse (WC6)	Narrow channel with extensive overhanging vegetation running through a wetland. At sample site substrate was predominantly rock. Much of the watercourse through the ROW is no more than 0.2 m wide and in some areas is subterranean. Average depth 0.1 m, wet width 0.4 m.	Stable, vegetated/rocky banks, extensive overhanging vegetation. Rocky substrate.	None Observed
Unnamed Watercourse (WC7)	Narrow, shallow channel running through coniferous forest. Average depth of 0.04 m, wet width of 0.8m.	Stable moss-covered banks, extensive overhanging coniferous forest. Predominantly muck substrate with some silt and organics.	None Observed

Table 5.2-6 Electrofishing Results

Month	Watercourse	Species	Length (mm)*	Weight (g)
June 2020	Betty's Cove Brook**			
		Brook Trout	113	--
		American Eel	173	--
September 2020	Betty's Cove Brook**			
		Brook Trout	48	1.24
		Brook Trout	56	1.75
		Brook Trout	108	13.37
		Brook Trout	44	1.02
September 2020	WC-5			
		Brook Trout	153	41.17
		Brook Trout	122	18.77
		Brook Trout	59	2.28
		American Eel	195	10.63

*Fork length measurement (if fork present)
**Electrofishing in Betty's Cove Brook was not within the ROW

5.2.6 Species at Risk

Available information on the known occurrence of floral and faunal SAR and Species of Conservation Interest (SOCI) in the LSA was compiled and reviewed to determine their presence relative to the Project footprint. Sources included published and unpublished listings of occurrences of such species and these are described below.

Under the federal SARA, the listing process begins with a species assessment that is conducted by COSEWIC. SARA uses the COSEWIC scientific assessment when making the listing decision. Once a species is added to Schedule 1 it benefits from all the legal protection afforded, and the mandatory recovery planning required under SARA. The Act provides federal legislation to prevent wildlife species from becoming extinct and to provide for their recovery. The status of species protected under SARA can be found at the Species at Risk Public Registry (Government of Canada, 2020).

NS provides additional species protection through its own NSESA. For species listed under the NSESA the conservation and recovery of SAR is coordinated by the Wildlife Division of NS Lands and Forestry.

The ACCDC is part of the NatureServe network, a non-government agency which maintains conservation data for the Atlantic Provinces. An information request was submitted to the ACCDC on the 17th of August, 2020, for a list of occurrences of rare and endangered flora and fauna within and near the proposed Study Area (Appendix I). S1, S2, and S3 ranked species are considered extremely rare to uncommon within its range in the Province. S4 and S5 ranked species are considered widespread and their occurrences are fairly common to abundant.

SAR and SOCI can be found in numerous taxonomic groups; including lichens, vascular plants, molluscs, odonates, butterflies, fish, amphibians, reptiles, mammals, and birds. Following is a brief description of

species that are federally or provincially listed that have been confirmed during field surveys for the Realignment.

Four terrestrial fauna species (excluding birds) have been identified in the LSA. The Little Brown Myotis (*Myotis lucifugus*), Northern Long-Eared Myotis (*Myotis septentrionalis*) and a bat species presumed to be a Hoary Bat (*Vespertilionidae* sp.) are all listed as Endangered by SARA, COSEWIC, and NSESA. The Mainland Moose is listed as Endangered by NSESA. A complete list of terrestrial fauna SAR and SOCI is attached in Table I-1, Appendix I.

Three avian species have been identified in the LSA. The Short-eared Owl (*Asio flammeus*) is listed as Special Concern by SARA and COSEWIC. The Canada Warbler (*Cardellina canadensis*) and Barn Swallow (*Hirundo rustica*) are listed as Threatened by SARA and COSEWIC and Endangered by NSESA. Of note, no suitable nesting habitat for the Short-eared Owl was observed in the ROW. A complete list of avian SAR and SOCI is attached in Table I-2, Appendix I.

A single plant species at risk was identified in the PDA. The Blue Felt Lichen is listed as Special Concern by SARA and COSEWIC and Vulnerable by NSESA. A complete list of vascular and non-vascular plant SAR and SOCI is attached in Table I-3, Appendix I.

A single aquatic species at risk was identified in the LSA. The Atlantic Salmon (*Salmo salar*) (Southern upland population) is listed as Endangered by COSEWIC. Atlantic salmon habitat was not noted in any of the watercourses within the ROW. A complete list of aquatic SAR and SOCI is attached in Table 1-4; Appendix I.

LEGEND:

- Avifauna Point Counts
- Highway 316 Realignment ROW
- Highway 316 Realignment
- Roads
- Watercourse
- LNG Wharf and Jetty
- LNG Facility Footprint
- Proposed Temporary Work Camp/Laydown

0 125 250 500 750 1,000

Meters

The map shown here has been created with all due and reasonable care and is strictly for use with Wood. Project Number: TE201007. This map has not been certified by a licensed land surveyor, and any third party use of this map comes without warranties of any kind. Wood. assumes no liability, direct or indirect, whatsoever for any such third party or unintended use.

CLIENT:

PIERIDAE ENERGY (CANADA) LIMITED

wood.

PROJECT:

ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

GOLDBORO LNG

TITLE:

AVIFAUNA FIELD SURVEYS

DATUM:	DWN BY:	DATE:
NAD 83	CM	FEB 2021
PROJECTION:	CHK'D BY:	SCALE:
UTM ZONE 20 NORTH	BM	1:15,000
PROJECT NO:	REV NO:	FIGURE NO:
TE201007	1	FIGURE 5.2-1

Path: G:\5290 PROJECTS\2020\TE201007_Pieridae_Energy_Goldboro_LNG\GIS\MXD\500_100 EA REPORT\TE201007_FIGURE_5_2-1_AvifaunaPointCounts.mxd User: candace.macdonald Date: 2/26/2021

LEGEND:

- Bat Detector
- 2020 Moose and Other Wildlife Observations
- Moose Transect Survey - May 2020
- Moose Transect Surveys - March & May 2019
- Moose Transect Survey - Dec 2018
- Highway 316 Realignment ROW
- Highway 316 Realignment
- Roads
- Watercourse
- LNG Facility Footprint
- Proposed Temporary Work Camp/Laydown

0 125 250 500 750 1,000

Meters

CLIENT:

PIERIDAE ENERGY (CANADA) LIMITED

wood.

PROJECT:

ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

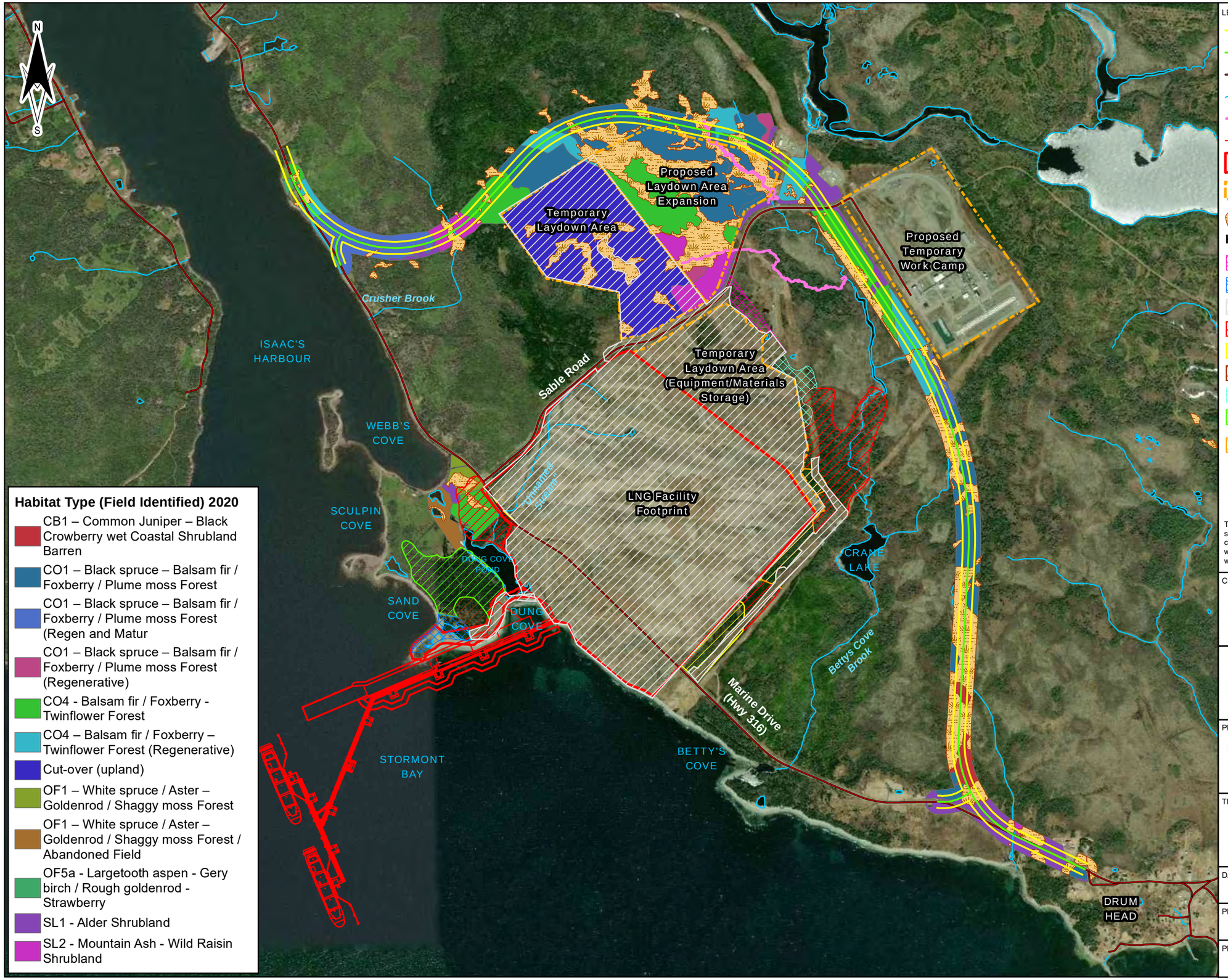
GOLDBORO LNG

TITLE:

FAUNA SURVEY LOCATIONS

DATUM:	DWN BY:	DATE:
NAD 83	CM	FEB 2021
PROJECTION:	CHK'D BY:	SCALE:
UTM ZONE 20 NORTH	BM	1:17,500
PROJECT NO:	REV NO:	FIGURE NO:
TE201007	1	FIGURE 5.2-2

Path: G:\5290 PROJECTS\2020\TE201007_Pieridae_Energy_Goldboro_LNG\GIS\MXD\500_100 EA REPORT\TE201007_FIGURE_5_2-2_Faunal_Survey_Locations.mxd User: candace.macdonald Date: 2/26/2021



Habitat Type (Field Identified) 2020

- CB1 – Common Juniper – Black Crowberry wet Coastal Shrubland Barren
- CO1 – Black spruce – Balsam fir / Foxberry / Plume moss Forest
- CO1 – Black spruce – Balsam fir / Foxberry / Plume moss Forest (Regen and Matur
- CO1 – Black spruce – Balsam fir / Foxberry / Plume moss Forest (Regenerative)
- CO4 - Balsam fir / Foxberry - Twinflower Forest
- CO4 – Balsam fir / Foxberry – Twinflower Forest (Regenerative)
- Cut-over (upland)
- OF1 – White spruce / Aster – Goldenrod / Shaggy moss Forest
- OF1 – White spruce / Aster – Goldenrod / Shaggy moss Forest / Abandoned Field
- OF5a - Largetooth aspen - Gery birch / Rough goldenrod - Strawberry
- SL1 - Alder Shrubland
- SL2 - Mountain Ash - Wild Raisin Shrubland

LEGEND:

- Hwy 316 Road Realignment ROW
- Hwy 316 Road Realignment
- Roads
- Watercourse
- Field Verified Streams (2020)
- LNG Wharf and Jetty
- LNG Facility Footprint
- Proposed Temporary Work Camp/Laydown
- Field Identified Wetland (2020)

Habitat Type

- Alder
- Barren
- Cleared Land
- Coniferous Forest
- Disturbed Regenerating
- Ericaceous Shrubs Barren
- Tall Shrubs
- White Spruce Forest
- Young (Regenerating) Coniferous Forest

0 125 250 500 750 1,000
Meters

CLIENT:

PIERIDAE ENERGY (CANADA) LIMITED

wood.

PROJECT:

ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

GOLDBORO LNG

TITLE:

ENVIRONMENTAL FEATURES

DATUM:	DWN BY:	DATE:
NAD 83	CM	FEB 2021
PROJECTION:	CHK'D BY:	SCALE:
UTM ZONE 20 NORTH	BM	1:15,000
PROJECT NO:	REV NO:	FIGURE NO:
TE201007	1	FIGURE 5.2-3

Path: G:\5290 PROJECTS\2020\TE201007_Pieridae_Energy_Goldboro_LNG\GIS\MXD\500_100 EA REPORT\TE201007_FIGURE_5_2-3_EnvironmentalFeatures.mxd User: candace.macdonald Date: 2/25/2021

LEGEND:

- Blue Felt Lichen
- Hwy 316 Realignment
- Raw Water Supply Pipeline
- Roads
- Watercourse
- Lake
- LNG Wharf and Jetty
- LNG Facility Footprint
- Blue Felt Lichen 100 m Buffer
- Proposed Temporary Work Camp/Laydown Areas
- Field Identified Wetland (2020)
- Inferred Wetland
- Cut Area
- Fill Area

0 125 250 500 750 1,000

Meters

The map shown here has been created with all due and reasonable care and is strictly for use with Wood. Project Number: TE201007. This map has not been certified by a licensed land surveyor, and any third party use of this map comes without warranties of any kind. Wood. assumes no liability, direct or indirect, whatsoever for any such third party or unintended use.

CLIENT:

PIERIDAE ENERGY (CANADA) LIMITED

wood.

PROJECT:

ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

GOLDBORO LNG

TITLE:

WETLAND HABITAT

DATUM:	DWN BY:	DATE:
NAD 83	CM	FEB 2021
PROJECTION:	CHK'D BY:	SCALE:
UTM ZONE 20 N	BM	1:17,500
PROJECT NO:	REV NO:	FIGURE NO:
TE201007	1	FIGURE 5.2-4

Path: G:\5290 PROJECTS\2020\TE201007_Pieridae_Energy_Goldboro_LNG\GIS\MXD\500_100 EA REPORT\TE201007_FIGURE_5_2-4_WetlandHabitat.mxd User: candace.macdonald Date: 2/26/2021

LEGEND:

- Benthic Sample Location
- Flow Sampling Location
- Electrofishing Site
- Hwy 316 Road Realignment
- Hwy 316 Road
- Roads
- Watercourse
- Field Verified Streams (2020)
- LNG Wharf and Jetty
- LNG Facility Footprint
- Proposed Temporary Work Camp/Laydown Areas

0 125 250 500 750 1,000
Meters

CLIENT:

PIERIDAE ENERGY (CANADA) LIMITED

wood.

PROJECT:

ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

GOLDBORO LNG

TITLE:

WATERCOURSE CROSSINGS

DATUM:	DWN BY:	DATE:
NAD 83	CM	FEB 2021
PROJECTION:	CHK'D BY:	SCALE:
UTM ZONE 20 N	BM	1:15,000
PROJECT NO:	REV NO:	FIGURE NO:
TE201007	1	FIGURE 5.2-5

Path: G:\5290 PROJECTS\2020\TE201007_Pieridae_Energy_Goldboro_LNG\GIS\MXD\500_100 EA REPORT\TE201007_FIGURE_5_2-5_WatercourseCrossings.mxd User: candace.macdonald Date: 2/26/2021

5.3 Socio-Economic Environment

The County of Guysborough has a population of 7625; the County of Antigonish has 19,301. The MODG, where the Project area is located, is one of two municipalities in Guysborough. It is comprised of 2,116.86 km^2, has a population of 4,670 (StatsCan, 2016) and a population density of 2.21 persons per km^2.

The Project area communities are mostly small hamlets consisting of few homes, a gas station, and a general store which service a greater population that is distributed along the major paved roads, primarily Route 316. The main service centres for the Project area are the Towns of Guysborough and Antigonish. Guysborough is located 40 km northeast of Goldboro and is the main service-oriented area for the Municipality. There are no major industries located in the Town; however, it does provide many services, both government and private, for its residents. The Town is home to the Municipal Building, court facilities, a hospital and rest home complex, and a small shopping mall.

The Town of Antigonish is located 70 km northwest of Goldboro. It is home to the only university in the Project area (St. Francis Xavier University) and has many associated services including a regional health centre (St Martha's Regional Hospital), hotels and motels, restaurants, and a large centre suitable for conventions, sporting events, and cultural activities.

5.3.1 Land Use

Goldboro and the surrounding communities, as well as municipal infrastructure and services, were described in detail in the Goldboro LNG EA Report (AMEC, 2013). Since then, land use characteristics in the area have remained unchanged except for the former ExxonMobil gas plant. It was located immediately to the northeast of the Goldboro Facility and has now been decommissioned. Pieridae intends to use the vacated site for its temporary work camp during the LNG Project's construction phase.

The proposed new road realigns approximately 3.5 km of Marine Drive (Hwy 316) closely around the LNG Facility site. The limited number of residences located along Marine Drive are concentrated along the start and end points of the proposed Realignment. Upon completion of the Realignment, five residences along Marine Drive segments will be situated along cul-de-sacs, i.e., segments of Marine Drive that will end at the Pieridae LNG Facility site boundary. The cul-de-sacs will be approximately 1 km in length on both the eastern and western sides of the facility boundary. Water supply wells associated with the mapped residences are illustrated in Figure 5.1-9. One well, located within the former ExxonMobil gas plant site, may be used by Pieridae as an additional water supply for the temporary work camp.

An area north and west of the Goldboro LNG Project is a former gold mine. Several active mineral exploration licences are located within the area. In June 2017, Anaconda Mining Inc. commenced exploration and development activities of the Goldboro Project (Anaconda Mining, 2021).

5.3.2 Traffic Volumes

Existing traffic volume for the access route road sections was the subject of a study in 2018 (Amec Foster Wheeler, 2018). NSTIR has obtained periodic traffic count data at various locations on Trunk 7, and Routes 276 and 316 for many years, with the most recent counts obtained during May and June 2017. Historical Annual Average Daily Traffic (AADT) volume data was gathered for locations on each of those routes. AADT data were estimated for 2018 and projected for 2021 and 2027 (Table 5.3-1). Design Hourly Volumes (DHVs) on Trunk 7 were low to moderate for a primary trunk highway and volumes on Routes 276 and 316 were very low for normal collector roads. Annual volume growth rates vary from 1.7% to 2.7% for the 8 locations, with an average annual growth rate of 2.2% (Amec Foster Wheeler, 2018).

Table 5.3-1 Projected 2013, 2017, and 2024 Background DHVs

Location	2013 DHVs[1]		2017 DHVs[2]		2024 DHVs[2]	
	AM	PM	AM	PM	AM	PM
Trunk 7 – 1.0 km South of Highway 104	370	455	390	480	430	530
Trunk 7 – 1.0 km South of Salt Springs	22	225	235	260	260	265
Route 276 – Halfway Trunk 7 and Route 316	55	65	60	65	65	70
Route 316 – 1.0 km South of Route 276	50	65	55	60	60	75
Route 316 – 1.5 km north of Isaac's Harbour	40	65	40	45	45	75

1. 2013 DHVs have been estimated by increasing average AM and PM peak hour volumes from 2008 or 2011 machine counts by 10% and a 1.5% annual traffic volume growth factor.
2. 2017 and 2024 DHVs have been estimated using the 2013 values increased by 1.5% per year.

Existing 2013 background DHVs on Trunk 7 are considered low to moderate for a primary trunk highway, and volumes on Routes 276 and 316 very low for a normal collector road. Review of traffic count data indicates that, while volumes have generally reduced since the completion of the 2007 study (Atlantic Road & Traffic Management (ARTM), 2007), an annual traffic volume growth rate of 1.5% is still considered to be appropriate to Project future background DHVs. As a comparison, annual average daily traffic volumes for busy two-lane roads ranged between 6,800 and 15,300 vehicles per day (AMEC, 2013).

5.3.3 Land Ownership and Zoning

Property owners affected by the Realignment include the MODG, NSDNR (provincial Crown land), ExxonMobil Canada Properties (to be taken over by Pieridae) and Nova Scotia Power Inc. (the portion of realigned highway will no longer run through the property) (Figure 5.3-1). Two natural gas pipeline ROWs, held by Encana and ExxonMobil, are located on municipal land. Private properties (either vacant or with country-side homes) are located around the start and end points of the Realignment. Once the Realignment is established, some properties along Marine Drive will no longer have direct access to Hwy 316; they will be situated on a cul-de-sac.

All property owners/stakeholders are aware of the proposed Road Realignment by NSTIR. The western part of the Road Realignment together with the Goldboro LNG Facility lands are located within the Municipality's designated Goldboro Industrial Park (Figure 5.3-2). The privately owned vacant or residential lands are zoned "Coastal Community" or "Mixed Use Rural Residential".

5.3.4 First Nations Communities

As described in the Goldboro LNG EA Report (AMEC, 2013), no First Nations communities (Reserves) are located in or near the Goldboro LNG site and proposed Realignment. The nearest mainland First Nation (Mi'kmaq) community is Paq'tnkek First Nation (in Afton, NS), which is located 77 km north of Goldboro in Antigonish County near Heatherton. Band members from the Paq'tnkek, Millbrook and Indian Brook First Nations are known to have also been involved in resource harvesting in the lands and waters near the ROW.

A Mi'kmaq Ecological Knowledge Study (MEKS) was prepared for the EA for the proposed Goldboro LNG Facility (AMEC 2013). It highlights the Mi'kmaq nation's long-standing relationship with, and attachment to, the region in and around Goldboro, NS. The region holds historical significance to the Mi'kmaq nation and to the development of relationships between European settlers and the Mi'kmaq. While the Goldboro area is not home to present day Mi'kmaq communities, it was in this region that Mi'kmaq demonstrated local hunting, trapping and gathering practices to newcomers; thus fostering a lasting relationship of peace

and friendship with the French, and eventually other European inhabitants of the Eskikewa'kik area. This intimate relationship between the Mi'kmaq and the region is demonstrated with the extensive awareness of flora and fauna resources in the Project area despite the interruption in use of the area due to development and national Aboriginal policies. The existence of numerous species of plants, fish, and game in the Project area that are known to be culturally significant to Mi'kmaq is evidence that the site was likely used by the ancestors of today's local Mi'kmaq communities (AMEC 2013).

The MEKS concludes that presently the involvement of Band members in the Goldboro area is limited but there may be a future interest in fishing, hunting and possibly gathering in the Project area as land-use changes, and urbanization and other developments impact areas currently used by Mi'kmaq hunters and fishers.

Since the EA for the Goldboro Project was approved in 2014, Pieridae has been continuously in close contact with the Kwilmu'kw Maw-klusuaqn Negotiation Office (KMKNO) to engage Mi'kmaq communities in the development of the Goldboro LNG Project. This has included information exchange related to the proposed Realignment. The exchange occurred in direct communication with KMKNO and through the regular meetings of the Community Liaison Committee (CLC) and the Fisheries Advisory Committee (FAC) - both of which the KMKNO is a member. The two committee were established for the Goldboro LNG Project in 2014 and address all of Pieridae's development proposals. Through this communication, no updates on traditional uses of lands and resources related to the Realignment have been obtained.

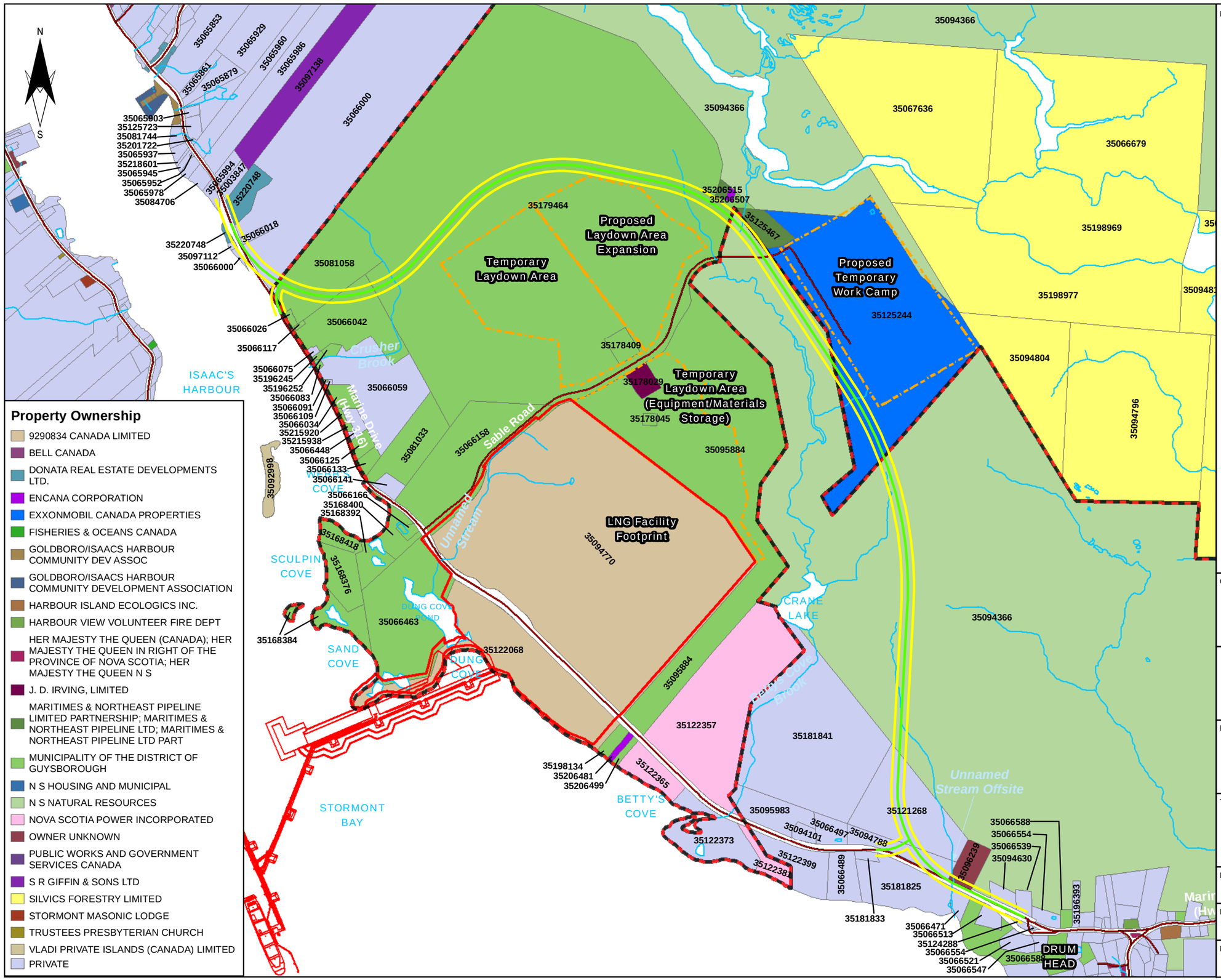
5.3.5 Heritage/Archaeological Resources

Extensive heritage/archaeological investigations have been undertaken for the Goldboro LNG Project and in its immediate vicinity (Wood, 2019a; AMEC, 2014; Davis Archaeological Consultants Ltd. (DAC), 2010, 2009, 2008, 2007a, 2007b, 2004, 1999; Niven, 2001; Niven et al., 2001; and Washburn & Gillis 1998). The findings have been documented in the Goldboro LNG EA Report (AMEC, 2013) and subsequent archaeological research reports generated in response to the Goldboro LNG EA Conditions of Approval. Key features identified within and near the Goldboro LNG site are shown in Figure 5.3-3 and have been described in detail in the Goldboro EA Report (AMEC, 2013).

The proposed Realignment ROW has not been included in previous heritage / archaeological studies and therefore has undergone a preliminary Archaeological Resources Impact Assessment (ARIA) desktop review. The objective of the review was to determine whether the area along the Realignment ROW has been previously investigated or whether it may require additional heritage/archaeological investigations. The desktop research also investigated the corridor for both known (registered) resources and elevated potential areas (EPAs) for archaeological resources. The full preliminary ARIA report can be found in Appendix H. It describes the desktop review, presents findings and offers recommendations for next steps for the archaeological program for the Realignment.

Based solely on the desktop review, without field verification, no registered heritage / archaeological resources were identified within the Realignment ROW. However, eight areas with moderate potential for undiscovered archaeological resources are within the proposed ROW. These EPAs are associated with all mapped watercourses, which have potential for Indigenous resources and with possible historic mining sites within one section of the proposed Realignment ROW (Church, 1876). The remainder of the ROW exhibits low archaeological potential for Indigenous and historic archaeological resources.

Based on the preliminary desktop review, recommendations have been made for further investigations and characterization of archaeological resources (Appendix J).



Property Ownership

- 9290834 CANADA LIMITED
- BELL CANADA
- DONATA REAL ESTATE DEVELOPMENTS LTD.
- ENCANA CORPORATION
- EXXONMOBIL CANADA PROPERTIES
- FISHERIES & OCEANS CANADA
- GOLDBORO/ISAACS HARBOUR COMMUNITY DEV ASSOC
- GOLDBORO/ISAACS HARBOUR COMMUNITY DEVELOPMENT ASSOCIATION
- HARBOUR ISLAND ECOLOGICS INC.
- HARBOUR VIEW VOLUNTEER FIRE DEPT
- HER MAJESTY THE QUEEN (CANADA); HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF NOVA SCOTIA; HER MAJESTY THE QUEEN N S
- J. D. IRVING, LIMITED
- MARITIMES & NORTHEAST PIPELINE LIMITED PARTNERSHIP; MARITIMES & NORTHEAST PIPELINE LTD; MARITIMES & NORTHEAST PIPELINE LTD PART
- MUNICIPALITY OF THE DISTRICT OF GUYSBOROUGH
- N S HOUSING AND MUNICIPAL
- N S NATURAL RESOURCES
- NOVA SCOTIA POWER INCORPORATED
- OWNER UNKNOWN
- PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
- S R GIFFIN & SONS LTD
- SILVICS FORESTRY LIMITED
- STORMONT MASONIC LODGE
- TRUSTEES PRESBYTERIAN CHURCH
- VLADI PRIVATE ISLANDS (CANADA) LIMITED
- PRIVATE

LEGEND:

- Highway 316 Realignment ROW
- Highway 316 Realignment
- Roads
- Watercourse
- LNG Wharf and Jetty
- LNG Facility Footprint
- Proposed Temporary Work Camp/Laydown
- Goldboro Industrial Park

0 125 250 500 750 1,000

Meters

CLIENT:

PIERIDAE ENERGY (CANADA) LIMITED

PROJECT:

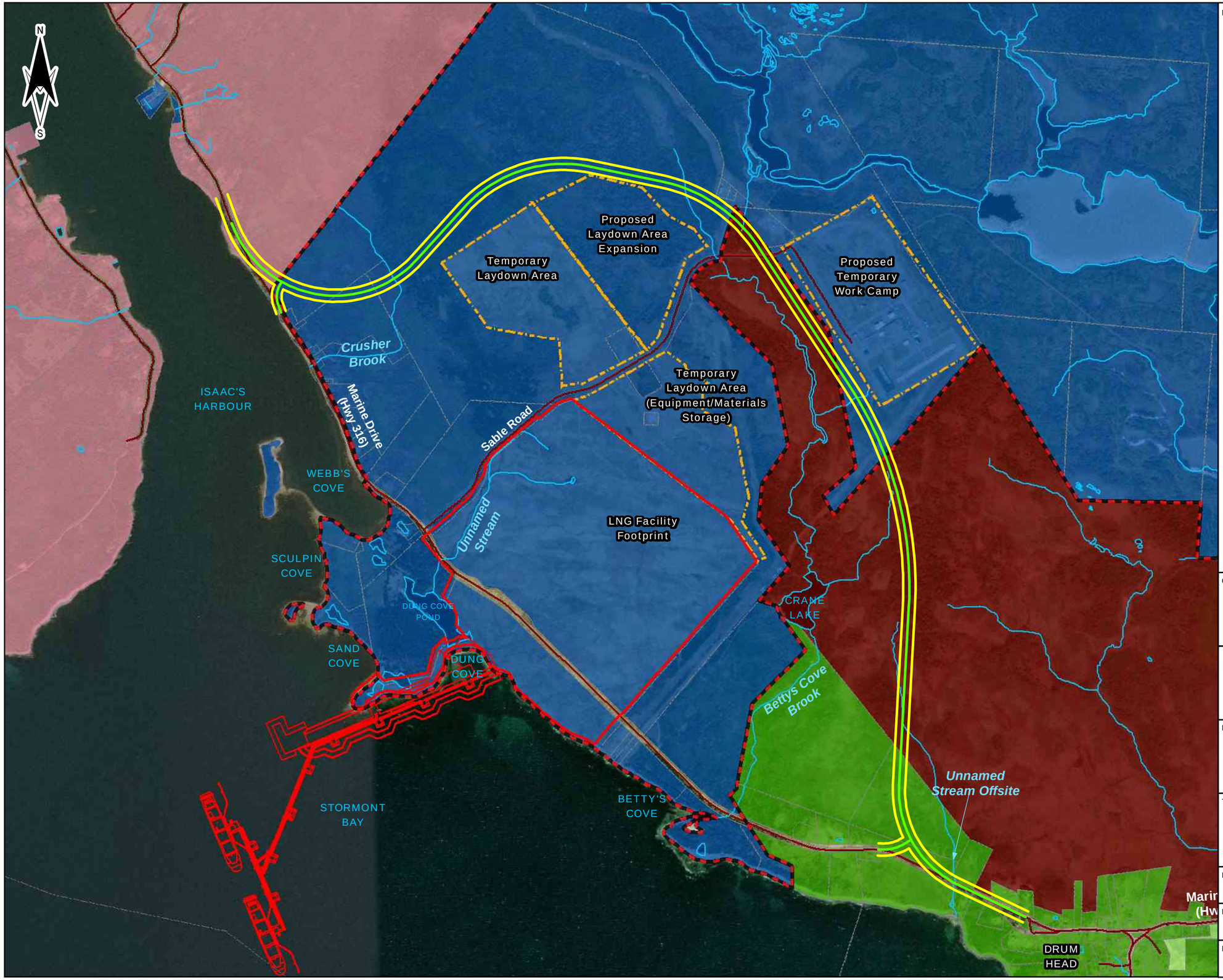
ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

TITLE:

PROPERTY OWNERSHIP

DATUM:	DWN BY:	DATE:
NAD 83	CM	FEB 2021
PROJECTION:	CHK'D BY:	SCALE:
UTM Zone 20 North	BM	1:15,000
PROJECT NO:	REV NO:	FIGURE NO:
TE201007	1	FIGURE 5.3-1

Path: G:\5290 PROJECTS\2020\TE201007_Pieridae_Energy_Goldboro_LNG\GIS\MXD\500_100 EA REPORT\TE201007_FIGURE_5_3-1_PropertyOwnership.mxd User: candace.macdonald Date: 2/26/2021



LEGEND:

- Highway 316 Realignment ROW
- Highway 316 Realignment
- Roads
- Watercourse
- LNG Wharf and Jetty
- LNG Facility Footprint
- Proposed Temporary Work Camp/Laydown
- Goldboro Industrial Park

Land Zoning - Municipality of the District of Guysborough

- Coastal Community
- Industrial
- Mixed Use Rural Residential
- Natural Resource and Conservation
- Natural Resources

0 125 250 500 750 1,000
Meters

The map shown here has been created with all due and reasonable care and is strictly for use with Wood. Project Number: TE201007. This map has not been certified by a licensed land surveyor, and any third party use of this map comes without warranties of any kind. Wood. assumes no liability, direct or indirect, whatsoever for any such third party or unintended use.

CLIENT:

PIERIDAE ENERGY (CANADA) LIMITED

wood.

PROJECT:

ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

GOLDBORO LNG

TITLE:

LAND ZONING

DATUM:	DWN BY:	DATE:
NAD 83	CM	FEB 2021
PROJECTION:	CHK'D BY:	SCALE:
UTM Zone 20 North	BM	1:15,000
PROJECT NO:	REV NO:	FIGURE NO:
TE201007	1	FIGURE 5.3-2

Path: G:\5290 PROJECTS\2020\TE201007_Pieridae_Energy_Goldboro_LNG\GIS\MXD\500_100 EA REPORT\TE201007_FIGURE_5_3-2_Zoning.mxd User: candace.macdonald Date: 2/26/2021

LEGEND:

- Heritage Resource
- Highway 316 Realignment ROW
- Highway 316 Realignment
- Roads
- Watercourse
- LNG Wharf and Jetty
- LNG Facility Footprint
- Proposed Temporary Work Camp/Laydown

0 125 250 500 750 1,000

Meters

CLIENT:

PIERIDAE ENERGY (CANADA) LIMITED

wood.

PROJECT:

ENVIRONMENTAL ASSESSMENT - REALIGNMENT OF MARINE DRIVE (HIGHWAY 316)

GOLDBORO LNG

TITLE:

HERITAGE RESOURCES

DATUM:	DWN BY:	DATE:
NAD 83	CM	FEB 2021
PROJECTION:	CHK'D BY:	SCALE:
UTM ZONE 20 NORTH	BM	1:15,000
PROJECT NO:	REV NO:	FIGURE NO:
TE201007	1	FIGURE 5.3-3

Path: G:\5290 PROJECTS\2020\TE201007_Pieridae_Energy_Goldboro_LNG\GIS\MXD\500_100 EA REPORT\TE201007_FIGURE_5.3-3_HeritageResources.mxd User: candace.macdonald Date: 2/26/2021

SECTION 6.0
ENVIRONMENTAL EFFECTS ASSESSMENT AND MITIGATION

GOLDBORO LNG

6.0 Environmental Effects Assessment and Mitigation

6.1 Groundwater Resources

Groundwater resources were identified as a VEC based on the potential for adverse effects on water supply wells as a result of blasting and excavation during road construction.

6.1.1 Significance Definition

The significance of effects on groundwater resources is evaluated by considering potential effects of Project-related activities on well water quantity and quality. A change in water well yields that result in a long-term reduction in water supply at a receiver location is considered a significant effect. Project-related effects to well water quality resulting in values outside of the GCDWQ (Health Canada, 2020 rev.) is also considered a significant effect.

6.1.2 Potential Interactions and Effects

Water wells located near the Realignment are shown in Figure 5.1-9. Blasting activities and excavations could alter the groundwater regime and adversely impact baseflow to watercourse and well water supply. The magnitude and significance of effects are dependent upon:

- the exact locations and nature of the source;
- well type;
- nature of the surficial and bedrock geology present between the source and the well; and
- distance to the well.

Construction Phase

Potential Project-related adverse effects of construction on water supply wells include:

- temporary siltation (for dug and drilled wells) and possible permanent reduction in well yield (for drilled wells) from damages due to blasting and vibration; and
- water level reductions during and after construction (dug well effects) due to trenching, site drainage and large cuts or changes in surface topography.

The potential for adverse effects to well water supply is expected to be a function of the construction methods, as well as the well characteristics, distance from the Project footprint, overburden thickness and the hydraulic properties of the soil and bedrock. The approach to the road construction is described in Section 2.7 and includes specific designs and construction methods.

Direct effects to groundwater quantity could also result in indirect effects on surface waterbodies such as stream dewatering, which may be caused by deep and/or large-scale site drainage.

Operation and Maintenance Phase

Operation and maintenance may result in Project-related effects on groundwater quality, primarily associated with potential chemistry changes from salt intrusion to downgradient wells due to uncontrolled road runoff. NSTIR does not apply herbicides for vegetation management and will therefore not be addressed.

The potential for the above operation-related adverse effects on water supply wells is expected to be a function of well type, age of the well, well construction method, distance from the site boundaries,

overburden thickness, and hydraulic properties of the soil and bedrock.

6.1.3 Mitigation Measures

The following documentation is applicable for both construction and operation/maintenance phases of the Project. They offer specific guidance for the mitigation measures.

- Standard Specification; Highway Construction and Maintenance (NSTIR, 1997 and revisions); and
- Generic EPP for the Construction of 100 Series Highways (NSTIR 2007).

Contamination

The following mitigation measures will be implemented to minimize potential adverse effects to groundwater due to contamination during Project construction and operation/maintenance:

- Adhere to Project design to minimize trenching, site drainage and large cuts or changes in surface topography.
- Develop and adhere to Project-specific EPP.
- Use mechanical vegetation control where possible and limit use of herbicides (avoid use if possible). Herbicides can be used only under the guidance of NSTIR's Integrated Roadside Vegetation Maintenance (IRVM) program. No pesticides can be used.
- Follow NSTIR's Salt Management Plan during winter road maintenance.

Sedimentation

The following mitigation measures will be implemented to minimize potential adverse effects to groundwater due to sedimentation during Project construction and operation/maintenance:

- Avoid blasting to the extent possible within 500 m of residential wells.
- Use ripping techniques as an alternative to blasting where possible.
- Conduct a pre-blast survey of potable water wells within 500 m of a blast site.
- Monitor and implement remedial action as necessary to restore damaged wells and/or provide temporary potable water as needed.
- Install sediment and erosion control measures as outlined in guidance documents and/or permit approvals.
- Undertake regular inspection of sediment and erosion control measures to ensure they have remained in place and are working properly.
- Monitor and implement local remedial actions as necessary to restore damaged wells.
- Limit removal of riparian zone vegetation.
- Adhere to applicable federal and provincial regulations and conditions of authorization.

6.1.4 Residual Effects and Determination of Significance

The effects on groundwater quality and quantity in the Project area caused by the construction, operation and maintenance of the Realignment are not expected to be significant. Table 6.1-1 summarizes the residual environmental effects for groundwater resources.

Table 6.1-1 Residual Effects - Groundwater Resources

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Residual Environmental Effects					Residual Effects, Significance**
			Magnitude*	Geographic Extent	Duration / Frequency	Reversibility (R=reversible NR=Non-reversible)	Ecological / Social-cultural and Economic Context	
Construction								
Siltation of dug and drilled wells and possible permanent change in water quality or well yield of drilled wells from blasting and vibrations.	A	• Avoid blasting to the extent possible within 500m of residential wells. • Pre-blast well survey. • Remedial action as necessary to restore damaged wells and/or provide temporary potable water as needed.	Low	Approximately max 500 m around blast site.	Construction Phase Temporary (dug and drilled wells) Possibly permanent (drilled)	R/NR	• Predominantly vacant Project site; sparsely populated area; 13 drilled wells in community of Goldboro.	Minor, not significant
Water level reductions in dug wells as a result of trenching, site drainage, and large cuts or changes in surface topography.	A	• Monitoring and remedial action as necessary to restore damaged wells and/or provide temporary potable water as needed.	Low	Approximately out to 500 m around blast site.	Construction Phase	NR	• Predominantly vacant Project site; sparsely populated area; 13 drilled wells in community of Goldboro.	Minor, not significant
Contamination of wells and/or on-site streams from road salting and vegetation management (herbicides)	A	• Use mechanical vegetation control where possible and limit use of herbicides. • Follow NSTIR's Salt Management Plan during winter road maintenance	Low	Wells in close proximity (<100 m) to road	Operation and Maintenance	R	• 13 drilled wells in community of Goldboro.	Minimal, not significant

Notes:
* For definition of levels of magnitude (high, moderate, low, nil, unknown) refer to Section 3.0
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 3.0

6.2 Surface Water Resources

Surface water was identified as a VEC based on the effects that construction, operation and maintenance may have on surface waterbodies, watercourses, and wetlands within and adjacent to the road corridor. Effects on fish and fish habitat are further discussed in Section 6.9.

The principal interactions between the Project activities and surface waters are associated with effects to:

- surface water quality (total suspended solids (TSS) due to land disturbance during construction and effects during operation and maintenance activities (road salting);
- surface water quantity due to stormwater discharge during the construction, operation and maintenance phases of the Project; and
- surface water quantity due to changes in groundwater flows as a result of excavation work.

6.2.1 Significance Definition

The CCME Guidelines for FAL (CCME, 2007) recommend the following:

- TSS concentration in surface waters should not increase by more than 25 milligrams per litre (mg/L) for any short-term exposure (i.e., 24-hour period) with a maximum average increase of 25 mg/L from background levels for longer term exposures (i.e., inputs lasting between 24 hours and 30 days).
- TSS concentration in surface waters should not increase by more than 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L. When background levels are greater than or equal to 250 mg/L, TSS concentration should not increase more than 10% of background levels.

Section 36(3) of the *Fisheries Act* states that "no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish or in any place under any conditions where the deleterious substance or any other deleterious substance that results from the deposit of the deleterious substance may enter any such water".

The NS *Environment Act* promotes the protection and prudent use of the environment and includes the goal of maintaining the principles of sustainable development. The Watercourse Alteration Program pursuant to the *Environment Act* has an objective to protect aquatic habitat from unmitigated works in or near watercourses and wetlands.

Based on the above, a significant adverse residual environmental effect on the aquatic environment is defined as a Project-related environmental effect that:

- results in the deposition of a deleterious substance (under Section 36(3) of the *Fisheries Act*) into the aquatic environment; and
- results in the exceedance of water quality guidelines outlined in the conditions of approval.

A positive effect is one that enhances the quality or area of habitat or increases species diversity.

6.2.2 Potential Interactions and Effects

The construction, operation and maintenance of the Realignment may result in adverse effects on surface water quality and quantity. DFO has developed Pathways of Effects (PoE) diagrams (DFO, 2014) to identify stressors which ultimately lead to effects in the aquatic environment. PoEs that may be relevant to the proposed project include:

- addition or removal of aquatic or riparian vegetation;
- placement of material or structures in water;
- use of industrial equipment; and
- use of explosives.

The relevant effects identified by these PoEs are discussed below in context of the construction, operation and maintenance phases of the Project.

Construction Phase

The principal interactions between construction activities and surface waters are associated with:

- the clearing of vegetation and earthworks including grubbing and stripping topsoil and overburden;
- the placement of excess material in temporary stockpiles which may be susceptible to erosion and result in sedimentation of watercourses adjacent to the site;
- installation of culverts;
- use of heavy equipment adjacent to watercourses;
- blasting and the potential exposure of acid generating rock; and
- excavations impacting the groundwater environment and indirectly affecting flow regimes in watercourses.

The primary effects of these interactions on surface water quality are the introduction of excess sediment and contaminants such as POLs to the watercourse.

Sedimentation resulting from erosion of the stream bank as well as riparian zone soils and rocks can affect physical processes, structural attributes, and ecological conditions such as water clarity (by reducing visibility and sunlight as well as damaging fish gills) and reducing the availability and quality of spawning / rearing habitat (through infilling) (DFO, 2014). Sources of sedimentation include the use of mechanized equipment in or near the watercourse, the removal of vegetation in the riparian zone and the disturbance of substrate during culvert installation.

An increase in concentrations of contaminants in sediments and waters can result in exceedance of the ranges of chemical parameters that support healthy aquatic communities. Effects on fish and fish habitat can include direct fatality to organisms; alteration of the ecosystem structure through changes in the abundance, composition, and diversity of communities and habitats; and persistence and progressive accumulation in sediments or biological tissues. Deformities, alterations in growth, reproductive success, and competitive abilities can result (DFO, 2014). Contaminant sources include ARD, releases from equipment used during construction and POLs stored onsite to fuel and service that equipment.

Operation and Maintenance Phase

The principal interactions between operation and maintenance activities and surface waters are associated with:

- winter road salting and sanding;
- culvert maintenance;
- vegetation maintenance; and
- storm water run-off.

The primary effects of these interactions on surface water quality are the introduction of excess sediment and contaminants to the watercourse. The effects of sedimentation are discussed in Section 6.2. Sources of potential sedimentation include run-off of sand (if used) from winter road maintenance as well as the use of equipment used for vegetation control and in-stream culvert maintenance (very rare).

The effects of contaminant introduction to the watercourse are discussed in Section 6.2. Sources of potential contamination include run-off of chlorides used in winter road maintenance, POLs from equipment used for vegetation or culvert maintenance and POLs from automobile fluids in storm-water runoff.

No disturbance of acid generating rock is anticipated during operation and maintenance.

6.2.3 Mitigation Measures

The following documentation is applicable for both construction and operation / maintenance phases of the Project. They offer specific guidance for the mitigation measures below.

- Nova Scotia Watercourse Alterations Standard (NSE, 2015a).
- Standard Specification; Highway Construction and Maintenance (NSTIR, 1997 and latest revisions).
- Generic EPP for the Construction of 100 Series Highways (NSTIR, 2007).
- Guidelines for the Protection of Fish and Fish Habitat: The Placement and Design of Large Culverts (DFO, 1998).
- Guidelines for the design of fish passage for culverts in Nova Scotia (DFO, 2015).
- Guide to Altering Watercourses (NSE, 2015b).

Sedimentation

During construction, erosion and sedimentation control measures from NSTIR's Standard Specifications and EPP will be used, including but not limited to the following actions:

- Install sediment and erosion control measures as outlined in NSTIR's Standard Specifications and EPP (Section 3.2.4) and carried out according to "*NS Watercourse Alterations Standards*" (NSE, 2015a).
- Educate all construction personnel about the Project and importance of ESC measures and plans.
- Runoff shall be controlled, and sediment will be prevented from leaving the Site at all times.
- Abide by construction monitoring / inspection programs outlined in NSTIR's EPP Section 4.

- To maintain ESC measures during construction, all installed ESC measures will be periodically inspected (especially before and after a rainfall event) and any exposed soil will be protected with either temporary or permanent covers after grading.
- Divert clean water from undisturbed areas around the Site using berms or lined channels, or carry the water across the Site in lined channels or pipes.
- Maintain sufficient staff and equipment to manage erosion and sediment control during storm events and other emergencies.
- All instream work will be carried out strictly in accordance with NSE and DFO Approvals, Terms and Conditions, and Letters of Advice.
- Erodible soils will be stabilized using slope roughening, riprap and filter fabric, or by re-establishing vegetation through seeding and rehabilitation by means of mulching, erosion control blankets, or sod, immediately after grading.
- During construction and operations / maintenance:
- limit removal of riparian zone vegetation;
- minimize the use of heavy equipment within 30 m of the watercourse; and
- adhere to federal and provincial approval conditions.

Contamination

During construction and operations / maintenance:

- Ensure that machinery arrives onsite in a clean condition and is maintained free of fluid leaks.
- Biodegradable fluids should be considered in place of petroleum products whenever possible as a standard for best practices.
- Do not dispose of petroleum products or any other deleterious substances on ground.
- Be diligent and take all necessary precautions to avoid spills and contamination of the soil (both surface and subsurface) when handling petroleum products onsite and during fueling and servicing of vehicles and equipment.
- All onsite chemicals and POLs should also be stored at a designated fueling and material storage site with secondary containment at least 30 m from any surface waters.
- No washing, fueling, or maintenance of vehicles or equipment in the vicinity of a watercourse without secondary containment.
- Ensure pumps operating within 50 m of a watercourse or wetland utilize an appropriate secondary containment system.
- Provide for training, equipment, and implementation of response procedures-based spill contingency response planning detailed in the Generic EPP.

During operations / maintenance:

- Use mechanical vegetation control where possible and avoid the use of herbicides. Herbicides can be used only under the guidance of NSTIR's IRVM program. No pesticides can be used.
- Follow NSTIR's Salt Management Plan during winter road maintenance.

6.2.4 Residual Effects and Determination of Significance

The effects on surface water quality and quantity in watercourses crossed by the Realignment that may be caused by the construction, operation and maintenance of the Realignment are not expected to be significant. Table 6.2-1 summarizes the residual environmental effects for surface water resources.

Table 6.2-1 Residual Effects – Surface Water Resources

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Residual Environmental Effects					Significance**
			Magnitude*	Geographic Extent	Duration / Frequency	Reversibility (R=reversible NR=Non-reversible)	Ecological / Social-cultural and Economic Context	
Construction								
Introduction of excess sediment into watercourses	A	• Implementation of EPP • Implementation and inspection of sediment and erosion control measures • Adherence to federal and provincial regulations	Low	Downstream of sediment introduction; full extent depends on water volume and flow	Construction phase	R	Similar habitat exists in the region Generally poor-quality aquatic habitat	Minimal, not significant
Introduction of contaminants into watercourses	A	• Proper use and storage of chemicals and POLs • Spill kits must be available onsite • Workers should be trained in spill clean-up • Adherence to federal and provincial regulations • see also measures in Section 6.14 – Accidents and Unplanned Events	Low	Downstream of contaminant introduction; full extent depends on water volume and flow	Construction phase	R	Similar habitat exists in the region Generally poor-quality aquatic habitat	Minimal, not significant
Blasting and excavations	A	• Implementation of EPP • Adherence to federal and provincial regulations	Low	LSA	Construction phase	R	Similar habitat exists in the region Generally poor-quality aquatic habitat	Minimal, not significant

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Residual Environmental Effects					Significance**
			Magnitude*	Geographic Extent	Duration / Frequency	Reversibility (R= reversible NR=Non-reversible)	Ecological / Social-cultural and Economic Context	
Operation								
Introduction of excess sediment into watercourses	A	• Adherence to federal and provincial regulations	Low	Downstream of sediment introduction; full extent depends on water volume and flow	Operation phase	R	Similar habitat exists in the region Generally poor-quality aquatic habitat	Minimal, not significant
Introduction of contaminants into watercourses	A	• Use of mechanical vegetation control and avoid use of herbicide, where practicable • Adherence to NSTIR Salt Management Plan • Adherence to federal and provincial regulations	Low	Downstream of contaminant introduction; full extent depends on water volume and flow	Operation phase	R	Similar habitat exists in the region Generally poor-quality aquatic habitat	Minimal, not significant

Notes:

* For definition of levels of magnitude (high, moderate, low, nil, unknown) refer to Section 3.0

** For definition of levels of significance (major, medium, minor, minimal) refer to Section 3.0

6.3 Atmospheric Environment

The atmospheric environment has been identified as a VEC as the use of equipment during Project construction will result in temporary, short-term dust effects and emissions of air pollutants during the construction phase.

6.3.1 Significance Definition

A significant adverse effect on air quality is defined as a condition where regulatory objectives are routinely exceeded. Contaminants of concern include TSP, $PM_{2.5}$, NO_2, and SO_2 as regulated under the NS Air Quality Regulations.

Current provincial and federal guidance documents on assessing project-related impacts on climate change do not provide guidelines for determining significance. The construction's effects on GHG and climate change is considered negligible in context to the impacts from the overall LNG facility construction and operation. An increase of vehicle traffic following completion of the Project is not anticipated; therefore the operation phase will not increase any impacts to GHG and climate change compared to the present situation.

6.3.2 Potential Interactions and Effects

Construction Phase

Emissions will be generated during the following construction activities:

- use of heavy construction equipment such as excavators, earth movers, dump trucks and graders to prepare the Site;
- use of heavy construction equipment to handle fill material including dumping, grading and compaction;
- movement of construction vehicles over unpaved road that will generate dust;
- operation of construction equipment that will generate exhaust emissions containing TSP, CO, CO_2, NO_2, SO_2 and volatile organic compounds (VOCs);
- paving the road will generate polycyclic aromatic hydrocarbons (PAHs); and
- painting lines on the road will generate VOCs.

These emissions are not anticipated to result in significant adverse effects on the air quality within the vicinity of the Project. Fugitive dust control measures are to be implemented, if required.

Operation and Maintenance Phase

Operation of the Realignment will result in localized emissions from gas and diesel fired vehicles. Assuming population and infrastructure in the area remain unchanged, the Project will not increase overall traffic and the Realignment will add a negligible increase in length compared to the existing alignment. As a result, additional impacts (including GHG) to the airshed from the operation phase are not expected.

Maintenance operations will include the use of heavy equipment for snow removal, road salt application, vegetation and road maintenance (grading, excavation, repaving and repainting). These activities may result in particulate and combustion emissions in the immediate vicinity of the Project. However, given the magnitude, frequency and duration of these activities, it is considered unlikely that these emissions will exceed regulated thresholds.

6.3.3 Mitigation Measures

The following mitigation measures will be implemented to minimize potential adverse effects on the airshed during construction, operation and maintenance of the Realignment:

- enforce speed limits for onsite vehicles during construction;
- stabilize exposed erodible material;
- ensure proper truck loading and tarping when appropriate;
- minimize drop height for material transfer points;
- apply water for dust suppression;
- ensure vehicles and equipment are maintained as per manufacturer specifications; and
- minimize vehicle idling.

6.3.4 Residual Effects and Determination of Significance

Table 6.3-1 summarizes the residual environmental effects assessment for the atmospheric environment. Impacts on air quality from the operation of the highway will occur on a localized basis resulting from emissions from gas and diesel fired vehicles that use it. The Realignment is not anticipated to increase traffic. As a result, additional impacts (including GHG) to the local airshed from the operation of the highway are predicted to be minimal due to potential change in local travel patterns, but otherwise are not expected to increase in the region.

Table 6.3-1 Residual Effects – Atmospheric Environment

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Residual Environmental Effects					Significance**
			Magnitude*	Geographic Extent	Duration / Frequency	Reversibility (R=reversible NR=Non-reversible)	Ecological / Social-cultural and Economic Context	
Construction								
Particulate emissions	A	• Adhere to the EPP to minimize particulates (e.g., onsite speed limits, minimizing loading drop height, use of dust suppressants). • If possible, schedule activities when weather conditions (winds) are favourable. • Adhere to idling restrictions. • Maintain all equipment as per manufacturer specifications.	Low	LSA and RSA	Construction phase	R	• Air Quality parameters within Regional Study Area are well below standards. • Majority of construction work (1.5 out 5 km) will occur away from developed areas.	Minimal, not significant
Contribution to GHG emissions and climate change	A	• Adhere to idling restrictions. • Maintain all equipment as per manufacturer specifications.	Low	LSA and RSA	Construction phase	NR	• Rural environment with no major existing sources for GHG emissions	Minimal, not significant
Operation								
Particulate emissions	A	• Adhere to EPP for maintenance activities that may generate particulate emissions. • Maintain all maintenance equipment as per manufacturer specifications.	Low	RSA and LSA	Operation phase	R	• Air Quality parameters within Regional Study Area are well below standards	Minimal, not significant

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Residual Environmental Effects					Significance**
			Magnitude*	Geographic Extent	Duration / Frequency	Reversibility (R=reversible NR=Non-reversible)	Ecological / Social-cultural and Economic Context	
Contribution to GHG emissions and climate change	A	• Maintain all maintenance equipment as per manufacturer specifications.	Low	LSA and RSA	Operation phase	NR	• LNG facility will be a major source for GHG emissions.	Adverse effects: Minimal, not significant

Notes:

* For definition of levels of magnitude (high, moderate, low, nil, unknown) refer to Section 3.0

** For definition of levels of significance (major, medium minor, minimal) refer to Section 3.0

6.4 Acoustic Environment

In general, the more a new sound exceeds the previously existing ambient noise level, the less acceptable the new sound will be judged by those hearing it. A new source of sound will be perceived as more aggravating in a quiet area than it would be in an area with more ambient background sound. The following empirical relationships can be helpful in understanding the quantitative changes in noise levels (Cowan, 1994):

- change of only 1 dBA in sound level cannot be perceived (no impact);
- 3 dBA change is considered a "just-noticeable" difference (low impact);
- change in level of at least 5 dBA is required before any community response would be expected (impact); and
- 10 dBA change is subjectively heard as approximately a doubling in loudness and may cause an adverse community response (significant impact).

These relationships take place in part as a result of the logarithmic nature of sound and the decibel system: two noise sources do not combine in a simple additive fashion, but rather logarithmically. For example, if two identical noise sources each produce noise levels of 50 dBA, the combined sound level would be 53 dBA, not 100 dBA.

6.4.1 Significance Definition

For the purpose of the effects assessment, a predicted noise level that exceeds the Nova Scotia Guideline sound levels during daytime or nighttime is considered a significant effect. The NSE *Guidelines for Environmental Noise Measurement and Assessment* (NSDEL, 2005) define the maximum acceptable noise levels at specific times as follows:

- Leq of 65 dBA between 0700 to 1900 hours (daytime);
- Leq of 60 dBA between 1900 to 2300 hours (evening time); and
- Leq of 55 dBA between 2300 to 0700 hours (nighttime, all day Sunday and statutory holidays).

6.4.2 Potential Interactions and Effects

Construction Phase

Construction is usually performed in a series of steps or phases, and noise associated with different phases can vary greatly. However, similarities in noise sources allow typical construction equipment to be placed into one of three categories: heavy equipment, stationary equipment, or impact equipment. In order to estimate the construction noise level, it is necessary to know the type of equipment and its acoustic specifications. At this early stage of Project development this information is unavailable; therefore, quantitative assessment of construction noise is not possible. However, given the low existing ambient noise levels, it can be assumed that construction activities will result in a temporary increase in existing noise levels.

Operation and Maintenance Phase

Traffic noise associated with operation of the Realignment will be generated by three sources: engine noise, exhaust system noise, and tire noise. Engine noise can only be controlled by vehicle manufacturers and through proper maintenance. Exhaust noise is controlled by mufflers and relies on proper maintenance by vehicle owners. Tire noise is caused by the interaction between tires and the road surface and can be

substantial at speeds over 80 km/h. Generally, the volume of traffic noise increases with the volume of traffic, with increased speeds, and when heavy trucks comprise a larger proportion of the vehicles.

The majority of the Realignment will take traffic away from current residences so no increase in noise levels from traffic are anticipated.

6.4.3 Mitigation Measures

Construction Phase

Mitigation measures that will be implemented to minimize potential noise-related adverse effects on receptors during construction of the Realignment include the following actions:

- regularly inspect and maintain construction vehicles and equipment to ensure that quality mufflers are installed and worn parts are replaced;
- restrict noise pollution by specifying and enforcing construction noise limits;
- reduce power operation – use only necessary size and power;
- enforce vehicle speed limits;
- use quieter methods and equipment when possible;
- turn equipment off when not in use if practicable;
- schedule noisy operations during daytime hours;
- specify stringent noise emission limits, including shielding and installation of quality mufflers on construction and fixed equipment;
- maintain Project roads to reduce noise associated with vibration and vehicle noise;
- enclose noisy equipment, and use baffles to reduce transmission of noise beyond the construction site;
- locate stationary equipment, such as compressors and generators, away from the noise receptors to the extent practicable;
- replace or repair parts generating excessive noise;
- educate truck drivers and mobile equipment operators about the characteristics of diesel engines (i.e., that the flat torque characteristic allows ascending an incline in a higher gear, which is a less noisy operation); and
- implement Pieridae's Noise Monitoring and Management Plan that has been developed for the construction of the Goldboro LNG site and its components.

Operation and Maintenance Phase

It is not anticipated that noise mitigation will be required for the operation phase, since noise levels are anticipated to be equal or less than current levels.

6.4.4 Residual Effects and Determination of Significance

Table 6.4-1 summarizes the residual environmental effects assessment for the acoustic environment.

Table 6.4-1 Residual Effects – Acoustic Environment

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Residual Environmental Effects					Significance**
			Magnitude*	Geographic Extent	Duration/Frequency	Reversibility (R=reversible NR=Non-reversible)	Ecological/Social-cultural and Economic Context	
Construction								
Adverse effects on acoustic environment	A	• Enforce noise limits on construction vehicle • Schedule work during daytime hours. • Adhere to idling restrictions. • Maintain all equipment as per manufacturer specifications.	Low	LSA	Construction phase	R	• Rural environment, most of the construction work will occur away from residences.	Minimal, not significant

Notes:

* For definition of levels of magnitude (high, moderate, low, nil, unknown) refer to Section 3.0

** For definition of levels of significance (major, medium minor, minimal) refer to Section 3.0

6.5 Avifauna

The Avifauna has been identified as a VEC as birds (including migratory birds) can be adversely impacted during the Realignment construction. This includes the potential for disturbance of nesting birds during clearing activities as well as the permanent loss of habitat.

6.5.1 Significance Definition

A significant adverse effect on avifauna (birds) would be one which results in contravention of MBCA, SARA or NSESA provisions; for non-SARA or non-NSESA listed priority species, a decline in abundance and/or a change in distribution beyond which natural recruitment (reproduction and immigration from unaffected areas) would not return the population to its pre-Project level within several (three to five) generations.

6.5.2 Potential Interaction and Effects

Construction Phase

The main impact on migratory birds and raptors, including priority species, will be the loss of nesting and foraging habitat. Further, vegetation clearing and grubbing activities may cause destruction of nests and nestlings or eggs if conducted during the breeding season. According to ECCC's general avoidance information for migratory birds, the Project site is located within Breeding Zone C3. In this Zone, the regional nesting period for most migratory birds covered under the MBCA extends from mid-April to the end of August (ECCC, 2018b), although it is recognized that some avian species nest outside of this period; such as corvids, owls, crossbills and waxwings. According to the Maritimes Breeding Bird Atlas (MBBA; Bird Studies Canada, 2018) and field surveys conducted along the Realignment, breeding evidence has been observed for several species within the ROW, including 23 priority species (Section 5.2.4). Approximately 18 ha of terrestrial bird habitat, consisting mainly of coniferous and mixed forest of varying ages, may be removed.

In addition to habitat loss, disturbance due to construction activities may have deleterious effects on animals in and near the Project area. Anthropogenic noise can interfere with normal avian behaviour such as feeding, migrating, and breeding. Nesting birds may be startled from their nests, resulting in decreased productivity due to increased predation of young; and to adult birds altering foraging behaviour (Beale, 2007). In addition, birds may leave the Project area and be forced to move to less favourable nesting sites (Larkin, 1996). There are few studies defining an effective distance due to noise disturbance; field studies have shown effects up to 200 m from the edge of an area of disturbance. The distance of effect is related to noise volume, frequency / duration, and quality. Negative effects from noise vary from species to species due to differences in both hearing abilities and in behavioural and physiological responses to stimuli. In addition to interspecies differences, there is considerable intraspecies variation in vulnerability to effects of noise attributable to different times of year and changing life stages (i.e., different stages of the breeding cycle) (Blumstein et al., 2005). The effects of noise onsite during construction are expected to be temporary and short-term; there will be a long-term but a lower magnitude increase in ambient noise due to traffic.

Operation and Maintenance Phase

Increased human presence associated with the operation phase is expected to result in increased populations of species that are adapted to human environments; such as European Starlings, American Robins, Common Grackles and Rock Pigeons who may compete with native woodland and forest edge birds.

Roadways are a source of anthropogenic noise and light, and as such, their presence disproportionately effects species that are not well adapted to human presence (Jacobsen, 2005). These species tend to be

replaced by species that are less subject to disturbance, such as those listed above.

6.5.3 Mitigation Measures

Construction Phase

- Limit Project footprint and temporary work areas to the extent practical.
- Clearing and grubbing should be restricted to areas necessary to complete the Realignment.
- Dust-prevention and dust abatement measures shall be implemented.
- Workers will be instructed to maintain good housekeeping practices and not leave any food items and garbage at the Project site in order to avoid attracting omnivorous predators which may disturb or cause direct mortality or injury to wildlife (including birds).
- If an Osprey, Bald Eagle or Northern Goshawk nest is found within the forested areas to be cleared, even outside the breeding season, a buffer zone must be placed around the nest and clearing can only occur outside of the buffer zone.
- To minimize interference of nesting activities from noise and human presence, workers will be encouraged to refrain from entering surrounding undisturbed habitat areas where no work is being performed since those areas likely hold the largest number of birds.
- Should impacts on migratory birds or their nests be detected during construction, further mitigation will be developed in consultation with NSDLF and ECCC.

Construction / Operation and Maintenance Phases

- All construction equipment should have appropriate noise-muffling equipment installed and in good working order to minimize noise disturbance. The duration of noise disturbance should be minimized. Lighting should be restricted to areas where it is necessary and should be shielded downwards if practical to reduce attraction of night-flying birds.
- Vegetation clearing will be avoided during the nesting season (April 10 to August 31).

6.5.4 Residual Effects and Determination of Significance

Table 6.5-1 provides a summary of recommended mitigation measures and residual environmental effects that may be anticipated after successful implementation of the above mitigation measures. With the successful implementation of the mitigation measures described above, Project activities related to construction, operation and maintenance of Project components are not likely to result in significant adverse residual adverse effects on migratory birds and raptors, including priority species.

Table 6.5-1 Residual Effects - Avifauna

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Residual Environmental Effects					Residual Effects, Significance**
			Magnitude*	Geographic Extent	Duration / Frequency	Reversibility (R=reversible NR=Non-reversible)	Ecological / Social-cultural and Economic Context	
Construction								
Loss of habitat for avifauna	A	• Minimize Project footprint. • Use existing access routes to the ROW when possible.	Low	Limited to cut and fill area (about 18 ha).	• Permanent loss; occurring once.	NR	Similar habitat for priority species in the region. ROW largely in designated Industrial Park and near-by abandoned gas plant site.	Minor, not significant
Fragmentation of terrestrial habitat in and around the Project area	A	• Minimize Project footprint.	Low	Project footprint and adjacent areas of similar habitat.	• Permanent; occurring once.	NR	Habitats in the Project footprint are not unique; birds able to fly over road corridor.	Minor, not significant
Disturbance of avifauna due to construction activities (noise, dust generation)	A	• Implementation of EPP. • Adherence to applicable guidelines for noise. • Environmental awareness training.	Low	Limited to Project footprint and approximately 200 m zone of influence (noise).	• Construction phase; frequent.	R	ROW largely in designated Industrial Park and near-by abandoned gas plant site.	Minimal, not significant

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Residual Environmental Effects					Residual Effects, Significance**
			Magnitude*	Geographic Extent	Duration / Frequency	Reversibility (R=reversible NR=Non-reversible)	Ecological / Social-cultural and Economic Context	
Destruction of active migratory bird nests during vegetation clearing.	A	• Avoidance of the breeding bird season and adherence to EPP. • Environmental awareness training.	Low	Limited to Project footprint.	• Construction phase; occasional.	NR	ROW largely in designated Industrial Park and near-by abandoned gas plant site.	Minor, not significant
Operation								
Disturbance of avifauna due to increased human presence.	A	• Implementation of EPP.	Low	Limited to Project footprint.	• Operations phase; frequent.	R	ROW largely in designated Industrial Park and near-by abandoned gas plant site.	Minimal, not significant
Loss or degradation of habitat for wetland-associated priority bird species during maintenance activities.	A	• Implementation of EPP. • Adherence to NSTIR Salt Management Plan. • Measures outlined in Section 6.2.3 (surface water) and 6.8.3 (wetlands)	Low	Wetlands, watercourses within and transected by ROW.	• Operations phase; occurring once to frequently.	R	ROW largely in designated Industrial Park and near-by abandoned gas plant site. Similar habitat and priority species in the region.	Minimal, not significant

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Residual Environmental Effects					Residual Effects, Significance**
			Magnitude*	Geographic Extent	Duration / Frequency	Reversibility (R=reversible NR=Non-reversible)	Ecological / Social-cultural and Economic Context	
Increased lighting attracting and/or disorienting nocturnal avifauna.	A	• Minimizing use of road lighting to the extent possible.	Low	Limited to Project footprint.	• Operations phase; frequent.	R	ROW largely in designated Industrial Park and near-by abandoned gas plant site.	Minor, not significant
Increased numbers of human-adapted species competing with native species.	A	• Implementation of EPP; proper housekeeping practices and avoiding activities that may attract wildlife.	Low	Project footprint and adjacent habitat.	• Operations phase; occasional.	R	ROW largely in designated Industrial Park and near-by abandoned gas plant site.	Minimal, not significant
Increased avian mortality due to traffic collisions	A	• Appropriate speed limits on new road. • No increase in traffic is anticipated	Low	Limited to Project footprint.	• Operations phase; occasional.	R	ROW largely in designated Industrial Park and near-by abandoned gas plant site.	Minor, not significant

Notes:

* For definition of levels of magnitude (high, moderate, low, nil, unknown) refer to Section 3.0

** For definition of levels of significance (major, medium, minor, minimal) refer to Section 3.0

6.6 Terrestrial Wildlife

The Terrestrial wildlife can be adversely impacted during the Realignment construction and operation. This includes effects related to the loss of habitat and collisions with vehicles. Wildlife has therefore been identified as a VEC.

6.6.1 Significance Definition

A significant adverse effect on wildlife would be one that results in contravention of the *Nova Scotia Wildlife Act*, SARA or NSESA provisions; or for non-SARA or non-NSESA listed priority species, one which causes a decline in abundance and/or a change in distribution beyond which natural recruitment (reproduction and immigration from unaffected areas) would not return the population to its pre-project level within several (three to five) generations. An adverse effect that does not cause such declines or changes is not considered to be significant.

6.6.2 Potential Interaction and Effects

Construction Phase

During construction, habitat removal and fragmentation will result in displacement of wildlife within the ROW. Species that can travel easily will likely move to similar habitats elsewhere, if such habitat is available. Ultimately, however, there will be adverse effects on terrestrial wildlife populations within the Project area. These effects will be non-reversible for the duration of the Project lifetime. During construction activities, temporary and reversible effects from noise and dust generation may also affect terrestrial wildlife in and around the Project area.

The loss of ponds, wetlands and riparian areas in the Project area will result in habitat loss for species such amphibians and turtles while increased sedimentation from dust generated by construction may further impact aquatic habitats.

Habitat removal and disturbance due to human activities may result in some wildlife species being no longer present in the area. Impacts on other mammals are also expected to be mainly related to habitat loss and fragmentation. Clearing and construction is expected to slightly reduce the available area used by deer and interrupt local movement to and from adjacent areas of suitable habitat. Project activities may cause changes in the diversity and relative abundance of local mammal populations, including a potential increase in species that are well-adapted to human presence such as Red Fox, Raccoon and Striped Skunk. This effect could be exacerbated if good housekeeping practices are not maintained onsite.

Operation and Maintenance Phase

Potential effects of the operation phase of the Realignment are anticipated from increased noise and disturbance from traffic. Local nocturnal species (including bats, moths and certain bird species) may be attracted to and/or disoriented by changes in ambient lighting. Habitat fragmentation may disrupt natural patterns of wildlife movement. Fragmentation is not anticipated since one side of the ROW will be largely developed into an industrial site (Goldboro LNG) that will not offer any wildlife habitat.

6.6.3 Mitigation Measures

Construction Phase

- Reduce Project footprint and temporary work areas to the extent possible.
- Clearing and grubbing should be restricted to areas necessary to complete the Realignment.

- Dust prevention and abatement measures shall be implemented.
- Workers will be instructed to maintain good housekeeping practices and not leave any food items and garbage at the Project site to avoid attracting omnivorous predators which may disturb or cause direct mortality or injury to wildlife (including birds).
- All construction equipment should have appropriate noise-muffling equipment installed and in good working order to minimize noise disturbance. The duration of noise disturbance should be minimized. Lighting should be restricted to areas where it is necessary.
- To minimize interference to nesting activities from noise and human presence, workers will be encouraged to refrain from entering surrounding undisturbed habitat areas where no work is being performed since those areas likely hold the largest number of birds.

Operation and Maintenance Phases

- Restrict speed limits.
- Promptly remove roadkill to reduce potential for mortality of scavengers.
- Implement NSTIR's Integrated Roadside Vegetation Management Manual (NSDTPW, undated).
- If required, monitor loss of wildlife and consider construction of wildlife fencing in conjunction with the planned wildlife crossing.

6.6.4 Residual Effects and Determination of Significance

Table 6.6-1 provides a summary of recommended mitigation measures and residual environmental effects after successful implementation of the above mitigation measures.

With the successful implementation of the mitigation measures described above, Project activities related to construction, operation and maintenance of Project components are not likely to result in significant adverse residual effects on terrestrial wildlife.

Table 6.6-1 Residual Effects – Terrestrial Wildlife

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Residual Environmental Effects					Significance**
			Magnitude*	Geographic Extent	Duration/Frequency	Reversibility (R=reversible, NR=Non-reversible)	Ecological/Social-cultural and Economic Context	
Construction								
Loss of habitat for terrestrial wildlife.	A	• Minimizing Project footprint. • Use of existing access routes to the ROW when possible.	Low	Limited to cut and fill area (about 18 ha).	• Permanent loss	NR.	Similar habitat for priority species in the region. Until recently there was an active industrial plant in the area.	Minor, not significant
Disturbance of terrestrial fauna due to construction activities (noise, dust generation).	A	• Implementation of EPP. • Adherence to applicable guidelines for noise.	Low	Project footprint and about 200 m zone of influence (noise).	• Construction phase; frequent	R	Until recently there was an active industrial plant in the area.	Minimal, not significant
Operation								
Disturbance of terrestrial fauna due to increased human presence.	A	• Implementation of EPP.	Low	Limited to Project footprint.	• Operations phase; frequent.	R	Until recently there was an active industrial plant in the area.	Minimal, not significant
Loss or degradation of habitat for aquatic / wetland priority species due	A	• Implementation of EPP. • Adherence to NSTIR Salt Management Plan. • Application of measures outlined in Section 6.2.3	Low	Wetlands, watercourses within ROW.	• Operations phase; on-going.	R	Similar habitat and priority species in the region. Until recently there	Minimal, not significant

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Residual Environmental Effects					Significance**
			Magnitude*	Geographic Extent	Duration/Frequency	Reversibility (R=reversible, NR=Non-reversible)	Ecological/Social-cultural and Economic Context	
to maintenance activities		(surface water) and 6.8.3 (wetlands)					was an active industrial plant in the area.	
Increased lighting attracting and/or disorienting nocturnal wildlife.	A	• Minimizing the use of road lighting to the greatest extent possible.	Low	Limited to Project footprint.	• Operations phase; on-going.	R	Until recently there was an active industrial plant in the area.	Minor, not significant
Habitat fragmentation	A	• Ensure culverts at water crossings are sufficiently large to function as wildlife crossing for smaller wildlife.	Low	Local	• Operation phase; / on-going	R	No unique habitat features on either side of Road corridor; Until recently there was an active industrial plant in the area.	Minimal, not significant
Increased wildlife mortality due to traffic collisions	A	• Appropriate speed limits on Realignment. • Maintenance of shoulder and backslopes. • Prompt removal of roadkill will reduce potential for mortality of scavengers.	Low	Limited to Project footprint.	• Operations phase; frequent.	R	Until recently there was an active industrial plant in the area.	Minor, not significant

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Residual Environmental Effects					Significance**
			Magnitude*	Geographic Extent	Duration/Frequency	Reversibility (R=reversible, NR=Non-reversible)	Ecological/Social-cultural and Economic Context	
Increased numbers of human-adapted species competing with native species.	A	• Implementation of EPP; proper housekeeping practices.	Low	Project footprint and adjacent habitat.	• Operations phase; on-going.	R	Until recently there was an active industrial plant in the area.	Minimal, not significant

Notes:

* For definition of levels of magnitude (high, moderate, low, nil, unknown) refer to Section 3.0

** For definition of levels of significance (major, medium, minor, minimal) refer to Section 3.0

6.7 Terrestrial Habitat and Flora

Terrestrial habitat and plant life have been identified as a VEC since the Realignment construction will remove the existing habitat and associated plant life within the Project footprint. Additional adverse effects may also occur in adjacent areas, for example due to changes in the local microclimate.

6.7.1 Significance Definition

A significant adverse effect on terrestrial habitat and vegetation would be one which results in contravention of SARA or NSESA provisions; or for non-SARA or non-NSESA listed priority species, a decline in abundance and/or change in distribution beyond which natural recruitment (reproduction and immigration from unaffected areas) would not return the population to its pre-project level within several (three to five) generations. A significant adverse effect on sensitive / critical habitat would be a permanent net loss of habitat function. A positive effect is one that may enhance the quality of habitat, increase species diversity, or increase the area of valued habitat.

6.7.2 Potential Interactions and Effects

Construction Phase

Construction activities associated with the Project may result in temporary or permanent adverse effects on terrestrial flora that can result from site and roadbed preparation (e.g., clearing, grubbing, grading, blasting), as well as associated dust, erosion and sedimentation, and possible introduction of invasive species. Potential effects on terrestrial flora, habitat, communities and individuals during construction may also occur as a result of accidental events. Effects can be limited to the footprint of the Project or may extend to adjacent lands as indicated below.

During construction, potential adverse effects on vegetation and habitat include:

- direct and indirect mortality of plants;
- temporary or permanent loss or alteration of habitat and habitat availability;
- impairment from changes to wind exposure and microclimatic conditions;
- impairment or displacement from introduction of invasive species; and
- mortality or impaired growth due to accidental events (discussed in Section 6.14).

Habitat Loss / Alteration

Site clearing, grubbing and grading will result in loss of vegetation habitat, as well as direct mortality of the vascular and non-vascular plants in the area affected. For the purposes of this EA, it is assumed that all the vegetation in the cut and fill area (approximately 18 ha) will be permanently lost for the lifetime of the Project. Blue Felt Lichen, a federally and provincially listed SAR, has been confirmed as present within the ROW.

Clearing may also change wind exposure and microclimatic conditions in adjacent forests, resulting in some die-off and reduced growth of forest species until edge vegetation matures.

Given the common nature of the habitat and vegetation affected and the previous disturbance through human activities, the effects are not expected to adversely impact floral populations, habitat diversity, quality and availability.

Erosion / Sedimentation

Clearing and grubbing required for all Project components, results in disturbed soil surfaces without vegetative cover. Site clearing will be completed early in the construction phase. Grubbing is completed as a separate activity when construction of the Realignment begins. Grubbing is performed later to minimize the exposure time of the underlying soil. Exposed soil is vulnerable to erosion, and the resulting sedimentation may smother vegetation or impair plant growth in adjacent terrestrial and aquatic habitats. These potential effects can be effectively mitigated and avoided through standard sediment and erosion control measures.

Fugitive Dust

Earthwork, movement of construction and transportation machinery, and storage of soil and construction materials may result in emissions of fugitive dust. The deposition of dust on the leaf surfaces of nearby vegetation may cause temporary inhibition of photosynthesis and transpiration in the affected plants, potentially resulting in slower growth rates (Farmer, 1993). However, dust deposition that could have such effects on plant growth are not expected to occur beyond a few metres from the source. Standard dust abatement measures and measures for the protection of air quality as outlined in Section 6.3 will mitigate the potential effects of dust on vegetation in all habitats.

Introduction of Alien and Invasive Species

Clearing, grading and construction activities will result in disturbed areas without cover of natural vegetation. Open soil surfaces encourage the establishment of non-native and potentially invasive species of plants. As the plant inventory indicates, several alien plant species have already been detected in the footprint of the Project, which may be the result of previous disturbance from forest harvesting or other human use.

Seeds, roots or "rootable" fragments of invasive species may stick to construction equipment, transportation vehicles or shoes of workers. Introduction of non-native or invasive species may lead to alteration of nearby habitat and may have an adverse effect on the abundance and diversity of native flora.

The identified potential effects can be effectively mitigated through a variety of BMPs (Section 6.7.3). Further, the landscaping in the ROW will maximize the use of native seed mixtures and plant material to benefit local flora and fauna. Herbicides will not be used.

Operation and Maintenance Phase

Road salt used on the Realignment may adversely affect terrestrial vegetation and soil conditions immediately adjacent to the ROW. Herbicides are no longer used for road maintenance based on TIR's current standard practices and therefore are not a concern. With the application of mitigation measures outlined in the Integrated Roadside Vegetation Management Manual (NSDTPW, undated), as well as NSTIR's Standard Specifications and the Generic EPP Section 6.7.3, the adverse effects on vegetation from road salt are expected to be minimal.

6.7.3 Mitigation Measures

The following documentation is applicable for both construction and the operation and maintenance phases of the Project. They offer specific guidance for the mitigative measures below.

- Standard Specification; Highway Construction and Maintenance (NSTIR, 1997 and latest revisions);
- Generic EPP for the Construction of 100 Series Highways (NSTIR, 2007); and,

- Integrated Roadside Vegetation Management Manual (NSDTPW, undated).

Infilling and Road Drainage Design

During construction:

- Develop a management plan for Blue Felt Lichen observed within the ROW.
- Mark Project boundaries to prevent accidental impacts outside the work area.
- Dust prevention and abatement measures will also protect local flora and habitats.
- Stabilize and rehabilitate areas of temporary disturbance as soon as practical.
- Maintain surface water paths through culvert placement and appropriate structure sizing.
- Consider presence of downgradient priority plants in road drainage design.

During operations and maintenance:

- Implement follow-up monitoring of ROW priority species outside Footprint.

Introduction of Invasive Species

During construction:

- Construction and transportation equipment should be cleaned of vegetation and soil residues and inspected before entering the Project site.
- Areas of exposed soil should be revegetated as soon as practical, following completion of work activities.
- Use only non-invasive plant species for restoration.

Sedimentation

During construction:

- Install sediment and erosion control measures as outlined in guidance documents and/or permit approvals.
- Undertake regular inspection of sediment and erosion control measures to ensure they have remained in place and are working properly.
- The site should be inspected prior to, during, and after a rainfall event.
- Promote growth of vegetation in areas adjacent to wetlands following disturbance. Use temporary measures (e.g. jute mats or mulch) until permanent cover has been established.

During construction and operations / maintenance phases:

- Limit removal of riparian zone vegetation.
- Adhere to federal and provincial approval conditions.

Contamination

During construction and operations / maintenance phases:

- Ensure that machinery arrives onsite in a clean condition and is maintained free of fluid leaks.

- Biodegradable fluids should be considered for use in place of petroleum products whenever possible, as a standard for best practices.
- Do not dump petroleum products or any other deleterious substances on ground.
- Be diligent and take all necessary precautions to avoid spills and contamination of the soil (both surface and subsurface) when handling POLs onsite and during fueling and servicing of vehicles and equipment.
- All onsite chemicals and POLs should also be stored at a designated fueling and material storage site with secondary containment at least 30 m from any surface waters.
- Workers should be trained in spill clean-up.
- Spill clean-up kits must be available.
- All rock excavation will be tested for acidic conditions. If found, it will be treated as acid generating and deposited and contained within an approved containment.

<u>During operations / maintenance:</u>

- Use mechanical vegetation control and do not apply herbicides or pesticides.
- Follow NSTIR's Salt Management Plan during winter road maintenance.
- Mitigation measures pertaining to air emissions pollution control as outlined in Section 6.3.3 will also protect common lichen species sensitive to air quality.
- Priority plant management plan is to include provisions for mitigating winter salting in potential habitat.
- Inclusion of operator environmental awareness training.

6.7.4 Residual Effects and Determination of Significance

Table 6.7-1 provides a summary of comprehensive mitigation measures and residual environmental effects after successful implementation of the mitigation measures described above.

With the implementation of the recommended mitigation measures, Project activities are not likely to result in significant adverse residual effects on flora (including priority species) and terrestrial habitats.

Table 6.7-1 Residual Effects – Terrestrial Habitat and Flora

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Residual Environmental Effects					Residual Effects, Significance**
			Magnitude*	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Social-cultural and Economic Context	
Construction								
Direct plant mortality, habitat removal or alteration due to site preparation, clearing and grubbing, and wetland infill.	A	• Minimize Project footprint. • Minimize lay-down areas. • Implement EPP provisions for clearing, grubbing and blasting. • Comply with regulatory approvals (including wetland alteration approvals).	Low	Limited to cut and fill area (about 18 ha).	• Permanent loss; occurring once.	NR	Similar habitat and priority plants in the region. Until recently there was an active industrial plant in the area.	Minor, not significant
Indirect plant mortality as a result of habitat changes through potential erosion, altered hydrology, sediment loading, stormwater discharges, and spills.	A	• Temporarily disturbed surfaces to be rehabilitated as soon as possible. • Save and store organic soil layer and apply in rehabilitation. • Implement erosion and sediment control plans. • Monitoring of EPP implementation, success of rehabilitation and erosion control measures.	Low	LSA	• Construction phase.	R	See above	Minimal, not significant
Plant displacement or loss of suitable habitat due to the introduction of invasive species.	A	• Revegetate or disturbed surfaces as soon as possible. • Equipment to be cleaned from vegetation and soil residues before entering the Project site. • Discourage workers from entering off-site areas.	Low	LSA; depends on size of affected area.	• Project lifetime; Infrequent.	R	See above	Minimal, not significant

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Residual Environmental Effects					Residual Effects, Significance**
			Magnitude*	Geographic Extent	Duration/Frequency	Reversibility (R – reversible	Ecological/Social-cultural and Economic Context	
Impairment of plant growth as result of fugitive dust emissions.	A	• Implement dust abatement measures and sediment control measures as outlined in EPP.	Low	LSA	• Construction phase; frequent.	R	See above	Minimal, not significant
Operation								
Increase in levels of salt	A	• Vegetation growth to be controlled by physical cutting. • Inclusion of operator environmental awareness training.	Low	Local (within ROW and down-gradient).	• Operation phase; Short term/ infrequent	R	See above.	Minimal, not significant

Notes:

* For definition of levels of magnitude (high, moderate, low, nil, unknown) refer to Section 3.0

** For definition of levels of significance (major, medium, minor, minimal) refer to Section 3.0

6.8 Wetlands

Similar to terrestrial habitat wetland habitat as been identified as a VEC since the Realignment construction will remove the existing wetland within the Project footprint. Additional adverse effects may also occur in adjacent wetland areas, for example due to changes in the local drainage regime.

6.8.1 Significance Definition

A significant adverse effect from the Project on wetlands is defined as an effect that is likely to cause a permanent net loss of flora and wetland function as established during the wetland evaluation. A positive effect is one that may enhance the quality of wetland habitat / function, increase species diversity, or increase the area of valued habitat.

6.8.2 Potential Interactions and Effects

Construction, operation and maintenance of the Realignment could result in adverse effects on wetland function and species diversity due to:

- partial or complete infilling;
- fragmentation;
- disturbance;
- erosion and sedimentation;
- nutrient loading (hydroseeding);
- changes to hydrology;
- introduction of invasive species; or
- release of hazardous materials.

The effects can result from short-term activities during the construction phase, as well as long-term activities during Project operation. In addition to these direct effects, contaminated runoff from acid-generating material potentially exposed during blasting may have an adverse effect on wetlands. Excavation activities can lead to changes in the local groundwater regime with potential indirect effects on water regimes in wetlands.

Construction Phase

As described in Section 5.2.4, field surveys have identified 32 wetlands within the Study Area (Figure 5.2-4). A draft Wetland Management Plan (Wood, 2021) has determined that 23 wetlands representing 3.75 ha are located within the Realignment footprint (Table 6.8-1). The largest area of wetland to be impacted is 1.8 ha, and none of the remaining 22 wetlands are larger than 0.52 ha. Two wetlands (20-WL-15 and 24) will be lost entirely; however, portions of numerous wetlands will be infilled, with a total maximum infilled area of approximately 3.75 ha (Table 6.8-1). Wetlands may also be adversely affected through changes in the groundwater regime as a result of excavation activities. These indirect effects are expected to be negligible in comparison to the anticipated direct loss through infilling. One of the wetlands (20-WL-22) provides mature conifer and hardwood species that provide habitat for several SAR / SOCI lichen species including Blue Felt Lichen and is therefore considered a WSS.

The infilling of the wetlands requires NSE approval of a Wetland Alteration application and will be subject to wetland compensation and monitoring. A compensation plan for the identified direct impacts on wetlands will be developed in conjunction with Ducks Unlimited and in consultation with NSE. The plan will

be developed by Pieridae during the wetland alteration approval phase of the Project which may include one or a combination of wetland compensation strategies.

Wetlands depend on a certain level of soil humidity. If the water regime is changed, so will the vegetation, character and functionality of the wetland. In addition to the direct impacts due to localized infilling, wetlands surrounding the Project footprint could potentially be adversely affected by changes to the hydrology due to impeded drainage caused by the construction of the Realignment. Wetlands located upgradient of the construction may be flooded if drainage is impeded, and wetlands located down-gradient could be adversely affected if surface water flow decreases. If stormwater from the roads, which is collected in roadside ditches, is allowed to enter wetlands in quantities exceeding natural pre-construction flow, similar adverse effects are possible.

Wetlands could also be adversely affected by sediment runoff during construction activities. Exposed soil associated with earth movement, site clearing, grubbing, grading, stripping and storage of topsoil or construction materials may result in erosion and subsequent sedimentation. Sediments carried into wetlands could smother existing vegetation but may also contribute nutrients to the wetlands. Changes in nutrient levels will change water quality, potentially affecting plant communities in the wetlands. Effects would be greatest in low nutrient systems such as treed bogs and shrub bogs and would likely result in adverse effects on wetland function.

Dust and minerals from road runoff may have similar effects. Most fugitive dust will be formed during the construction phase from soil movement, soil and material storage, and the movement of construction equipment and transportation vehicles. The dust may cover native vegetation and smother it, but dust also deposits minerals and nutrients into the wetlands.

Wetlands near the Project footprint may be adversely affected if accidental spills of deleterious substances such as POLs occur while using construction and transportation equipment.

Where construction activities occur in wetlands, there is potential for introduction of invasive species. Seeds, roots or "rootable" fragments of invasive species may stick to construction equipment, transportation vehicles or shoes of workers. These propagules may be introduced into wetlands directly when equipment or people access the wetlands, or indirectly via runoff or dust from the roads. Invasive species such as Purple Loosestrife (*Lythrum salicaria*), are known to severely degrade wetland habitat and thus one or more of wetland functions. The potential for introduction of invasive species is highest in wetlands in or near the construction zone; including lay-down areas, followed by wetlands downstream or downgradient of those areas. Since the amount of traffic during the construction and operations phases will be increased over current levels, especially long-distance traffic, the likelihood of introduction of invasive species is elevated.

Operations and Maintenance Phase

During the operation phase, wetlands located near the Project footprint could be adversely affected by the release of hazardous materials during maintenance activities or accidents and malfunctions, dust/ sedimentation, introduction of invasive species, as well as disturbance. The unmanaged use of road salt for winter safety may adversely affect vegetation and water quality in wetlands. Road salt is a toxic substance, controlled under CEPA that can harm wildlife. Road salt runoff can influence vegetation species composition in wetlands, though the area would be very small. Maintenance of roadsides will involve mechanical vegetation management. If herbicides are used indiscriminately, wetland vegetation and wildlife could be adversely affected. The potential for introduction of invasive species carried on vehicles operated on roads is lower than during operation, since disturbed wetland soils will be revegetated. These effects would be limited to wetlands immediately adjacent to the Project footprint.

Table 6.8-1 Summary of Wetland Characteristics of the Realignment Area

Wetland #	Coordinates		Type	Total Area (ha)	Impacted Area (ha)	Landscape Position	Water Flow Path	Landform
	Easting	Northing						
20-WL 8	606254	5003405	Cut-over Swamp	0.0241	0.01477	Terrene	Throughflow via drainage down hillside	Sloped
20-WL 9	606241	5003446	Shrub Swamp	0.0787	0.03496	Terrene	Isolated	Sloped
20-WL 11	606281	5003353	Cut-over Swamp	0.1040	0.06625	Terrene	Isolated	Sloped
20-WL 12	606549	5003130	Shrub Swamp	0.0618	0.01451	Terrene	Isolated	Sloped
20-WL 13	606882	5003195	Treed Swamp	0.5436	0.2158	Lotic stream entrenched	Throughflow via watercourse	Sloped
20-WL 14	606897	5003289	Treed Swamp	0.0212	0.00206	Terrene	Isolated	Basin
20-WL 15	606989	5003308	Treed Swamp	0.0158	0.01584	Terrene	Isolated	Sloped
20-WL 16	607019	5003353	Shrub Swamp	0.0870	0.07582	Terrene	Isolated	Slightly sloped basin
20-WL 20	607658	5003767	Treed Swamp	1.2450	0.09703	Terrene	Isolated	Basin
20-WL 21	607820	5003589	Treed Swamp	0.3829	0.01762	Terrene	Isolated	Basin
20-WL 22	607813	5003430	Treed Swamp- Shrub Swamp-Graminoid Fen-Shrub Bog Complex	13.8245	0.4646	Lotic stream floodplain	Throughflow via watercourse	Basin
20-WL 24	607525	5003688	Treed Swamp	0.0565	0.05648	Terrene	Isolated	Sloped basin
20-WL 25	608191	5003558	Shrub Bog	0.1248	0.01199	Terrene	Isolated	Basin
20-WL 27	608336	5003403	Treed Swamp	0.0398	0.02949	Terrene	Isolated	Basin
20-WL 28	608395	5003286	Treed Swamp	0.0235	0.01567	Lotic stream entrenched	Throughflow via watercourse	Basin
20-WL 29	608519	5003046	Treed Swamp	4.3863	0.08985	Terrene	Isolated	Basin

Wetland #	Coordinates		Type	Total Area (ha)	Impacted Area (ha)	Landscape Position	Water Flow Path	Landform
	Easting	Northing						
20-WL 31	608927	5002321	Treed Swamp-Shrub Bog-Graminoid Fen Complex	7.7223	0.4611	Lotic stream entrenched	Throughflow via watercourse and outflow via watercourse	Flat basin
20-WL 32	608989	5002085	Shrub Bog	0.1393	0.0940	Terrene	Isolated	Basin
20-WL 34	609005	5000924	Treed Swamp-Bog-Graminoid Fen Complex	70.4730	1.8045	Terrene	Watercourse flowing within but none observed entering / exiting / Terrene	Flat
20-WL 35	609157	5000792	Graminoid Fen	0.1398	0.0273	Lotic stream entrenched	Throughflow via watercourse	Sloped basin
20-WL 36	609242	5000750	Treed Swamp – Fen Complex	0.4956	0.0922	Lotic stream entrenched	Throughflow via watercourse	Basin
20-WL 38	609389	5000620	Shrub Swamp	0.5700	0.0444	Terrene	Isolated	Basin
20-WL 39	609267	5000672	Treed Swamp	0.2018	0.0006	Terrene	Isolated	Basin
Total Wetland Area Directly Impacted (ha)					**3.75**			

It is noted that adverse effects to wetlands could have indirect adverse effects on the priority species that depend on these wetlands. Effects on priority species are discussed in Section 6.10 (Species at Risk).

6.8.3 Mitigation Measures

The following documentation is applicable for both construction and the operation and maintenance phases of the Project. They offer specific guidance for the mitigation measures below.

- Standard Specification; Highway Construction and Maintenance (NSTIR, 1997 and latest revisions); and
- Generic EPP for the Construction of 100 Series Highways (NSTIR, 2007).

Upon completion of the road work, the extent of actual wetland habitat affected will need to be verified through monitoring. Monitoring will also be required to document the successful implementation of the required wetland compensation. Both the monitoring and the compensation will be implemented in accordance with the NSE Wetland Alteration Approval.

Infilling and Road Drainage Design

During construction:

- Vegetation clearing will take place outside the migratory bird nesting season (see Section 6.5.3).
- The Project footprint and temporary laydown areas will be reduced to that which is absolutely necessary.
- The Project boundaries will be physically delineated to prevent accidental impacts outside the work area.
- Topsoil (approximately upper 30 cm) will be stored separately and reused for site restoration where practicable.
- Dust prevention and abatement measures will also protect wetland plants and habitats.
- Stabilize and rehabilitate areas of temporary disturbance as soon as practicable.
- Maintain surface water paths through culvert placement and appropriate structure sizing.
- Consider presence of downgradient priority plants in road drainage design.

Sedimentation

During construction:

- Install sediment and erosion control measures as outlined in guidance documents and/or permit approvals.
- Undertake regular inspection of sediment and erosion control measures to ensure they have remained in place and are working properly.
- The site should be inspected prior to, during, and after a rainfall event.
- Promote growth of vegetation in areas adjacent to wetlands following disturbance. Use temporary measures (e.g. jute mats or mulch) until permanent cover has been established.

During construction and operations / maintenance:

- Limit removal of riparian zone vegetation.
- Adhere to federal and provincial approval conditions.

Contamination

During construction and operations / maintenance:

- Ensure that machinery arrives onsite in a clean condition and is maintained free of fluid leaks.
- Do not dump POLs or any other deleterious substances on ground.
- Be diligent and take all necessary precautions to avoid spills and contamination of the soil when handling POLs onsite and during fueling and servicing of vehicles and equipment.
- All onsite chemicals and POLs should be stored at a designated fueling and material storage site with secondary containment at least 30 m from any surface waters.
- Spill clean-up kits must be available, and workers should be trained in spill clean-up.

During operations/maintenance:

- Use mechanical vegetation control where possible and avoid use of herbicides. Herbicides can be used only under the guidance of NSTIR's IRVM program. No pesticides can be used.
- Follow NSTIR's Salt Management Plan during winter road maintenance.

6.8.4 Residual Effects and Determination of Significance

Table 6.8-2 provides a summary of recommended mitigation measures and residual environmental effects that may be anticipated after successful implementation of the mitigation measures described above. With the implementation of the recommended mitigation measures, Project activities are not likely to result in significant adverse residual effects on wetlands.

Table 6.8-2 Residual Effects - Wetlands

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Residual Environmental Effects					Residual Effects, Significance**
			Magnitude*	Geographic Extent	Duration / Frequency	Reversibility (R=Reversible NR=Non-reversible)	Ecological / Social-cultural and Economic Context	
Construction								
Wetland removal or loss of wetland functions as a result of infilling and development activities.	A	• Avoid wetlands during Project design and layout where practical. • Minimize Project footprint. • Comply with regulatory approvals (including wetland alteration approvals), post-construction monitoring and EPP. • Laydown areas not to be located in or near wetlands. • Workers will be instructed not to enter wetlands. • Wetlands which will be subjected to partial or total infilling to be formally evaluated in terms of wetland function. • Confirmation of wetland compensation in conjunction with the wetland alteration approval application. • See also Sections 6.10 (SAR), 6.5.2 (Avifauna), 6.6.2 (Terrestrial Wildlife), and 6.7.2 (Terrestrial Habitat and Flora)	Low	3.75 ha	• Permanent; occurring once	NR	Similar habitat and priority plants in the region. Until recently there was an active industrial facility in the area.	Minor, not significant

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Residual Environmental Effects					Residual Effects, Significance**
			Magnitude*	Geographic Extent	Duration / Frequency	Reversibility (R=Reversible NR=Non-reversible)	Ecological / Social-cultural and Economic Context	
Alteration of wetland hydrology.	A	• Stream and wetland drainage crossings to be constructed with culverts of sufficient size (Section 6.8.3). • Drainage structures of sufficient size to be constructed where infrastructure cuts across diffuse natural drainage paths, drainage channels and wetland habitat. • Drainage structures to dissipate hydraulic energy and maintain flow velocities sufficiently low to prevent erosion of native soil material. • Crushed rock used for road construction to allow for regular diffuse surface runoff to seep through. • Runoff collected along the roads not to enter directly into wetlands. • Maintain a vegetated buffer zone of 30 m minimum around wetlands outside of the ROW clearing. • Monitoring remaining wetlands to identify any signs of changed hydrologic regime.	Low	Local downstream of ROW; depends on size of affected wetland.	• Construction phase; once per wetland.	R	See above.	Minimal, not significant

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Residual Environmental Effects					Residual Effects, Significance**
			Magnitude*	Geographic Extent	Duration / Frequency	Reversibility (R=Reversible NR=Non-reversible)	Ecological / Social-cultural and Economic Context	
Alteration of water quality from sediments and dust.	A	• Maintain a vegetated buffer zone of 30 m minimum around wetlands. • Implement erosion and sediment control plans specifically for the wetland crossings (see EPP). • Implement dust control plan (see EPP). • Monitor efficacy of the erosion and sediment control measures.	Low	Local; depends on size of affected wetland.	• Construction Phase/Infrequent.	R	See above.	Minimal, not significant
Reduction in wetland functionality due to the introduction of invasive species.	A	• Construction and transportation equipment to be cleaned of vegetation and soil residues before entering the Project site.	Low	Local; depends on size of affected wetland.	• Construction Phase/ Infrequent.	R	See above.	Minimal, not significant
Operation								
Impacts from contaminated runoff and vegetation management.	A	• Vegetation growth to be managed by physical cutting. • Implementation of protection measures for watercourses (Section 6.2.3) • Implement all measures of EPP.	Low	Local; depends on size of affected wetland.	• Short term/ infrequent	R	See above.	Minimal, not significant

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Residual Environmental Effects					Residual Effects, Significance**
			Magnitude*	Geographic Extent	Duration / Frequency	Reversibility (R=Reversible NR=Non-reversible)	Ecological / Social-cultural and Economic Context	
Reduction in wetland functionality due to the introduction of alien invasive species.	A	• Monitor and remove noxious weeds as per guidance from NSE and NSDLF.	High	Local; depends on size of affected wetland.	• Permanent/ Infrequent	R	See above.	Minor, not significant

Notes:

* For definition of levels of magnitude (high, moderate, low, nil, unknown) refer to Section 3.0

** For definition of levels of significance (major, medium, minor, minimal) refer to Section 3.0

6.9 Aquatic Environment

This section will focus on impacts directly to fish and fish habitat. For the effects and mitigation for surface water refer to Section 6.2.

The principal interactions between the Project activities and aquatic environment are associated with effects to fish and fish habitat due to in-water work during the construction, operation and maintenance phases of the Project.

6.9.1 Significance Definition

A significant adverse effect from the Project on fish and fish habitat is defined as an effect that is likely to cause a permanent net loss of species and/or available habitat.

The legislative authority for the management and conservation of fish and fish habitat in Canada is provided by the federal *Fisheries Act*. Section 2(1) of the *Fisheries Act* defines fish habitat as: "water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas."

The main provision of the *Fisheries Act* regarding the protection of fish habitat is Section 35. Section 35(1) states that: "No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat."

The SARA states: "The Act aims to prevent wildlife species from becoming extirpated or extinct, to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity, and to manage species of special concern to prevent them from becoming endangered or threatened". If a species is listed under Schedule 1 of SARA as extirpated, endangered or threatened, it is an offence to kill, harm, harass, capture or take an individual (s. 32[1]), and that species has legal protection related to the species' residence and critical habitat as specified in SARA (s. 56, 58[1]) (Department of Justice Canada, 2021).

The NSESA prohibits killing or disturbing SAR; destroying or disturbing its residence; and destroying or disturbing core habitat. Penalties, both for individuals and corporations, can be incurred when the Act is violated (NSDNR, 2013).

Based upon the above, a significant adverse residual environmental effect on the aquatic environment is defined as a Project-related environmental effect that, after mitigation measures are applied:

- results in the harmful alteration, disruption or destruction of fish habitat (as defined by the *Fisheries Act*), that occurs as a result of Project activities without federal approval and/or without required implementation of approval conditions (e.g., offsetting plan);
- results in the death, harm, harassment or capture of a species listed as extirpated, endangered, or threatened under Schedule 1 of SARA.

A positive effect is one that enhances the quality or area of habitat or increases species diversity.

6.9.2 Potential Interactions and Effects

The construction, operation and maintenance of the Realignment may result in adverse effects on surface water quality and quantity, and thereby fish and fish habitat. DFO has developed PoE diagrams (DFO, 2014) to identify stressors which ultimately lead to effects in the aquatic environment. PoEs that may be relevant to the proposed Project include:

- addition or removal of aquatic or riparian vegetation;

- placement of material or structures in water;
- use of industrial equipment;
- use of explosives; and
- fish passage issues.

Note, the first three PoEs are discussed in Section 6.2 (Surface Water). The relevant effects identified by the fish passage and use of explosives PoEs are discussed below in context of the construction, operation and maintenance phases of the Project.

Construction Phase

The principal interactions between construction activities and the aquatic environment are associated with:

- the clearing of vegetation and earthworks, including grubbing and stripping topsoil and overburden;
- the placement of excess material in temporary stockpiles which may be susceptible to erosion and result in sedimentation of watercourses adjacent to the site;
- installation of culverts;
- use of heavy equipment adjacent to watercourses;
- blasting, and the potential exposure of acid generating rock; and
- excavations impacting the groundwater environment and, indirectly, flow regimes in watercourses.

Blasting can:

- produce shock waves that can damage fish swim bladders and rupture internal organs;
- cause vibrations that can kill or damage fish eggs or larvae;
- lead to the introduction of sediment or contaminants to the watercourse (DFO, 2014); and/or
- result in runoff and erosion that can impact surface water through ARD from exposed bedrock.

Excavation activities can lead to changes in the local groundwater regime with potential effects on the flow regimes in watercourses. However, fish habitat quality of the watercourses near and crossing the ROW is generally poor with limited flows (Sections 5.1.5 and 5.2.5), so that any such indirect effects would be of limited consequence.

Operation and Maintenance Phase

The principal interactions between operation and maintenance activities and surface waters are associated with:

- winter road salting and sanding;
- culvert maintenance;
- vegetation maintenance; and
- storm water run-off.

The primary effects of these interactions on surface water quality are the introduction of excess sediment and contaminants to the watercourse. The effects of sedimentation and contaminant introduction are discussed in Section 6.2.2

6.9.3 Mitigation Measures

The following documentation is applicable for both construction and operation / maintenance phases of the Project. They offer specific guidance for the mitigation measures below.

- Nova Scotia Watercourse Alterations Standard (NSE, 2015a)
- Standard Specification; Highway Construction and Maintenance (NSTIR, 1997 and latest revisions)
- Generic EPP for the Construction of 100 Series Highways (NSTIR, 2007)
- Guidelines for the Protection of Fish and Fish Habitat: The Placement and Design of Large Culverts (DFO, 1998)
- Guidelines for the design of fish passage for culverts in Nova Scotia (DFO, 2015)
- Guide to Altering Watercourses (NSE, 2015b)

Fish habitat

- An NSE Water Approval will be obtained for all watercourse crossings. NSE will forward applications for alteration to DFO for further review, evaluation of Harmful Alteration, Disruption or Destruction of fish or fish habitat (HADD) and need for additional mitigation and habitat offsetting.
- A certified Watercourse Alteration Installer will conduct or supervise watercourse crossings.
- Structures will be sized according to federal and provincial guidance.
- Work sites will be de-watered and all Project activities completed in dry conditions. These activities will be preceded by a fish salvage program.
- If the watercourse is flowing during construction, flow will be maintained by pumping water around the construction site. While pumping the watercourse, hoses will be fitted with screens according to federal and provincial guidelines.
- Pumps, while in use, will be monitored to ensure that they are functioning properly.
- Hoses will be positioned to prevent streambed scour at pump discharge.
- Watercourse substrates will be restored, as similar as practical, to the pre-construction condition to ensure habitat availability.
- To diminish the risk of transferring invasive plants, or their seeds, rhizomes or vegetative structures, it is recommended that construction equipment (e.g. tracked vehicles) transported from elsewhere in NS or Canada be thoroughly cleaned and inspected prior to transport to ensure that no vegetative matter is attached to the machinery.
- In-water works are to take place outside of spawning / fish migration season and will be conducted between June 1st and September 30th.
- Minimize to the extent practical the duration of activity in watercourses as well as the duration of sediment releases, unless otherwise authorized.
- All slash and woody debris generated by the Project will be removed and disposed of such that it cannot enter a watercourse and/or washed downstream by floodwaters.
- Use upland access roads wherever practical.

- Soil disturbance and fill placement within 30 m of the shoulder of the banks of a watercourse and/or the edge of a wetland will be limited to the footprint required to prepare a stable foundation for the structure.

Blasting and Excavations

- Authorization will be acquired from DFO prior to the use of any explosives in or near a watercourse.
- Blasting will be conducted in accordance with the Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters (Wright and Hopky, 1998) and relevant federal and provincial guidelines.
- Flow regimes in watercourses within the Study Area will be monitored, if required.

6.9.4 Residual Effects and Determination of Significance

Table 6.9-1 provides a summary of recommended mitigation measures and residual environmental effects after successful implementation of the mitigation measures described above. With the implementation of the recommended mitigation measures, Project activities are not likely to result in significant adverse residual effects on the aquatic environment.

Table 6.9-1 Residual Effects – Fish and Fish Habitat

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Residual Environmental Effects					Significance**
			Magnitude*	Geographic Extent	Duration/Frequency	Reversibility (R=reversible NR=Non-reversible)	Ecological/Social-cultural and Economic Context	
Construction								
Degradation / destruction of fish and fish habitat	A	• Acquisition of NSE Water Approval and DFO Fisheries Act authorization • Proper sizing and installation of culverts • Use of a certified watercourse alteration installer • Adherence to federal and provincial regulations	Low	LSA	Construction phase	R	Similar habitat exists in the region Generally poor-quality aquatic habitat	Minimal, not significant
Blasting and excavations	A	• Implementation of EPP • Adherence to federal and provincial regulations	Low	LSA	Construction phase	R	Similar habitat exists in the region Generally poor-quality aquatic habitat	Minimal, not significant
Operation								
Degradation / destruction of fish and fish habitat	A	• Acquisition of NSE Water Approval and DFO Fisheries Act Authorization • Adherence to federal and provincial regulations	Low	LSA	Operation phase	R	Similar habitat exists in the region Generally poor-quality aquatic habitat	Minimal, not significant

Notes:
* For definition of levels of magnitude (high, moderate, low, nil, unknown) refer to Section 3.0
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 3.0

6.10 Species at Risk

Species of avian, terrestrial wildlife, and terrestrial flora SAR and SOCI have been noted within or adjacent to the ROW and could be adversely affected by the Realignment construction primarily due to habitat loss and alteration.

6.10.1 Significance Definition

A significant adverse effect on SAR and SOCI would be one which results in contravention of SARA or NSESA provisions. Significance definitions outlined in Sections 6.5.1 (Avifauna), 6.6.1 (Terrestrial Wildlife), and 6.7.1 (Terrestrial Habitat and Flora) would also apply to SAR / SOCI.

6.10.2 Potential Interactions and Effects

Construction activities associated with the Project may result in temporary or permanent adverse effects on SAR and SOCI. Potential adverse effects to terrestrial flora can result from site and roadbed preparation (e.g., clearing, grubbing, grading, blasting), as well as associated dust, erosion and sedimentation, and possible introduction of invasive species. Potential effects on terrestrial and aquatic flora, habitat, communities and individuals during construction may also occur as a result of accidental events. Effects can include:

- alteration / displacement of habitat;
- loss of sensitive / critical habitat;
- noise/disturbance to wildlife;
- behavioural changes; and
- mortality.

Effects can be limited to the Project footprint or may extend to adjacent lands as indicated below.

6.10.3 Mitigation Measures

Mitigation for potential effects on identified SAR and SOCI mirror that provided in Sections 6.5.2 (Avifauna), 6.6.2 (Terrestrial Wildlife), and 6.7.2 (Terrestrial Habitat and Flora).

6.10.4 Residual Effects and Determination of Significance

Residual effects for SAR and SOCI will mirror that provided in Tables 6.5-1, 6.6-1, and 6.7-1.

6.11 Land Use

The Realignment has the potential to affect road access temporarily or permanently to properties along the existing Marine Drive.

6.11.1 Significance Definition

A significant effect on existing and planned land uses outside the Realignment ROW is one that results in a permanent change in current use of land or future opportunities to develop land - or a permanent loss of access to private property.

6.11.2 Potential Interactions and Effects

No direct adverse effects are anticipated on local land uses from construction or operation of the proposed Project, as the work will remain within the defined ROW.

Construction Phase

Direct effects to physical VECs (e.g., groundwater, atmospheric environment) may result in indirect adverse effects on local land use during construction. For example, roadbed preparation involves ground disturbance and use of equipment which will result in temporary, short-term air emissions and noise. While these have potential to temporarily affect land use, effects on air quality will be reduced via mitigation measures as described in Section 6.3.3 and, as a result, these emissions will likely not result in significant adverse effects to the air quality within the vicinity of the Realignment.

No significant adverse effects are anticipated pertaining to property access. Road-access to all residences and private properties along Marine Drive will be provided by maintaining cul-de-sac road segments up to the planned Goldboro LNG facility from the start and end point of the Realignment. Traffic on the existing Marine Drive will not be disrupted as the existing Marine Drive will not be closed unless the Realignment is open to public use. Very short traffic disruptions may be experienced when the intersections between the new Realignment and existing Marine Drive are finalized.

Operation and Maintenance Phase

Indirect effects on local land use may also occur during operation from direct effects to these same physical VECs potentially affected during construction. Given domestic wells in the local area, potential Project-related effects on groundwater have the potential to affect land use. The effects assessment on groundwater have determined that any adverse effect on quality and quantity is not expected to be significant (Section 6.1). No adverse effects are anticipated pertaining to property access. Road-access to all residences and private properties along Marine Drive will be maintained through cul-de-sac road segments from the start and end point of the Realignment up to the planned Goldboro LNG facility.

6.11.3 Mitigation Measures

The mitigation measures to minimize adverse effects on physical VECs of groundwater, air quality and noise are described in the respective VEC sections. As noted, these are pathways for indirect effects on local land use during Project construction and operation. Traffic and access to private properties will not be adversely affected. Short-term disruptions are minimal and will be addressed in the contractor's traffic management plan.

6.11.4 Residual Effects and Determination of Significance

There are no anticipated direct adverse effects on existing and planned land uses in the area. Indirect adverse effects on local land use may result from direct effects on the VECs of groundwater, air quality and noise. As the effect assessments on these VECs determined that no significant adverse effects are expected from the proposed Project, no resulting significant adverse effects to land use are anticipated.

6.12 Traditional Use of Lands and Resources

6.12.1 Significance Definition

A significant adverse effect on traditional use of land and resources is defined as one which results in a detrimental long-term change in current use of the land and resources for traditional purposes by the Mi'kmaq of Nova Scotia by the Project.

6.12.2 Potential Interactions and Effects

As stated in Section 5.3.4, a MEKS was prepared for the EA for the proposed Goldboro LNG Facility (AMEC, 2013). Since the EA for the Goldboro Project was approved in 2014, Pieridae has been continuously in close contact with the KMKNO to engage Mi'kmaq communities in the development of the Goldboro LNG Project. This has included the dissemination of comprehensive information on the proposed Realignment with details on the potential adverse effects, mitigation and monitoring commitments. Similarly, Pieridae addressed the Realignment in the context of the CLC and the FAC, both of which the KMKNO is a member.

No concerns specific to the proposed Realignment have been articulated. However, based on the historic use and potential future interest in the area (Section 5.3.4), Pieridae assumes that the potential adverse effects of the Realignment on the environment as discussed in this EA Registration document are shared by the Mi'kmaq community. As such, the effects assessment in Sections 6.1 to 6.11 and 6.13 and associated mitigation measures are considered to also represent Mi'kmaq interests.

From its ongoing engagement and relationship with the Mi'kmaq community, Pieridae is aware that Project development within lands used by the Mi'kmaq, or considered for use in the future, is of interest to the Mi'kmaq with respect to opportunities for economic and educational benefits. In response, Pieridae has signed a Collaborative Benefits Agreement (CBA) with KMKNO. Through the CBA Pieridae expressed its commitment to actively promote, support and provide the Mi'kmaq community with job opportunities and educational benefits such as job training and scholarships in the implementation of the Goldboro LNG Project.

Through recent years, Pieridae has already repeatedly hired resources from the Mi'kmaw Conservation Group of The Confederacy of Mainland Mi'kmaq for conducting ecological baseline studies for the Realignment corridor. In addition, Mi'kmaq archaeological experts were invited to participate in construction crew training and to accompany archaeological field investigations. This will continue for the Realignment; however, most benefits to the Mi'kmaq community will materialize in the context of the Goldboro LNG project for which the Realignment is prerequisite.

6.12.3 Mitigation Measures

Mitigation measures developed in this EA Registration document for all VECs (Section 6 and Section 8) are considered to equally address Mi'kmaq concerns. The measures will be implemented to minimize any effect of the Realignment on the environment. Monitoring (Section 8) will be applied to verify the effects predictions and effectiveness of the mitigation. In addition, the beneficial effects of the Realignment related to economic and educational benefits to the Mi'kmaq community will be maximized through the CBA between Pieridae and KMKNO. This includes continuation of the involvement of Mi'kmaq community members in baseline studies, monitoring, and contract opportunities related to both the Realignment as well as the Goldboro LNG Project development.

6.12.4 Residual Effects and Determination of Significance

There are no anticipated significant adverse effects on traditional use of land and resources. Beneficial effects of the Realignment relate to present and future economic opportunities.

6.13 Cultural and Archaeological Resources

The Mi'kmaq Nation has a long-standing relationship with, and attachment to, the region in and around Goldboro with respect to the present and potential future use of the land and its resources. The Realignment has the potential to affect the ecological and cultural features of the land within and adjacent to the Realignment ROW.

6.13.1 Significance Definition

A significant adverse effect on cultural and archaeological resources is defined as one which results in a permanent disturbance or destruction of an archaeological, cultural or heritage resource considered by provincial heritage regulators or the Mi'kmaq of Nova Scotia to be of major importance where this effect is not mitigated or compensated.

6.13.2 Potential Interactions and Effects

Ground disturbing activities associated with construction of this Project could have significant adverse effects on archaeological resources. If unmitigated, activities such as grubbing, grading, and excavation could result in the permanent loss of irreplaceable cultural and archaeological resources and the knowledge that can be gained from them.

As summarized in Section 5.3.5, an ARIA was completed under permit issued by the Province. The desktop review noted eight areas with moderate potential for undiscovered archaeological resources within the proposed ROW. The remainder of the ROW exhibits low archaeological potential for Indigenous and historic archaeological resources.

6.13.3 Mitigation Measures

As cultural and archaeological features are non-renewable resources and any impact is permanent, clearly-defined mitigative measures are necessary to avoid a significant residual environmental effect. These mitigations include:

- completion of a pedestrian visual survey of 100% of the proposed ROW by a permitted Archaeologist;
- continued engagement with representatives of the Indigenous community (KMKNO); and
- implementation of training for contractors prior to construction on the Contingency Plan, to ensure that any suspected discovery is reported to NSTIR for notification and assessment as per the Plan.

6.14 Accidents and Unplanned Events

The assessment presented in Section 6.0 addresses potential effects of routine, planned Project activities associated with the construction and operation / maintenance phases. Potential for adverse effects on VECs that could be caused by unplanned, accidental events is discussed below.

Plausible accidents and unplanned events that may occur during construction and operation / maintenance of the Realignment that have the potential to adversely impact VECs include:

- Spills
- Erosion and Sediment Control Failures
- Fire
- Vehicular Collisions.

Table 6.14-1 provides an overview of the VECs that are of primary concern for each of the listed scenarios. Each scenario is briefly discussed in the following subsections.

Table 6.14-1 Accidents and Unplanned Events

Works and Activities	Soil / Sediment Quality	Groundwater Resources	Surface Water Resources	Atmospheric Environment	Acoustic Environment	Avifauna	Terrestrial Wildlife	Terrestrial Habitat and Flora	Wetlands	Aquatic Environment	Species at Risk (SAR)	Land Use	Traditional Use of Lands and Resources	Cultural and Archaeological Resources
Spills	•	•	•	•		•	•	•	•	•	•	•	•	•
Erosion / Sediment Control Failures	•	•	•			•		•	•	•	•	•	•	•
Fire		•	•	•		•	•	•	•	•	•	•	•	•
Vehicular Collisions					•		•				•	•		

6.14.1 Spills of Chemicals and Petroleum, Oils or Lubricants (POLs)

Accidental spills of POLs and other chemical substances during the construction and operation / maintenance phases of the Realignment have the potential to contaminate soil, sediment, surface water and groundwater. The potential contaminants resulting from a spill may also adversely affect vegetation, wildlife and wetlands and could result in contaminants in nearby water wells.

During construction, the contractor will be responsible for reducing the likelihood of spills by implementing effective prevention measures including the careful handling and proper storage of the products in use. Referring to the EPP for the Realignment and in accordance with regulations, the contractor is accountable to prevent, eliminate and/or remediate an adverse effect resulting from a spill and to report the spill to the Project Engineer and other applicable organizations as requested in NSE and DFO approvals, authorizations, terms and conditions and letters of advice.

Applicable generic notification and containment procedures and subsequent clean-up and restoration measures are specified in the generic EPP (NSTIR, 2007, Appendix F of the EPP) and will be detailed, if required, in supplementary Realignment-specific EPP information.

During highway operation and maintenance, spills may occur as a result of a vehicular accident. Should a vehicle (e.g., tanker truck) containing larger amounts of hazardous goods / waste be involved in an accident, the spill could adversely impact receiving watercourses and wetlands downstream of the accident site, affecting water quality, fish and wildlife. Any such spill, however, is an unlikely event. Should it occur, local and provincial emergency response services and procedures would be initiated.

6.14.2 Failure of Erosion and Sedimentation Control (ESC) Measures

The risk of failure of ESC measures is heightened during spring runoff and extreme or prolonged rainfall events. Failure of ESC measures may cause discharge of runoff with elevated levels of TSS to surface water bodies, potentially causing adverse effects on fish and fish habitat, particularly should runoff with elevated TSS enter fish spawning habitat.

The failure of ESC measures will be mitigated according to the EPP, which specifically addresses this unplanned event (NSTIR, 2007; EPP Section 5.5). The contractor is responsible for providing an outline of an appropriate contingency plan to the Project Engineer and Pieridae's' Environmental Manager. The Contingency Plan will address extreme or prolonged rainfall events and failure of ESC measures, particularly those in proximity to watercourses. Crucial components of the Plan include staff training; storm alertness; approaches for temporary control of water flow and erosion; standard protocols for notification of ESC failure; and Incident and 'Near Miss' reporting (NSTIR, 2007, Section 5.5) to the Project Engineer and Pieridae's' Environmental Manager to provide documentation of ESC failure (a Near Miss Report details failures that did not result in the loss / release of sediment; the intention is to identify the cause and help prevent future occurrences).

6.14.3 Fires

Accidental fires during Project construction and operation / maintenance activities have the potential to occur. Activities that may accidentally cause a fire include equipment or hot exhaust, refuelling, brush burning, careless smoking near construction / work areas and vehicle accidents.

Accidental fires may have serious adverse effects on sensitive receptors through habitat loss, mortality to wildlife and vegetation, atmospheric emissions and damage or loss of property or heritage / archaeological resources. There is potential for chemicals in runoff during firefighting to adversely affect surface water and fish and fish habitat.

In the unlikely event of a fire, local and provincial emergency response services and procedures would be initiated. Mitigation measures and contingency plans for fire prevention and related spill containment and clean up procedures are to be addressed in the contractor's EPP as specified in the Generic EPP (NSTIR`, 2007).

6.14.4 Vehicular Collisions

During the construction phase of the Project, standard essential barriers and signage will be erected to minimize the potential for vehicular collision. The Realignment will be designed and constructed to NSTIR's standards and designated speed limits will optimize the safety of drivers and passengers. Upon completion of road construction, NSTIR will take ownership of the realigned road segment of Marine Drive and operate the road in accordance with its highway maintenance and safety standards.

During the active development of the Goldboro LNG Facility, Pieridae will implement a Traffic Management Plan. It will be developed in close consultation with NSTIR and prescribe traffic flow within the LNG construction site and establish safe access and egress to and from the LNG construction site, laydown areas and temporary work camp.

Potential adverse effects of vehicular collisions on environmental components are addressed through subsections of spills and fires.

6.14.5 Conclusion

Unplanned events and accidents related to road construction and operation / maintenance are considered by NSTIR's Generic EPP. The NSTIR generic EPP will used by Pieridae during construction of the Realignment. The EPP prescribes responsibilities for contingencies including notification and containment procedures and subsequent clean-up and restoration measures. It also stipulates the contractor's responsibility to develop and implement a Contractor's Contingency Plan. The proposed Realignment is being designed to be operated to NSTIR's standards. The discussed construction and operation related unplanned events and accidents are rare occurrences. Together with the prescribed contingency planning,

significant adverse effects are unlikely to occur.

6.15 Effects of the Environment on the Project

Potential effects of the environment on the condition and function of the Project could result from severe weather and/or climate change.

6.15.1 Seismic Considerations

Eastern Canada is located within a stable continental part of the North American Tectonic Plate. As such, it has a relatively low rate of earthquake activity. Nevertheless, within Canada's eastern seismic region, large earthquakes have occurred in the past and will inevitably occur in the future. The causes of earthquakes in Eastern Canada are not well understood but seem to be related to the regional stress fields (Ruffman, 1994), with the earthquakes concentrated in regions of crustal weakness (Bent, 1995) at depths varying from surface to 30 km (Geological Survey of Canada (GSC), 2003).

The known earthquake seismic source zones of most concern to the populated areas of Eastern Canada are the Charlevoix, Passamaquoddy and offshore Laurentian Slope seismic zones where major earthquakes of magnitudes 7.0, 5.7 and 7.2 occurred in 1925, 1869 and 1929, respectively (AMEC, 2013). The magnitude 7.2 1929 earthquake on the Laurentian Slope (known also as the Grand Banks earthquake of 1929) triggered a large submarine slump, which ruptured 12 transatlantic cables and generated a tsunami that was recorded along the Eastern seaboard as far south as South Carolina and across the Atlantic Ocean in Portugal, and caused the loss of 28 lives on the Burin Peninsula in Newfoundland (AMEC, 2013).

The Isaac's Harbour River may have developed along a fault or shear zone in which the River would have been able to more easily carve into bedrock which is already broken and thus, more easily eroded. These same geological structures are believed to be responsible for the surplus of water discharging at the Isaac's Harbour River relative to total precipitation (AMEC, 2013).

No potential for interaction of the Project with seismic events is anticipated due to the low frequency and seismic forces anticipated in the area, and thus there will be no adverse effects on the Project.

6.15.2 Tsunami

Ruffman and Tuttle (2005) have noted that written history of tsunami by European settlers on the western side of the Atlantic Ocean is relatively short and little oral history from Indigenous peoples or Viking visitors survives. Ruffman and Tuttle's work cited nine tsunami events dating back to 1755. The tsunami that is most relevant to the proposed Project site occurred on November 18, 1929, as a result of a magnitude 7.2 earthquake along the southern edge of the Grand Banks. In NS, there was minimal damage due to earthquake vibrations in Cape Breton Island; however, the earthquake triggered a tsunami that traveled to the coast of the Burin Peninsula. It claimed a total of 28 lives in Newfoundland, one life in Cape Breton, NS, and caused significant damage. This represents Canada's largest documented loss of life directly related to an earthquake.

The proposed Goldboro LNG site was shown by the GSC (2005) to be just at the edge of the "minor damage" zone for the 1929 tsunami.

No potential for interaction of the Project with tsunamis are anticipated due to the low frequency anticipated in the area, and thus there will be no adverse effects on the Project.

6.15.3 Severe Weather

The main concern during construction relates to severe precipitation events and the potential for soil erosion and the release of a large quantity of runoff with elevated TSS to receiving watercourses, and subsequent adverse effects on fish and fish habitat. Proper installation, monitoring and maintenance of ESC measures to avoid adverse effects is therefore essential.

Extreme cold temperatures, as well as freezing rain, hail, ice and snow, are also a concern since they could delay construction activities and require additional mitigation measures. Prolonged dry and warm weather is unlikely to impact the construction schedule but could cause increased dust emissions and could require intensified dust management.

Severe precipitation events are also the prime concern during operation of the Realignment. NSTIR highways are designed to effectively and quickly transport water away from the road surface in order to minimize the risk of hydroplaning. The watercourse crossings and the water collection ditches alongside the highway will be designed to manage severe storm events, divert water away from the roadway, and avoid any flooding. Extreme rainfall, therefore, is unlikely to adversely affect highway operation. The range of temperatures in the Project area will be considered in the design phase.

Fog, freezing rain, hail, ice and snow can interfere with the operation of vehicles on the Realignment by causing slippery driving conditions and limiting visibility. This will be mitigated through NSTIR road (winter) maintenance and web- and media-based advisory services for motorists.

6.15.4 Climate Change

The Guide to Considering Climate Change in Project Development in NS (NSE, 2011) identifies potential issues and provincial expectations for planning and design of new projects. A generally accepted prediction is that the number and perhaps severity of extreme weather events will increase.

Consequently, NSTIR considers climate change in its highway design and associated water management infrastructure, with focus on the prediction of short-duration high-intensity storms and prospective drainage flow requirements during the design of drainage and watercourse crossing structures. Sea level rise, another consequence of climate change, is not expected to affect the Project.

6.15.5 Significance of Effects

Project design will consider the potential effects of the environment on the Project. Climate change and severe weather will be considered in the Project design; particularly in the engineering of the water management infrastructure. Environmental management and mitigation measures outlined in the EA will be implemented during construction together with monitoring of the effectiveness of ESC measures and proper functioning of the water crossings and conveyance features. Adverse significant effects of the environment on the Project are therefore not likely to occur.

6.16 Other Undertakings in the Area

A review of other undertakings in the area that may potentially act in combination with the environmental effects of the proposed Realignment is required under the EA Regulations. In this context, the key development in the area is the proposed Goldboro LNG Project.

Pieridae is the Proponent of the Goldboro LNG Project, which entails the development and operation of a natural gas liquefaction plant, an LNG tanker terminal, marine facilities, a power plant, and a freshwater supply pipeline. During construction, the LNG development also requires extensive temporary laydown areas, as well as a temporary work camp for up to 5,000 workers. The proposed development is the reason

behind the planned Realignment to provide the LNG facility with unobstructed access to its marine infrastructure and a safe public transport route around the LNG site (Figure 1.3-1). The Goldboro LNG development is presented in an EA Report (AMEC 2013) together with a detailed assessment of its potential environmental effects. The EA for the Goldboro LNG Project concluded that the development is unlikely to cause significant adverse environmental effects, provided the proponent implements a comprehensive mitigation and monitoring program. On the 21st of March, 2014, NSE approved the Class II EA for the Goldboro LNG Facility (NSE 2014).

The key potential environmental effects of the Goldboro LNG development were determined to include:

- direct loss of flora and terrestrial habitat;
- loss and alteration of marine aquatic habitat due to construction in the marine environment and changes to sedimentation patterns;
- loss and alteration of freshwater aquatic habitat due to alteration of an on-site water course, pipeline-related watercourse crossings, and changes to the site drainage regime;
- reduction of wetland habitat through removal, and indirectly through changes to wetland quality and functions;
- direct loss of wildlife and avifauna from collisions with components of the LNG facility and birds being attracted by the flare stack;
- potential for increased contaminant loadings in watercourses and the marine environment resulting from earthworks involving contaminated soils and sediments and contaminated surface run-off;
- reduced groundwater quality and quantity resulting from earthworks, blasting activities, and accidental spills; and
- increased atmospheric emissions, including dust during construction activities and greenhouse gases (GHG) during operation of the liquefaction trains.

While the Realignment has the potential to cause some effects like the above, in particular the loss of terrestrial and wetland habitat, the residual adverse effects from the proposed Realignment are not expected to substantially add to the potential adverse effects from the Goldboro LNG Project.

Positive effects are expected from the Realignment in that it will facilitate the implementation of the Goldboro LNG development proposal. It will provide significant short- and long-term economic stimulus and job opportunities to Guysborough County and beyond. In addition, the Goldboro LNG development will manage the on-site contaminants from legacy mining activities in full compliance with the Nova Scotia Contaminated Sites Regulations. This will reduce current contaminant levels in site surfaces and eliminate on-site exposure risks.

The only other known project proposed for the area is the Anaconda Mining Goldboro project located approximately 3.5 km north of the Realignment. EAs for the project are on-going. This undertaking is anticipated to implement similar mitigation measures for environmental protection as those outlined in this document and in the EA for the Goldboro LNG development. The Anaconda Mining Goldboro project will only obtain EA approval if residual adverse effects of that project will be predicted to be likely not significant.

Based on the above, the proposed Realignment is not considered to cause significant cumulative adverse effects with the Goldboro LNG or the Anaconda Mining Goldboro projects.

SECTION 7.0
CONSULTATION AND ENGAGEMENT

GOLDBORO LNG

7.0 Consultation and Engagement

Public, stakeholder and agency consultation is a regulatory requirement for EAs in NS. Meaningful community engagement is also critically important for Pieridae to gain public acceptance for the proposed Realignment.

Engagement with Indigenous communities is a critical element in the regulatory review of all proposed projects throughout Canada, is a mandatory requirement in the provincial EA process, and is a best practice for project proponents to understand and address potential issues and concerns.

Pieridae has therefore discussed the Realignment of Marine Drive with the community at large, stakeholders, Mi'kmaq community representatives and regulators since the inception of the Goldboro LNG project and the start of the associated EA process in 2013.

The key consultation and engagement activities completed by Pieridae are documented in the following subsections. Issues and concerns raised during consultation and engagement are summarized, with how Pieridae has and/or will address them during Project implementation. Further details on consultation and engagement activities are provided in Appendix K as referenced herein.

7.1 Public Stakeholder and Agency Consultation

7.1.1 Consultation Activities

To facilitate discussion and solicit public input on the proposed Realignment, Pieridae held two community engagement sessions:

- Public Information Session #1 in Goldboro (Community Centre) on the 4th of June, 2019, with over 100 attendees; and
- Public Information Session #2 in Goldboro (Community Centre; also accessible online) on the 8th of November, 2020, with about 60 attendees.

For more information on the 18th of November 2020 session, including a summary and photographs, refer to Appendix K.

In the June 2019 Information Session, Pieridae presented and discussed with the community a draft route and various alternative realignment options. The Session is documented in the 2019 Goldboro LNG Project Update Report of July 2019 (Wood 2019b). Generally, the presented realignment options were not supported by the community due to its impacts on travel time and the by-passing of numerous residents along Marine Drive. In addition, visitors at the 2019 Information Session on the Realignment expressed:

- general approval of the Project and were eager to have economic development in the community;
- curiosity about the environmental permitting process and current status (no particular concerns identified); and
- an interest in the likelihood that the Project will proceed and why the final decision is taking so long.

Following feedback received from the community and to minimize adverse environmental effects, Pieridae shortened the Realignment by revising the eastern segment of the route presented in 2019. The result represents the Realignment as described in Section 2.0 of this Report. Pieridae presented this final Realignment in the second Public Information Session in November 2020. This Session was also accessible as a virtual public online meeting (Appendix K).

In addition to the information sessions, Pieridae discussed the Realignment with the FAC and the CLC.

Pieridae established both committees shortly after the approval of the EA for the Goldboro LNG project in 2014. They include representatives of the local community, Mi'kmaq First Nations, Guysborough Inshore Fisheries Association, and DFO. Most recent FAC meetings were held on the 7th of May and 29th of October, 2019 as well as the 30th of September, 2020. Recent CLC meetings took place on the 30th of April and 22nd of October, 2019, as well as the 13th of October, 2020. Pieridae will continue its consultation and engagement activities through both committees throughout the planning and implementation of all Goldboro LNG project components and the Realignment.

7.1.2 Concerns Identified and Steps Taken or Proposed

The Realignment as presented in Section 2.0 was widely accepted by participants in the second Information Session (18 November 2020). The issues and concerns raised did not question the general alignment but were mainly related to the road design, property access, schedule, and temporary traffic disruptions. A summary of the issues and concerns are presented in Table 7.1-1. The Table also includes the steps taken or proposed by Pieridae to address the comments, where applicable.

Table 7.1-1 Summary of Key Community Concerns and Pieridae's Responses

#	Comments Received	Pieridae Response
1	Along with the road I suppose communication and powerlines have to move. Is there a timeline yet and how long will the disconnect period be?	Road construction is scheduled to commence around mid-2021. New communication and powerlines will be established prior to disconnecting and dismantling the existing infrastructure. Short disruptions of service may occur during the transition from the old to the new lines. Pieridae will work closely with the contractor to ensure that disruption will be minimal. Any disruptions will be communicated to the affected residents well ahead of the work.
2	We are on a cistern system. Will the plant have an effect on our water quality? The meeting only covered wells.	Wells in the vicinity of the LNG facility are being surveyed as the blasting during initial stages of the site development and roadbed construction could affect wells. Pieridae will also survey cistern-based supply systems if it collects groundwater. A rainwater fed cistern-system is not expected to be adversely impacted by the proposed site development. Pieridae will contact the commentator to obtain more information on the type and location of the system used.
3	Please also get in touch as soon as you have news regarding the water ways and the effects on our developments on harbour Island.	Pieridae will continue to communicate details on the Project via the Community Liaison Committee, the Fisheries Advisory Committee, newsletters, and occasional public information sessions. The LNG tanker approach and departure routes have been discussed and defined in closed consultation with Transport Canada's TERMPOL Review Committee. The TERMPOL Review Report (Sept 2019) can be made available upon request.
4	If we can be of any help either by offering housing, catering or supplies we are more than happy to help.	Comment noted. Pieridae intends to provide as much as possible economic benefits of the development to the local community.

#	Comments Received	Pieridae Response
5	As discussed at the meeting we are also happy to ensure any information passed to us are displayed and spread to the community. We are looking forward to get a couple of your handouts to display at the store.	Comment noted. The realignment presented on 18 November was developed in response to the community's feedback on the initial alignment.
6	If you need you are also welcome to use our telecommunication infrastructure.	Comment noted. Pieridae appreciates the support offered.
7	Our community is relieved to see the change in the road layout and all voices I heard are more than happy.	Comment noted. The realignment presented on 18 November was developed in response to the community's feedback on the initial alignment.
8	I would be incredibly great full if we could get a few weeks heads-up for the power and com line disconnect.	Any disruptions to power and communication lines will be minimal and communicated to the affected residents well ahead of the work.
9	Will the village entry sign move to the new road?	Yes. Signage will be established in accordance with TIR's standards.
10	Will the old road stay till Betty's cove or be capped after Judy?	The old road will continue up to Pieridae's property boundary. Road access to all privately owned lands with frontage along the two old road segments will be maintained.
11	General approval of shorter route as it minimizes "dead-end" residences	Comment noted. The realignment presented on 18 November was developed in response to the community's feedback on the initial alignment.
12	What timelines are being followed and what traffic interruptions may be experienced?	Road construction is scheduled to commence around mid-2021. The new road will be completed and fully functional before it is opened to the public. Traffic disruptions are expected to be limited to the short period when the intersections between the new and the old road will be built. Traffic between the communities will always be maintained either along the old or the new road. Disruptions may relate to a temporary closure of one lane. This will be implemented with a traffic management system in place (e.g., lights). Pieridae will work closely with the contractor to ensure that disruption will be minimal. Any disruptions will be communicated to the affected residents well ahead of the work.
13	Can the Road Update Report be made available to the public?	The Road Update Report will be posted on Pieridae Project Website: http://goldborolng.com/reviews-assessments/meeting-materials/

#	Comments Received	Pieridae Response
14	Will there be warnings to traffic along the road (during operation) in case of an emergency at the LNG Facility; e.g., will there be warning lights or similar systems installed?	The new road provides for safe travels around the planned LNG site. Warning systems will be developed in context of a Contingency Plan that is being established in cooperation with the local emergency response providers. This will include the development of communication plans and infrastructure and may entail warning lights along Marine Drive.
15	Marine Drive in some past years has been flooded at "the dip" near Betty's Cove Brook, cutting off direct access to Drum Head and Seal Harbour.	Pieridae appreciates the information and will consider the potential for flooding in the design of the new and the existing road. The location of the proposed realignment bypasses this historic trouble-spot, thus reducing the potential for interruptions in road service to Drum Head and Seal Harbour in future.
16	Will the vegetation in the footprint of the development be removed for good?	Within the LNG site there will be some ornamental plantings and grassed areas in association with the administration building and parking areas. The temporary laydown areas and worker's camp will be handed back to the municipality. The subsequent development of those locations will be determined by the municipality. Wetland habitat currently within the footprint of the LNG facility, the road, and any temporarily used areas, will be compensated for by Pieridae through the development and enhancement of wetland habitat off-site. Objective is to implement the compensation within the region.
17	Will the old Marine Drive segments be maintained?	Yes, the old Marine Drive segments will remain in public ownership and will be subject to normal road maintenance including winter services.
18	Is Bear Head part of the Goldboro LNG Project?	No. Bear Head was a separate proposal from a different proponent. The Bear Head project is no longer active, the proponent declared bankruptcy.
19	Is the Goldboro LNG project receiving any government funds.	No. So far, the Goldboro LNG Project has received no provincial or federal financial support.

The complete report on the outcome of Pieridae's 2020 Information Session on the Realignment is presented in Appendix K. This information will be updated in an addendum report once final feedback has been received and upon completion of Pieridae's most recent initiatives on consultation and engagement.

7.2 Consultation with the Mi'kmaq of Nova Scotia

As part of its ongoing communication with the Mi'kmaq community, Pieridae made direct contact with KMKNO to solicit feedback on the Realignment planning and to obtain information on KMKNO's preferred means of communication for future engagement. In addition to the open invitations to participate in CLC and FAC meetings, Pieridae emailed KMKNO an invite on 3 November 2020 to the 18 November 2020 Information Session (for participation in person or online). On 20 November 2020, Pieridae provided the Information Session presentation and all Comment Cards to KMKNO. Pieridae solicited further feedback from KMKNO on 27 November 2020, with the submission of a comprehensive report on the proposed Realignment (Wood, 2020b).

The submitted report presents all subjects included in this EA Registration document; i.e., a description of the undertaking, the environmental conditions and field survey results, a discussion of potential adverse effects, and comprehensive commitments to environmental management, mitigation, and monitoring. Pieridae has not yet received feedback.

Pieridae remains committed to engage with the Mi'kmaq of Nova Scotia, including the Assembly of Nova Scotia Mi'kmaq Chiefs, which includes Sipekne'katik and Millbrook, throughout the EA approval process and Project implementation. Pieridae is also committed to implementing comprehensive mitigation measures relevant to the use of land and resources along the Realignment; e.g., mitigation measures related to fish and fish habitat, vegetation, etc. These measures are summarized in Section 8.0. In addition, Pieridae is determined to provide economic and educational benefits to the Mi'kmaq community through the signed CBA. This includes the continuation of Mi'kmaq involvement in baseline studies, monitoring, and contract opportunities related to both the Realignment and the Goldboro LNG Project development.

SECTION 8.0
MONITORING, FOLLOW UP AND MITIGATION

GOLDBORO LNG

8.0 Monitoring, Follow Up and Mitigation

The Realignment of Marine Drive will be subject to monitoring under a multitude of protection and management plans (Table 8.0-1). Many of these are being developed and implemented for the Goldboro LNG Project to ensure compliance with environmental standards, regulations and commitments established in the Goldboro LNG EA and Conditions of Approval. In addition, Pieridae's construction contractor for the Realignment will be responsible for designing and implementing an environmental compliance monitoring program to meet regulatory requirements. The contractor is expected to outline all road-specific inspection and monitoring in an EPP that reflects NSTIR's Generic EPP (NSTIR, 2007).

The objectives of the monitoring programs are to:

- assist in verifying effects predictions of the EA;
- confirm effectiveness of the mitigation measures proposed in the EA;
- determine the need for new mitigation strategies as required to address unanticipated adverse effects and/or ineffective mitigation;
- ensure proper implementation of the mitigation measures outlined in the EA; and
- ensure compliance with regulatory permits, approvals, and requirements.

Pieridae will make monitoring results related to the Realignment and the Goldboro LNG development available to the established CLC, the FAC, KMKNO and to all applicable regulatory agencies.

Table 8.0-1 Summary of Mitigation and Monitoring Commitments

VEC	Proposed Mitigation	Proposed Monitoring
Groundwater	• A detailed pre-construction inventory of water wells within 500 m of the highway centreline. Pre and post-blast well surveys if blasting is required within this buffer zone. • Implementation of EPP measures and adherence to federal and provincial regulations. • Implementation, inspection, and maintenance of ESC measures as outlined in guidance documents and/or permit approvals.	• Standardized water well survey of water wells within 500m of the road centreline. Survey to encompass analysis for potable water parameters including general chemistry, metals, and bacteria (total coliform and *E.coli*) in accordance with NSE guidelines for sampling domestic wells. • Post-construction well water monitoring if required (dependent on results of initial well survey). • Results will be subsequently entered into the provincial Water Quality Monitoring Program (WQMP) database.
Surface Water	• Implementation of EPP measures and adherence to federal and provincial regulations. • Implementation, inspection, and maintenance of ESC measures as outlined in guidance documents and/or permit approvals. • Proper use and storage of chemicals and POLs as well as training in spill response and access to emergency response kits. • Adherence to NSTIR Salt Management Plan	• Monitoring surface water environments during construction to ensure adequate EPP measures and permitting requirements are being implemented. • Pieridae has developed a water quality monitoring plan for all potentially receiving watercourses at and near the Goldboro LNG site. The plan covers the construction and operation phase of the Goldboro LNG project. Due to its vicinity, this program will cover all watercourses crossed by the Realignment.
Atmospheric Environment	• Contractor is encouraged to establish non-idling policies for all construction equipment and trucks to improve local air quality and reduce GHG emissions as outlined in NSTIR's EPP. • Application of water during dusty conditions. • Limit dust generating activities when high winds are present.	• Monitoring of Contractor-controlled equipment used during construction to ensure it is in good operating condition. • Visual dust monitoring by the Contractor and Project Engineer. • Dust monitoring according to NSE guidelines (High Volume TSP sampling) may be carried out in response to complaints received during construction. • Pieridae will implement a dust management plan for the Goldboro LNG Project. Due to its vicinity, this program will also benefit the Realignment Project. The plan also includes the implementation of a complaint protocol and follow up procedures. This will also apply to the Realignment Project.

VEC	Proposed Mitigation	Proposed Monitoring
Acoustic Environment	• Contractor is encouraged to establish non-idling policies and maintenance all construction equipment and trucks to lessen noise produced. • Implementation of a noise complaint protocol and follow up procedures.	• If required, noise monitoring at receptor location(s) will be conducted in response to complaints. • Pieridae is planning ambient noise measurements in early 2021 and to subsequently implement a noise monitoring and management plan for the Goldboro LNG Project. The plan also includes the implementation of a noise complaint protocol and follow up procedures. This will also apply to the Realignment Project.
Avifauna	• Minimize Project footprint. • Use existing access routes to the ROW when possible. • Implementation of EPP; proper housekeeping practices and avoiding activities that may attract wildlife. • Adherence to applicable guidelines for noise. • Avoidance of the breeding bird season and adherence to EPP. • Adherence to NSTIR Salt Management Plan. • Implementation of mitigative measures outlined for both surface water and wetlands. • Minimize use of lighting to the greatest extent as possible. • Set appropriate speed limits. • Environmental awareness training.	• No specific monitoring is recommended. • Pieridae is monitoring the avifauna at and near the Goldboro LNG site as part of an avifauna management and research plan. Due to its vicinity, this will also apply to the Realignment Project.
Terrestrial Wildlife	• Minimize Project footprint. • Use existing access routes to the ROW when possible. • Implementation of EPP; proper housekeeping practices and avoiding activities that may attract wildlife. • Adherence to applicable guidelines for noise. • Adherence to NSTIR Salt Management Plan. • Set appropriate speed limits. • Implementation of mitigation measures outlined for both surface water and wetlands.	• No specific monitoring is recommended. • Pieridae is monitoring the moose and bats at and near the Goldboro LNG site as part of a moose/bat related research plan. Due to its vicinity and overlap of survey transects with the Realignment corridor, this will also apply to the Realignment Project.
Terrestrial Habitat and Flora	• Minimize Project footprint and lay-down areas. • Implement EPP provisions for clearing, grubbing, and blasting.	• Implement a program of identification, monitoring (EEM) and removal of noxious weeds.

VEC	Proposed Mitigation	Proposed Monitoring
	• Temporarily disturbed surfaces re-habilitated as soon as practical. • Revegetate or seal disturbed surfaces as soon as practical. • Implementation, inspection, and maintenance of ESC measures as outlined in guidance documents and/or permit approvals. • Implement dust abatement measures and sediment control measures as outlined in EPP. • Implement measures outlined in a Project-specific EPP, including provisions for mitigating winter salting in potential habitat areas. • Follow NSTIR's Integrated Roadside Vegetation Management Plan. • Follow NSTIR's Salt Management Plan. • Environmental awareness training.	• Monitoring of EPP implementation, and success of rehabilitation measures (see also Monitoring for Wetlands and Species at Risk).
Wetlands	• Avoid wetlands during Project design and layout where practical. • Limit work in and near wetlands. • Wetlands subjected to partial or total infilling will undergo wetland functional assessments. • Development of a wetland compensation plan (including appropriate compensation of function) in conjunction with the wetland alteration approval. • Stream crossing constructed using sufficiently sized culverts. • Implementation of sufficiently sized drainage structures. • Runoff from roads directed away from wetlands where practical. • Monitor efficacy of ESC measures. • Construction and transportation equipment to be cleaned of vegetation and soil residues before entering the Project site. • Follow NSTIR's Salt Management Plan.	• Monitoring in accordance with Conditions of Approval that may be formulated as part of the NSE Water Approvals for Project-related wetland alterations and required wetland compensation work. • Monitor vegetation development in constructed, rehabilitated or enhanced wetlands and remove noxious weeds, if required.
Aquatic Environment	• Acquisition of NSE Water Approval and DFO *Fisheries Act* authorization. • Proper sizing and installation of culverts by a certified watercourse alteration installer.	• If required, post-construction fish habitat monitoring within and downstream of the Project footprint as per Project-specific DFO and/or NSE requirements (e.g.,

VEC	Proposed Mitigation	Proposed Monitoring
	• Blasting conducted in accordance with the *Guidelines for the use of Explosives in or Near Canadian Fisheries Waters* (Wright and Hopky, 1998) and relevant federal and provincial guidelines.	monitoring of successful implementation of mitigation and offset measures pursuant to the *Fisheries Act*.)
Species at Risk	• See mitigation for terrestrial habitat/flora, wildlife, avifauna, and fish • Development of a Blue Felt Lichen Conservation and Research Plan (including, if required, lichen translocation and monitoring)	• Implement a program of identification, monitoring (EEM) and removal of noxious weeds. • Monitoring in accordance with Conditions of Approval that may be formulated as part of the NSE Water Approvals for Project-related wetland alterations and required wetland compensation work. • Monitor vegetation development in constructed, rehabilitated or enhanced wetlands and remove noxious weeds, if required. • Monitoring of EPP implementation, and success of rehabilitation measures. • Post construction monitoring of Blue Felt Lichen
Land Use	• Implementation of Project-specific EPP. • Adherence to applicable guidelines for noise and implementation of a noise management plan (see also mitigation listed under Acoustic Environment"). • Implementation of a dust management Plan (see also mitigation listed under Atmospheric Environment"). • Adherence to NSTIR Salt Management Plan.	• See monitoring for Groundwater, Air Quality, Noise, all other natural environment VECs, and Cultural/Archaeological Resources
Traditional Use of Lands and Resources	• See all mitigation measures listed above and under "Cultural and Archaeological Resources"; plus: • Continuation of consultation throughout the implementation phase of the Project with the Mi'kmaq of Nova Scotia, including the Assembly of Nova Scotia Mi'kmaq Chiefs, which includes Sipekne'katik, and Millbrook. • Continuation of communication with the local community pertaining to Project implementation and construction.	• See monitoring for Groundwater, Air Quality, Noise, all other natural environment VECs, and Cultural/Archaeological Resources

VEC	Proposed Mitigation	Proposed Monitoring
	• Continued commitment to the signed Collaborative Benefits Agreement for the Goldboro LNG development including the Realignment Project.	
Cultural and Archaeological Resources	• Implementation of EPP. • Walk over and, if required, subsurface archaeological testing (shovel testing) within the proposed ROW upon vegetation clearing and prior grubbing and earthworks. • Obtaining clearance of any requirement for additional archaeological investigation from NS Communities, Culture & Heritage (NSCCH). • Cooperation and site visits with Mi'kmaq representative/ archaeologist. • Implementation of Archaeology Contingency Plan. • Provision of cultural awareness training in collaboration with Mi'kmaq archaeologist.	• Visual site inspections/monitoring of earthworks in compliance with conclusions of ARIA and NSCCH permit requirements.

SECTION 9.0
SUMMARY AND CONCLUSION

GOLDBORO LNG

9.0 Summary and Conclusion

Pieridae is the Proponent of the Realignment of approximately 3.5 km of the existing Marine Drive (Hwy 316) in Goldboro, NS. The Realignment will convey traffic along a new road segment of about 5.6 km around the site for the planned Goldboro LNG facility. Pieridae will design and construct the Realignment to NSTIR standards. NSTIR will review and approve the design and once constructed will take ownership of the Realignment and its operation and maintenance.

The potential adverse effects of the proposed Realignment on biophysical and socioeconomic environmental components were assessed. The assessment considered all works and activities associated with the construction and operation phases of the Project. The analysis included regular Project-environment interactions as well as potential effects of unplanned events and accidents. Subsequently, comprehensive mitigation and environmental management measures were developed to avoid and/or minimize adverse effects.

The assessment also looked at the potential effects that environmental conditions (severe weather, climate change) could have on the Project as well as potential effects that may arise from the realization of other projects in the Regional Study Area. The EA concluded that upon implementation of the environmental management and mitigation measures no significant adverse environmental effects are likely to occur.

Positive effects are expected from the Realignment in that it will facilitate the implementation of the Goldboro LNG development proposal. This development underwent a separate EA process and was approved by NSE in 2014. The LNG project will provide significant short- and long-term economic stimulus and job opportunities to Guysborough County and the Province of Nova Scotia. The Realignment will provide the LNG project with unobstructed access to future marine infrastructure and will provide for increased road safety. In addition, the Goldboro LNG development will manage the onsite contaminants from legacy mining activities in full compliance with the Nova Scotia Contaminated Sites Regulations to reduce current contaminant levels in site surfaces and eliminate onsite exposure risks.

To facilitate discussion of and solicit public input on the Realignment, Pieridae implemented a comprehensive consultation and engagement program. The assessed Realignment was widely accepted by the community. Pieridae will continue with its consultation and engagement activities throughout the implementation of the Realignment and beyond. This includes meetings with the established CLC, the FAC, and direct dialogue with the Mi'kmaq of Nova Scotia, including the Assembly of Nova Scotia Mi'kmaq Chiefs, which includes Sipekne'katik, and Millbrook First Nations.

SECTION 10.0
REFERENCES

GOLDBORO
LNG

10.0 References

AMEC Environment & Infrastructure, a division of AMEC Americas Limited (AMEC). 2013. Environmental Assessment Report (Class 2 Undertaking), Goldboro LNG Project, Natural Gas Liquefaction Plant & Marine Terminal, Pieridae Energy (Canada) Ltd. Final Report (dated September 2013).

AMEC Environment & Infrastructure, a division of AMEC Americas Limited (AMEC). 2014. Preliminary Archaeological Resource Impact Assessment Goldboro LNG Project - Natural Gas Liquefaction Plant and Marine Terminal, Goldboro, Guysborough County, NS. Research Permit A2013NS014. Manuscript on file, Nova Scotia Museum.

Amec Foster Wheeler. 2018. Goldboro LNG Project. Natural Gas Liquefaction Plant and Marine Terminal. Traffic Impact Study (Condition 2.12 of EA Approval). - Final Traffic Impact Study Goldboro LNG Project (Oct 2018) prepared by WSP. Halifax.

American Association of State and Transportation Officials (AASHTO). 2007. Environmental Stewardship Practices, Procedures and Policies for Highway Construction and Maintenance.

Anaconda Mining. 2021. Operations and Projects – Goldboro Project. Accessed at: https://www.anacondamining.com/anx/operations_and_projects/3302

Atlantic Road & Traffic Management (ARTM). 2007. Traffic Impact Study, Keltic Petrochemical Inc. and Maple LNG Liquefied Natural Gas Facilities (dated December 2007).

Barclay, R.M.R., Fullard J.H. and Jacobs, D.S. 1999. Variation in the echolocation calls of the hoary bat (Lasiurus cinereus): influence of body size, habitat structure, and geographic location. The Canadian Journal of Zoology 77:530-534.

Barclay, M.R. 1989. The effect of Reproductive Condition on the Foraging Behaviour of Female Hoary Bats, Lasiurus cinereus. Behavioural Ecology and Sociobiology. 24:31-37.

Beale, C.M. 2007. The behavioural ecology of disturbance responses. International Journal of Comparative Psychology 20:111-120.

Bent, A.L. 1995. A Complex Double-Couple Source Mechanism for the MS 7.2 1929 Grand Banks Earthquake; Bulletin of the Seismological Society of America, Vol. 85, No. 4, pp. 1003-1020, August 1995 .Boehner, R.C. and Giles P.S., 1982: Geological Map of the Antigonish Basin, Nova Scotia; NS Dept. of Mines and Energy Map 82-2, scale 1:50,000.

Betts B.J. 1998. Effects of Interindividual Variation in Echolocation Calls on Identification of Big Brown and Silver-Haired Bats. Journal of Wildlife Management 62(3): 1003-1010.

Bird Studies Canada (BSC). 2018. 2nd Maritimes Breeding Bird Atlas. Data accessed from NatureCounts, a node of the Avian Knowledge Network, Bird Studies Canada. Available: http://www.naturecounts.ca/. Accessed: 30 October 2018.

Blumstein, D.E. Fernandez-Juricic, P. Zollner, and S. Garity. 2005. Inter-specific variation in avian responses to human disturbance. Journal of Applied Ecology 42:943-953.

Broders, H.G., G.M. Quinn, and G.J. Forbes. 2003. Species status, and the spatial and temporal patterns of activity of bats in southwest Nova Scotia, Canada. Northeastern Naturalist 10:383-398.

Canadian Council of Ministers of Environment (CCME). 2012. Canada-wide Air Quality Management System (AQMS), encompassing Canadian Ambient Air Quality Standards (CAAQS). Accessed online: http://www.ccme.ca/en/resources/air/aqms.html

Canadian Council of Ministers of the Environment (CCME) 2007. Water Quality Guidelines for Freshwater Aquatic Life. Available online at: http://st-ts.ccme.ca/

Cann, D.B., and Hilchey, J.D. 1954. Soil survey of Antigonish County, Nova Scotia; Report 6, NS Soil Survey, Truro, NS, 54p. plus map, scale 1:63,360.

Church, Ambrose F. 1876. Topographical Township Map of Guysborough County, Nova Scotia.

Cowan J.P. 1994. Handbook of Environmental Acoustics, Chapter 2: Noise Descriptors. Van Nostrand Reinhold, New York, NY

Davis Archaeological Consultants Limited (DAC). 1999. Reconnaissance Survey Shipwrecks S.S. Finchley and Foundation Masson. Heritage Research Permit A1998NS38. Manuscript on file, Nova Scotia Nova Scotia Museum.

Davis Archaeological Consultants Limited (DAC). 2004. Archaeological Resource Impact Assessment: Goldboro Industrial Park. Heritage Research Permit A2004NS76. Submitted to Alan Bell Environmental Management, Halifax, NS. December 2004.

Davis Archaeological Consultants Limited (DAC). 2007a. Archaeological Resource Impact Assessment: Goldboro Petrochemical & LNG Facility: Part One – MapleLNG Facility. Heritage Research Permit A2007NS69. Manuscript on file, Nova Scotia Museum.

Davis Archaeological Consultants Limited (DAC). 2007b. Archaeological Resource Impact Assessment: Goldboro Petrochemical & LNG Facility: Part Two – Keltic Petrochemical Facility. Heritage Research Permit A2007NS69. Manuscript on file, Nova Scotia Museum.

Davis Archaeological Consultants Limited (DAC). 2008. Deep Panuke Landfall - Interim Report: Archaeological Resource Impact Assessment. Heritage Research Permit A2008NS70. Manuscript on file, Nova Scotia Museum.

Davis Archaeological Consultants Limited (DAC). 2009. Deep Panuke Landfall Preparation Project: Archaeological Resource Impact Assessment. Heritage Research Permit A2009NS03. Manuscript on file, Nova Scotia Museum.

Davis Archaeological Consultants Limited (DAC). 2010. Deep Panuke Onshore Pipeline: Archaeological Monitoring. Heritage Research Permit A2010NS02. Manuscript on file, Nova Scotia Museum.

Department of Justice Canada. 2021. *Species at Risk Act* (S.C. 2002, c. 29). Justice Laws Website, Accessed at https://laws.justice.gc.ca/eng/acts/S-15.3/

Environment and Climate Change Canada (ECCC). 2018a. National Air Pollution Surveillance Program (NAPS). Accessed October 2018 : http://maps-cartes.ec.gc.ca/rnspa-naps/data.aspx

Environment and Climate Change Canada (ECCC). 2018b. General Avoidance Guidelines for Migratory Birds. https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/reducing-risk.html. Accessed 31 October 2018.

Environment and Climate Change Canada (ECCC), 2020. Canadian Climate Normals 1981-2010: Stillwater-Sherbrooke. Accessible:

https://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnProv&lstProvince=NS&txtCentralLatMin=0&txtCentralLatSec=0&txtCentralLongMin=0&txtCentralLongSec=0&stnID=6482&dispBack=0

Farmer, A. M. 1993. The Effects of Dust on Vegetation – A Review. Environ. Poll. 79:63-75.

Fenton, M.B., Bell, G. 1981. Recognition of Species of Insectivorous Bats by Their Echolocation Calls. Journal of Mammology 62(2):233.

Fenton, M.B., Merriam, H.G., Holroyd, G.L. 1983. Bats of Kootenay, Glacier and Mount Revelstoke National Parks in Canada: Identification by Echolocation Calls, Distribution and Biology. Canadian Journal of Zoology 61:2503-2508.

Fisheries and Oceans Canada (DFO). 2015. Guidelines for the Design of Fish Passage for Culverts in Nova Scotia. Fisheries Protection Program, Maritimes Region. February 2015.

Fisheries and Oceans Canada (DFO). 2014. Pathways of Effects. Available online at: http://www.dfo-mpo.gc.ca/pnw-ppe/pathways-sequences/index-eng.html

Fisheries and Oceans Canada (DFO). 2013. Risk-Based Assessment of Climate Change Impacts and Risks on the Biological Systems and Infrastructure within Fisheries and Oceans Canada's Mandate - Atlantic Large Aquatic Basin. Accessed 2018: http://waves-vagues.dfo-mpo.gc.ca/Library/348874.pdf

Fisheries and Oceans Canada. 1998 (DFO). Guidelines for the Protection of Fish and Fish Habitat. The Placement and Design of Large Culverts. Final Draft, April, 1, 1998.

Fletcher, H., and Faribault, E.R. 1893. Province of Nova Scotia, Guysborough County: Map sheet No. 27 (Isaac's Harbour Sheet); GSC Map 381, scale 1:63,360.

Geological Survey of Canada (GSC). 2005. The Magnitude 7.2 1929 Grand Banks earthquake and tsunami: Geologic Survey of Canada web page http://www.seismo.nrcan.gc.ca/damage/1929/1929_e.php, last modified 2005-01-10.

Geological Survey of Canada (GSC). 2003. Earthquakes in Southeastern Canada; Geologic Survey of Canada web page http://www.seismo.nrcan.gc.ca/historic_eq/eastcan_e.php, last modified 2003-02-06.

Government of Canada. 2020. Species at Risk Public Registry. Accessed at: https://species-registry.canada.ca/index-en.html#/species?sortBy=commonNameSort&sortDirection=asc&pageSize=10

Government of Canada. 1991. The Federal Policy on Wetland Conservation.

Health Canada. 2017. Guidelines for Canadian Drinking Water Quality—Summary Table. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. February 2017.

Health Canada. 2020. Guidelines for Canadian Drinking Water Quality—Summary Table. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. September 2020.

Hilchey, J.D., Cann, D.B., and MacDougall, J.I. 1964. Soil Survey of Guysborough County, Nova Scotia; Canada Dept. of Agriculture and Nova Scotia Dept. of Agriculture and Marketing, Nova Scotia Soil Survey Report No. 14, 55 p.

Jacobsen, S.L. (2005). Mitigation Measures for Highway-caused Impacts to Birds. USDA Forest Service Gen. Tech. Rep. PSW-GTR-191.]

Jacques Whitford. 2007a. Noise Monitoring Plan – EA Condition 2.2. Keltic Petrochemicals Inc. November 9, 2007.

Keppie, J.D. 1977. Tectonics of Southern Nova Scotia; Nova Scotia Dept. of Mines Paper 77- 1, 34 p.

Larkin, R.P. 1996. Effects of military noise on wildlife: a literature review. US Army Construction Engineering Research Laboratories Technical Report 96/21. January 1996.

MacDonald, K., Matsui, E., Stevens, R. and Fenton, M.B. 1994. Echolocation Calls and Field Identification of the Eastern Pipistrelle (Pipistrellus subflavus: Chioptera: Vespertilonidae), Using Ultrasonic Bat Detectors. Journal of Mammology 75(2):462-465

MapleLNG Limited (MapleLNG). 2008. Application for Permit To Construct for the proposed MapleLNG Facility, dated March, 2008.

McBurney, T.S., Segers J.L. 2020. Acoustic Guide for Bat Monitoring in Atlantic Canada. Canadian Wildlife Health Cooperative. 233 p.

Natural Resources Canada (NRCan). 2008. From Impacts to Adaptation: Canada in a Changing Climate 2007.
Accessible:https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/assess/2007/pdf/full-complet_e.pdf

New Brunswick Department of the Environment and Local Government (NBDELG). 2001. An Introduction to Air Quality in New Brunswick. Accessible:
https://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/Air-Lair/AirQuality-QualiteDeLair/IntroductionAirQuality.pdf

Niven, L., N. Brown, and A. Richardson. 2001. Redhead Archaeology, 2001: Excavations at the Webb Family Cemetery, Goldboro, Guysborough County, Nova Scotia. Manuscript on file, Nova Scotia Museum.

Niven, Laird. 2001. Proposed Deep Panuke Project. Manuscript on file, Nova Scotia Museum.

Nova Scotia Department of Environment and Labour (NSEL). 2005. Guidelines for Environmental Noise Measurement and Assessment. Published in May 2005.

Nova Scotia Department of Lands and Forestry (NSDLF). 2021. Ecological Land Classification Map of Nova Scotia: Online Viewer. Available at: https://nsgi.novascotia.ca/plv/. Accessed February, 2021.

Nova Scotia Department of Lands and Forestry (NSDLF). 2018. Nova Scotia Significant Species and Habitats Database. Available at: https://novascotia.ca/natr/Wildlife/habitats/hab-data/

Nova Scotia Department of Natural Resources (NSDNR). 2013. Nova Scotia Endangered Species Act. Accessed at: http://novascotia.ca/natr/wildlife/biodiversity/legislation_nsesa.asp

Nova Scotia Department of Natural Resources (NSDNR). 2003. Ecological Land Classification for Nova Scotia, Volume 1 – Mapping Nova Scotia's Terrestrial Ecosystems. Report DNR 2003-2, April 2003.

Nova Scotia Environment (NSE), 2021. NS Station Locations, accessed 2021: https://novascotia.ca/nse/airdata/

Nova Scotia Environment (NSE), 2018. NS Air Zone Report – 2018. Accessed 2021: https://novascotia.ca/nse/air/docs/NS-Air-Zone-Report-2018.pdf

Nova Scotia Department of Natural Resources (NSDNR). 2018. Ecological Land Classification for Nova Scotia. ISBN 978-1-55457-749-1. Accessed at: https://novascotia.ca/natr/forestry/ecological/pdf/Ecological-Land-Classification-guide.pdf

Nova Scotia Environment (NS). 2015a. Nova Scotia Watercourse Alteration Standard for Watercourse Alterations Under Notification Process, Province of Nova Scotia. 19 pgs.

Nova Scotia Environment (NSE). 2015b. Guide to Altering Watercourses, Province of Nova Scotia. ISBN: 978-1-55457-644-7. 62 pgs.

Nova Scotia Environment (NSE). 2014. Environmental Assessment Approval. Approval Date: March 21, 2014. Goldboro LNG Project, Natural Gas Liquefaction Plant & Marine Terminal, Pieridae Energy (Canada) Ltd., NSE, Halifax.

Nova Scotia Environment (NSE). 2011. Guide to Considering Climate Change in Project Development in Nova Scotia. Dated February, 2011. 39pp.

Nova Scotia Federation of Agriculture. 2006. Sharing the Cost of Acidic Soil Conditions. An integrated approach to soil conservation and sustainable soil management. August 2006. 24 pgs

Nova Scotia Department of Transportation and Infrastructure (NSTIR). 2007. Generic Environmental Protection Plan (EPP) for the Construction of 100 Series Highways.

Nova Scotia Department of Transportation and Infrastructure (NSTIR). 1997. Standard Specification: Highway Construction and Maintenance. Available at: https://novascotia.ca/tran/highways.

Nova Scotia Museum of Natural History (NSMNH). 1996. The Natural History of Nova Scotia, Vol. 1 - Topics and Habitats and Vol. 2 - Theme regions. Davis, D.S. and S. Browne (editors). Nimbus/Government of Nova Scotia, Halifax, N.S.

Nova Scotia Department of Transportation and Public Works (NSDTPW). Undated. Integrated Roadside Vegetation Management Manual.

Rudloff, Willy. 1981. World Climates with Table of Climatic Data and Practical Suggestions. Books of the Journal Naturwissenschaftiche Rundschau, Edited by Prof. Wolfgang Holl, Munchen, Wissenschftliche Verslagsgelellschaft mbH, Stuggart.

Ruffman, A. 1994. The November 18, 1929 Tidal Wave': Canada's Most Tragic Earthquake; Atlantic Geology, 30 (2), p, 157-158.

Ruffman, A. and Tuttle, M.P. 2005. Tsunamis of Eastern Canada and New England: the primary historical record; Proceedings of the 12th Canadian Coastal Conference, Dartmouth, Nova Scotia, November 6-9, 2005.Salt Institute, 2004: Highway Salt and our Environment. Alexandria, Virginia.

StatsCan. 2016. The 2016 Census of Population. Available at: https://www.statcan.gc.ca/eng/start

Stea, R.R., Conley, H., and Brown, Y. 1992. Surficial Geology of the Province of Nova Scotia, Nova Scotia Dept. of Natural Resources, Mines and Energy Branches Map 92-3, scale 1:500,000.

Stea, R.R., and Fowler, J.H. 1979. Pleistocene Geology, Eastern Shore Region, Nova Scotia; N.S. Dept. of Mines Paper 79-4, accompanied by Map Sheet 1 and Map Sheet 2, scale 1:100,000.

Stewart, D. T., Perry, N. D., and L. Fumagalli, 2002. The Maritime Shrew, Sorex maritimensis (Insectivora: soricidae): A Newly Recognized Canadian Endemic. Can. J. Zod. 80: 94- 99.

United States Army Corps of Engineers (USACE). 2012. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Version 2.0).

Washburn & Gillis Associates Ltd (WGA). 1998. Proposed Maritimes & Northeast Pipeline Project, Goldboro, Nova Scotia to St. Stephen, NB – Archaeological Resources 1997 Field Program Final Report. Manuscript on file, Archaeological Services New Brunswick.

Wood. 2019a. Archaeological Resource Impact Assessment 2018: Pieridae Energy Ltd. Goldboro LNG Project – Natural Gas Liquefaction Plant and Marine Terminal, Guysborough County, Nova Scotia. Research Permit A2018NS093. Manuscript on file, Nova Scotia Museum.

Wood, 2019b. Goldboro LNG Project - Natural Gas Liquefaction Plant and Marine Terminal. Phase II Environmental Site Investigation. Unpublished Report prepared for Pieridae Energy Ltd. Halifax, Nova Scotia.

Wood, 2020a. Goldboro LNG Project - Pre-Blast Water Well Survey Report (Condition 2.7 of EA Approval). Prepared for Pieridae Energy Ltd. Halifax, Nova Scotia. Dated June 2020.

Wood, 2020b. Goldboro LNG Project – Natural Gas Liquefaction Plant and Marine Terminal. Project Change – Realignment of Highway 316 (Condition 1.2 of EA Approval). Prepared for Pieridae Energy Ltd. Halifax, Nova Scotia. October 2020

Wood. 2021. Goldboro LNG Project - Natural Gas Liquefaction Plant and Marine Terminal. Wetland Management Plan (Condition 2.8 of EA Approval). Road Realignment (Hwy 316)

Woodman, N., Reid, F. & NatureServe (Hammerson, G.) 2008. Sorex maritimensis. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2.

Wright, D.G. and G.E. Hopky. 1998. Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters.