

SECTION 8.0

ASSESSMENT METHODOLOGY AND VALUED ENVIRONMENTAL COMPONENT (VEC) SELECTION



**GOLDBORO
LNG**

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8.0 ASSESSMENT METHODOLOGY AND VALUED ENVIRONMENTAL COMPONENT (VEC) SELECTION

This section presents the study strategy, methodology, and boundaries, used in the EA.

The approach has been developed in a manner which incorporates:

- the EA requirements formulated in the Provincial TOR (NSE, 2013a) (Appendix A);
- the identification of the environmental and socio-economic factors of greatest concern;
- the consideration of all issues raised by stakeholders;
- the incorporation of environmental management planning into the engineering design process;
- the inclusion of cumulative effects in all stages of impact prediction; and
- compliance with all applicable regulatory requirements.

The following subsections describe the approach and strategy to:

- the definition of study boundaries (temporal and spatial);
- VECs;
- investigation of the interactions between the Project and each VEC;
- prediction and evaluation of environmental effects;
- development of avoidance and/or mitigative measures; and
- determination of the significance of residual effects.

8.1 Existing Relevant Environmental Assessments (EA)

The Project site is situated in an area of extensive past mining activities and developments for the energy sector. The Keltic Project EA report (AMEC, 2006) provided extensive information on the the description of the existing environment for the Project (Section 9.0). Some additional reports had also been created for the Keltic Project as required by the provincial EA Conditions of Approval. To the extent that these reports are relevant and accessible, Pieridae has made use of the information and incorporated it with work for the EA process. AMEC conducted several field surveys in 2012 and 2013 to complement these information sources.

The Keltic Project LNG component was purchased by MapleLNG in 2006; however, the federal and provincial assessment processes continued under the Keltic Project title. MapleLNG subsequently obtained a provincial Permit to Construct for a Gas Plant (June, 2008) and a Send Out Pipeline (September, 2009). MapleLNG formally terminated the permits in March 2011 following a decision not to proceed with the Project. Environmental documents supporting the MapleLNG approvals have similarly been used and applied in the EA process, to the extent that they are relevant and accessible to Pieridae.

8.2 Boundary Definitions

8.2.1 Temporal Boundaries

Project timelines are based on an expectation of approximately three years to achieve regulatory approval for Project construction and commissioning. Construction activities will consume slightly over four years (51 months construction and six months commissioning). The proposed temporary off-site work camp may not be required for the entire duration of the construction phase. However, for the purpose of the effects assessment the camp is assumed to be in place and operate over the entire construction phase (i.e., 51 months).

While the nominal design life of the process is 20 years, given normal maintenance, refinement, and re-investment, the operation and maintenance activities will likely extend well beyond the 20 year timeframe. For the purposes of this EA, we have assumed an operating life of 50 years. Closure, decommissioning, and post-decommissioning would follow the operating phase. The timing of this Project phase is uncertain. Pieridae will undertake decommissioning and reclamation for the Project as per the legislation and guidelines of the time.

Temporal boundaries define the duration over which the Project activities and phases interface with each VEC. Where applicable, specific aspects of temporal boundaries are addressed as part of the scope definition for each VEC (see Section 8.3.4).

8.2.2 Spatial Boundaries

The general study bounds of the EA have been defined as comprising:

- the Project site (Project footprint) (Figures 1.7- 1 to 1.7-3) situated on the eastern side of Country Harbour in Goldboro, NS (the development site encompasses the footprints of all permanent features presented in Section 3.0 plus the temporary work camp);
- the lands adjacent to the Project site; the extent of these lands is VEC-specific and dependent on functional ecological considerations as well the predicted Zone of Influence of the Project; adjacent lands therefore can be defined by such areas as a watershed, and the predicted geographic extent of air and noise emissions;
- the waters and shore of Isaac's Harbour and its extension into the area of Stormont Bay;
- the MODG;
- the Region encompassing the counties of Guysborough, Antigonish, and Pictou; and
- the Province of NS.

Spatial boundaries establish the limits within which the Project interacts with the surrounding environment. The Zone of Influence reflects an area beyond the Project footprint and incorporates aspects such as airborne plumes which can act to expand the physical area over which Project features interact with the receiving environment. The spatial boundaries can also vary in accordance with each VEC. Table 8.2-1 shows the spatial boundaries principally applied in the inventory work and effects assessment for each of the VECs. Where applicable, specific aspects of spatial boundaries are addressed as part of the scope definition for each VEC in Section 8.3.4, below.

Table 8.2-1 Spatial Boundaries Applied by VECs

Environmental Category	VEC	Project Site	Adjacent Lands	Isaac's Harbour, Stormont Bay	District Municipality	Region	Nova Scotia	Comment
Biophysical Environment	Geology, Soil Quality	✓	✓					
	Groundwater – Quality and Quantity	✓	✓					Adjacent lands/ off-site area defined by (sub-) watershed boundaries.
	Surface Water (Quality, Quantity, Sediment Quality and Transport)	✓	✓					Adjacent lands/ off-site area defined by (sub-) watershed boundaries of Meadow Lake, Gold Brook Lake, and Ocean Lake.
	Air Quality and Climate Change	✓	✓		✓	✓	✓	NS only addressed in context of Project contributions to GHG emissions.
	Acoustic Environment (Noise) and Ambient Lighting	✓	✓	✓	✓			
	Terrestrial Habitat, Flora, and Fauna (including SAR)	✓	✓	✓				Adjacent lands/ off-site area defined by (sub-) watershed boundaries/functional links to relevant drainage features and geographic extent of predicted air quality effects; marine areas only addressed in relation to waterfowl, wintering birds, and marine birds (including Roseate tern).
	Wetlands	✓	✓					Adjacent lands/ off-site area defined by (sub-) watershed boundaries/functional links to other wetlands and drainage features.
	Freshwater Habitat and Aquatic Species (including SAR)	✓	✓					Adjacent lands/ off-site area defined by (sub-) watershed boundaries.
	Marine Habitat (incl. Beaches) and Species (including SAR)			✓				
Socio-Economic and Cultural	Agriculture	✓	✓					Adjacent lands/ off-site area defined by (sub-) watershed boundaries/functional links to relevant drainage features and geographic extent of predicted air quality effects.
	Fisheries, Aquaculture and Harvesting			✓				
	Forestry	✓	✓					Adjacent lands/ off-site area defined by (sub-) watershed boundaries/functional links to relevant drainage features and geographic extent of predicted air quality effects.

Environmental Category	VEC	Project Site	Adjacent Lands	Isaac's Harbour, Stormont Bay	District Municipality	Region	Nova Scotia	Comment
Socio-Economic and Cultural (Continued)	Socio-Economic: Population, Economic Conditions, Property Value, Employment, Tourism	✓	✓	✓	✓	✓	✓	NS only addressed as part of the overall economic benefits.
	Human Health and Safety	✓	✓	✓				Adjacent lands/ off-site area defined by geographic extent of predicted air quality and noise effects; Isaac's Harbour and Stormont Bay included with respect to navigational safety and potential effects from fish consumption.
	Land Use – Existing and Planned	✓	✓		✓			
	Road Transportation				✓	✓		Main transport routes only.
	Recreational Opportunities and Aesthetics	✓	✓	✓	✓	✓		Aesthetics only addressed for Project site, and adjacent lands and waters to geographic extent of viewshed.
	Aboriginal Use of Land and Resources	✓	✓	✓	✓	✓		
	Archaeological Resources	✓	✓					

8.2.3 Technical Boundaries

Technical boundaries represent any technical limitations on the ability to inventory, assess, evaluate, and/or monitor potential environmental effects. For example, insufficient data or data gaps on the abundance, status, and distribution of a wildlife population may limit the ability to predict the potential effects of a proposed development on it. Where such limitations exist, it is important that they be recognized and acknowledged. Principally no such technical boundaries have been identified for the Project, unless explicitly addressed in Section 8.3.4, below.

8.2.4 Administrative and Legislative Boundaries

Administrative and legislative boundaries are the spatial and temporal dimensions imposed on the environmental assessment for political, socio-cultural, or economic reasons. Spatial administrative boundaries can include such elements as the way in which natural and/or socio-economic systems are managed (e.g., Northwest Atlantic Fisheries Organization (NAFO) Fishing Areas). Temporal administrative boundaries may include, for example, fishing seasons. Administrative boundaries also include those regulatory requirements that influence the Project and its implementation.

The Project is regulated under the jurisdiction of the Province of NS as well as the Federal government. Project-relevant legislation and regulations pertaining to both are described in Section 4.0 "Regulatory Environment" of this EA. Where applicable, specific aspects of administrative and legislative boundaries are addressed as part of the scope definition for each VEC in Section 8.3.4 below. They are taken into account as part of the inventory and assessment and, if required, expanded upon for each VEC in Section 9.0 and Section 10.0 respectively.

8.3 VEC Selection

8.3.1 Methods

It is widely recognized that there is a need to focus on those environmental components, known as VECs, which have the greatest relevance to the final EA decision (Beanlands and Duinker, 1983). VECs are generally defined as environmental attributes or components of the environment that are valued by society as identified through issues scoping. They are determined on the basis of perceived public concerns. For this Project, VECs were selected from the issues identified and intended to reflect the concerns expressed by regulators, technical specialists and the interested public.

For the Project at hand, the VEC selection process involved the following steps and considerations:

- review of requirements of the TOR and scoping document;
- review of the baseline studies;
- review of Project works and activities;
- consideration of potential Project-environment interactions; and
- identification of public, stakeholder, and government concerns.

VECs are generally interpreted as environmental; socio-economic; human health; reasonable enjoyment of life and property; and cultural, historical, archaeological, paleontological, and architectural features that may be impacted, whether positively or negatively, by the proposed Project. From these definitions, the EA team and Pieridae drew on their collective knowledge and experience to further define specific VECs. In addition, the public at large, government departments and agencies, stakeholder groups, and First Nations were extensively consulted and engaged (see Section 13.0).

Environmental components that are represented in the area, potentially affected by the Project, of public concern, representative of one or more of the features listed in the TOR (NSE, 2013a) were considered a VEC.

8.3.2 Determining Project-Environment Interaction

Project- environment interactions include direct and indirect effects of the Project. Determining these interactions involved:

- review of Project works and activities;
- analysis of direct effects;
- identification of pathways; and
- assessment of effects through pathways.

Plausible Project-environment interactions were identified based on professional judgment and a preliminary knowledge of the Project and the environmental characteristics of the site and the surrounding areas. These considerations contributed to the determination of the VECs. Subsequently, as part of the effects assessment (Section 10.0) and for each VEC, these

interactions were analyzed in detail. For example, it is plausible to assume that terrestrial habitat is affected by the Project as a consequence of habitat removal on site. During the effects assessment, this interaction was analyzed in detail and the type and geographic extent of the affected habitat specified.

In a subsequent step for each VEC, the potential for Project-related effects through pathways was analyzed. VECs are typically interacting via pathways. Air quality, for example, represents a pathway in that it provides a link between a source (i.e., an exhaust stack) to a receptor (i.e., flora, fauna, and human). Some VECs can function as both a pathway and a receptor. For example, soil quality can be affected by the Project via air quality (deposition of air-borne contaminants). Soil quality also becomes a pathway through contaminant uptake via plant roots and subsequent human or animal consumption.

This understanding of the links between sources for environmental change and VECs as pathways and receptors was the basis for the assessment of effects associated with pathways. It required that the effects assessment for each VEC also reviewed and incorporated the effect predictions established for other VECs.

The approach to actual effects assessment is described in Section 8.4 below.

Potential direct Project interactions with VECs are presented in Table 8.3-1. The interactions were identified on the basis of the assessment for the Keltic Project (AMEC, 2006), Pieridae's extensive experience with LNG projects such as the Kitimat LNG Facility in Bish Creek, British Columbia, input from Government Agencies and the study team's experience with similar projects. Potential for VECs to act as pathways has been included with Table 8.3-2.

8.3.3 VECs and Environmental Relevance, Public Concern, TOR Requirements

VECs for which a potential for an interaction with the Project was identified (Table 8.3-1) were reviewed further. A VEC was considered relevant for the EA if its assessment was deemed necessary based on one or more of the following criteria:

- legal requirement;
- scientific interest;
- environmental/ecological context;
- socio-economic relevance;
- human health relevance;
- relevance for reasonable enjoyment of life and property;
- cultural interest;
- raised as part of consultation/engagement activities;
- public / agency concern (key concerns identified as part of consultation/engagement programs); and
- listed in EA TOR (Appendix A).

Table 8.3-1 Potential Project Interactions¹ with Potential Valued Environmental Components (VEC's)

Project Activities	Geology, Soil/Sediment Quality (Terrestrial and Marine)	Groundwater Resources	Surface Water Resources	Climate Change (GHG)	Air Quality	Acoustic Environment (Noise)	Ambient Lighting	Terrestrial Habitat and Vegetation	Wetlands	Terrestrial Fauna	Migratory Birds	Freshwater Aquatic Species and Habitat	Marine Water Quality	Marine Species and Habitat	Species at Risk (SAR)	Employment and Local Economy	Fisheries (Freshwater and Marine)	Aquaculture and Marine Harvesting	Human Health and Safety	Marine Safety and Security	Navigation	Visual Landscape	Existing and Planned Land Uses (including: Agriculture and Forestry)	Tourism and Recreation	Aboriginal Use of Lands and Resources	Transportation	Archaeological Resources
Construction Phase																											
Clearing, grubbing, grading and excavation (All Project components including temporary off-site work camp, Meadow Lake intake structure, water pipeline)	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓				✓			✓	✓	✓	✓		✓
Machinery operation & private transportation				✓	✓	✓													✓			✓					
Temporary concrete and asphalt batch plants				✓	✓														✓			✓					
Blasting / excavation in bedrock		✓				✓						✓		✓													✓
LNG marine terminal / marginal wharf:																											
• marine & shoreline infilling;	✓		✓					✓	✓	✓	✓	✓	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓		
• pile driving & blasting; and						✓								✓	✓												
• marine transfer pipeline.								✓	✓	✓	✓	✓	✓	✓	✓		✓			✓	✓				✓		
Marine cargo vessels (navigation & waste/ballast disposal)				✓	✓	✓		✓				✓	✓	✓			✓		✓	✓	✓	✓			✓		
Water supply pipeline (connections between Meadow Lake and Project site):	✓		✓					✓	✓	✓	✓	✓			✓		✓						✓		✓		
• Watercourse/wetland crossings.																											
Meadow Lake water intake structure and access road	✓		✓			✓	✓	✓		✓	✓	✓			✓		✓				✓		✓		✓		
Wastewater treatment system including discharge structure (discharge to marine environment)		✓			✓							✓	✓						✓								
Stormwater management plan (discharge to sea)			✓									✓															
Groundwater well (temporary use - minor volumes)		✓																									
Employment and expenditures																✓							✓	✓	✓		
Operation Phase																											
Access roadways			✓		✓	✓						✓			✓										✓		✓
Machinery operation and private transportation				✓	✓	✓																					
LNG marine terminal and marine transfer pipeline	✓	✓			✓		✓		✓		✓	✓	✓	✓	✓		✓			✓			✓				✓
Marginal wharf		✓											✓				✓						✓				✓
LNG Tankers, Tugs (navigation and waste/ballast disposal)				✓	✓			✓				✓	✓	✓	✓		✓				✓						✓
LNG liquefaction facility and transfer pipelines (connections to M&NP Pipeline and power plant)				✓			✓				✓	✓	✓									✓	✓	✓			
Flaring and pressure release valves (all Project components)				✓	✓	✓	✓				✓											✓					

Project Activities	Geology, Soil/Sediment Quality (Terrestrial and Marine)	Groundwater Resources	Surface Water Resources	Climate Change (GHG)	Air Quality	Acoustic Environment (Noise)	Ambient Lighting	Terrestrial Habitat and Vegetation	Wetlands	Terrestrial Fauna	Migratory Birds	Freshwater Aquatic Species and Habitat	Marine Water Quality	Marine Species and Habitat	Species at Risk (SAR)	Employment and Local Economy	Fisheries (Freshwater and Marine)	Aquaculture and Marine Harvesting	Human Health and Safety	Marine Safety and Security	Navigation	Visual Landscape	Existing and Planned Land Uses (including: Agriculture and Forestry)	Tourism and Recreation	Aboriginal Use of Lands and Resources	Transportation	Archaeological Resources
Incinerator				✓	✓		✓				✓											✓					
Power plant (180 MW)				✓	✓		✓				✓											✓					
Water supply pipeline (300-500 m ³ /day)																							✓		✓		
Meadow Lake water intake structure and access road						✓	✓														✓		✓		✓		
Wastewater treatment system (discharge to marine environment)					✓							✓															
Stormwater management system (discharge to marine environment/ sea)			✓									✓	✓														
Employment and expenditures															✓								✓	✓	✓		
Accidental Events																											
Spills on land		✓							✓			✓					✓			✓							
Fire (on-site or on board ship)					✓															✓		✓		✓			
Marine collisions & spills in the marine environment												✓		✓	✓		✓	✓		✓		✓					

Note:

Check marks only indicate that there is a potential for interaction between the Project and the environmental component and does not imply that the potential effect is significant. A potential interaction may be large or small, wide range or local in area, significant or negligible. Refer to Section 10.0 for an in-depth discussion and evaluation..

Table 8.3-2 Basis for Selection of VECs

Environmental Category	VEC	Project-Environment Interaction (D=directly ; P=as pathway)	Relevance to Environmental Features							Key public / agency concern	Requirement of TOR	Rationale for VEC Selection (Interactions, Pathways and Environmental Relevance)
			Legal Requirement	Scientific Interest	Environmental/ Ecological Context	Socio-Economic	Human Health	Reasonable Enjoyment of Life and Property	Cultural			
Biophysical Environment	Geology, Soil Quality	D, P					X				X	<ul style="list-style-type: none"> • Potential for acid drainage generation. • Pathway to potential impacts on flora, fauna, and human health.
	Groundwater – Quality and Quantity	D, P	X		X		X				X	<ul style="list-style-type: none"> • Potential for groundwater quality impairment. • Potential for impacts on local water supply wells. • Pathway to potential impacts on flora, fauna, and human health.
	Surface Water (Quality, Quantity, Sediment Quality and Transport)	D, P	X		X		X			X	X	<ul style="list-style-type: none"> • Potential effects on water levels in Meadow Lake as a result of water withdrawal . • Potential fresh water and marine water quality impairments from acid generating rock, erosion from mine tailings (construction phase), and wastewater discharges. • Potential for alteration of sediment transport and beach formation/erosion. • Pathway to potential impacts on flora, fauna, and human health.
	Air Quality and Climate Change	D, P	X		X		X	X			X	<ul style="list-style-type: none"> • Potential for local air quality impairments. • Potential for contributions to local and global climate change. • Pathway to potential impacts on flora, fauna, and human health.
	Acoustic Environment (Noise) and Ambient Lighting	D, P	X		X		X	X			X	<ul style="list-style-type: none"> • Potential for changes in existing acoustic environment. • Potential for changes in the existing lighting conditions. • Potential pathway for impacts on fauna and human health.
	Flora, Fauna and Terrestrial Habitat (including SAR)	D, P	X	X	X		X		X	X	X	<ul style="list-style-type: none"> • Potential for terrestrial habitat removal and/or alteration. • Potential for adverse effects on terrestrial species as a result of effects on changes in terrestrial habitat. • Potential for adverse effects on terrestrial (including wetland) SAR as a result of direct impact or habitat changes . • Pathway to potential impacts on traditional land uses/ resource uses.

Environmental Category	VEC	Project-Environment Interaction (D=directly ; P=as pathway)	Relevance to Environmental Features							Key public / agency concern	Requirement of TOR	Rationale for VEC Selection (Interactions, Pathways and Environmental Relevance)
			Legal Requirement	Scientific Interest	Environmental/ Ecological Context	Socio-Economic	Human Health	Reasonable Enjoyment of Life and Property	Cultural			
Biophysical Environment <i>(Continued)</i>	Wetlands	D	X		X					X	X	<ul style="list-style-type: none"> Potential for adverse effects on extent and functions of local wetland habitat due to site development and lake water withdrawal.
	Freshwater Aquatic Species and Habitat (including SAR)	D, P	X		X	X			X	X	X	<ul style="list-style-type: none"> Potential for HADD (fish habitat alteration, deterioration, and destruction). Potential for adverse effects on fish species (incl. SAR) and populations as a result of HADD. Pathway to potential impacts on Aboriginal, commercial, recreational fisheries.
	Marine Species and Habitat (including SAR)	D, P	X	X	X		X		X	X	X	<ul style="list-style-type: none"> Potential for HADD (marine fish habitat alteration, deterioration, and destruction). Potential for adverse effects on marine fish species and populations as a result of HADD. Potential for adverse effects on marine SAR as a result of direct impact or HADD. Pathway to potential impacts on Aboriginal, commercial, recreational fisheries and Human Health.
Socio-Economic and Cultural	Agriculture					X	X				X	<ul style="list-style-type: none"> No agricultural lands identified in zone of influence of Project. Theoretical potential for deposition of contaminants on agricultural fields.
	Forestry	D	X		X	X					X	<ul style="list-style-type: none"> Reduction in area available for forestry.
	Fisheries, Aquaculture and Marine Harvesting	D	X			X	X			X	X	<ul style="list-style-type: none"> Potentially reduced (local) production rates/ sales volumes as a consequence of adverse effects on resource. Potential for impaired marketability (perception product quality).

Environmental Category	VEC	Project-Environment Interaction (D=directly ; P=as pathway)	Relevance to Environmental Features							Key public / agency concern	Requirement of TOR	Rationale for VEC Selection (Interactions, Pathways and Environmental Relevance)
			Legal Requirement	Scientific Interest	Environmental/ Ecological Context	Socio-Economic	Human Health	Reasonable Enjoyment of Life and Property	Cultural			
Socio-Economic and Cultural (Continued)	Employment and Local Economy: Population; Economic Conditions; services, Employment; Tourism and Recreation	D				X	X		X	X	X	<ul style="list-style-type: none"> • Short term employment opportunities (construction). • Long-term employment opportunities (operation). • Economic spin-off effects. • Effects on demographics. • Contributions to municipal tax base. • Contribution to Provincial energy strategy. • Effects on attractiveness for wilderness/nature oriented tourism. • Improved economics leading to improvement of tourism infrastructure.
	Human Health and Safety	D	X				X			X	X	<ul style="list-style-type: none"> • Potential effects on health of workers. • Potential effects on residents (as a consequence of water and/ or air quality impairments). • Potential effects on human consuming marine organisms.
	Land Use – Existing and Planned	D	X		X	X		X	X		X	<ul style="list-style-type: none"> • Potential for conflict with current planning strategy and zoning by-laws. • Potential for conflict with existing (actual) land uses (incompatibility; minimum separation distance).
	Road Transportation	D	X			X	X	X		X	X	<ul style="list-style-type: none"> • Potential for impaired road infrastructure. • Potential for Impaired local traffic flows and safety.
	Visual Landscape/ Aesthetics	D				X	X	X	X		X	<ul style="list-style-type: none"> • Potential for impairment through adverse visual impacts and emissions (i.e., Project-related noise, dust, odours).
	Aboriginal Use of Land and Resources	D	X			X			X	X	X	<ul style="list-style-type: none"> • Potential for conflict with traditional land uses and land claims.
	Archaeological Resources	D	X						X	X	X	<ul style="list-style-type: none"> • Potential for disturbance of archaeological site(s) and resources.

The VECs identified are presented in Table 8.3-2 together with the rationale for their selection. The Table also indicates which of the VECs are considered principal pathways. The individual VECs are discussed in further detail in the next section.

8.3.4 Description of Relevant VECs

The following is a summary of the scope of each VEC, and a rationale for selection. VECs as presented are not ranked by importance.

A total of twenty-three VECs have been identified.

8.3.4.1 Geology, Soil/Sediment Quality

Contaminated sites are known to occur within the Project footprint. Such areas can contain soil contaminated with heavy metals from mining and waste production (tailings). Other contaminants which are typical of mineral extraction activity can be present, including potentially acid generating rock. In some cases, sites may have been improperly de-commissioned; alternately the standards for de-commissioning may not reflect current standards or knowledge. During construction there is potential to disturb contaminated sites and mobilize contaminants. Depending on land ownership, both the federal and provincial levels of government have regulatory control over contaminated sites.

Particular concerns expressed in the provincial TOR relate to the Project interactions with contaminated sites, former mine sites, and mine disposal areas at or near the Project site.

8.3.4.2 Groundwater Resources

Groundwater is important for drinking water and as a recharge source for surface water. The Project will involve extractions, diversions, effluent discharge, and modification to groundwater flow. In addition to its use as drinking water and as habitat, water is a pathway for contaminant transport to the food chain and therefore, relevant for human health. Groundwater quality and quantity is regulated by the Province.

8.3.4.3 Surface Water Resources

Surface water provides drinking water, as well as habitat for a wide variety of species – aquatic vegetation, plankton, fish, waterfowl, and furbearers. Human uses include recreation – boating, swimming, hunting, and fishing. The quality and quantity of surface water is an important ingredient in ecosystem health. The Project will extract, consume, treat, and discharge surface water during construction and operations. Airborne dust and contaminants could become transported to enter the surface waters surrounding the Project footprint during construction and, to a lesser extent, during operations.

Marine water quality including sediment quality is of concern with respect to marine biota and coastal fisheries. Sediment transport is of significance from a navigational point of view and for coastal protection. The construction of the marginal wharf and the LNG jetty has the potential to affect water and sediment quality through disturbance of contaminated near-shore marine sediments. During operation, treated wastewater discharge, spills and other accidental events can lead to temporary water impairment. Once completed, the wharf and jetty could affect near-shore sediment transport, sedimentation within navigable waters, beach formation and erosion

along the shoreline. Marine resources and navigable waters are protected by federal legislation. Resource management of surface water is a Provincial responsibility.

8.3.4.4 Air Quality and Climate Change (GHG)

The quality of our atmosphere is important for the health and safety of people living and working near the Project site, as well as to local wildlife and vegetation. Climate change has become an important consideration in EA and for Project planning. Design criteria based on a calculated return period for natural events may be suspect if the underlying assumptions about climate prove to be inaccurate. Conversely, the reduction and control of air emissions has become one ingredient of a needed effort to address global warming and GHG emissions.

The Project will produce air emissions such as oxides, PM, and VOCs. These discharges will include exhaust from engines and ventilation, as well as dust from blasting, excavation, processing, vehicle operation, road use, and other Project activities. The atmospheric environment is a pathway for contaminants to the food chain due to the transport of particles to the surrounding vegetation and water. Air quality and climate conditions are important to overall ecosystem health and to other VECs. Air emissions are regulated federally and provincially.

8.3.4.5 Acoustic Environment (Noise)

Changes in the acoustic environment (i.e., changes in noise levels) can affect humans as well as wildlife. Human responses to changes in noise levels can include general disturbance phenomena, reduced enjoyment of property, disruption of sleep, and health effects. Wildlife can be affected through their daily activities such as resting and feeding/foraging. Acclimation can occur in cases of constant, steady-state levels. In other cases, an avoidance response is elicited such that exclusion occurs from habitat which would otherwise be suitable for occupancy. Noise is regulated by the Province.

8.3.4.6 Ambient Lighting

The proposed facility will include extensive lighting on the jetty, terminal wharf, and on-shore components. Flare stacks will be equipped with lights to comply with aviation safety requirements. The lighting associated with the facility is expected to change the rural character of the location and has the potential to impact birds. The lighting is largely driven by facility design, operation requirements, and safety considerations and potentially effects to migratory birds and bird SAR protected under provincial and federal laws.

8.3.4.7 Terrestrial Habitat and Vegetation

Terrestrial habitat and vegetation has ecological, aesthetic and recreational importance to the public and First Nations, primarily as a food source and as an economic and recreational resource. Terrestrial habitat also forms the basis for biological diversity in the region. Project development will diminish or eliminate the productive capacity of some terrestrial habitat in the Project footprint. Other indirect interactions (airborne dust, emissions, water extraction, and consumption) may affect flora and habitat within the zone of influence of the Project.

The spatial ecological boundaries include all naturally vegetated, i.e., undeveloped terrestrial environments within the footprint of the proposed Project including LNG facility with marginal

wharf, temporary work camp, water supply pipeline and water intake structure at Meadow Lake. Also included are naturally vegetated terrestrial areas within a 100 m buffer of the LNG Project footprint including the temporary work camp, or 20 m either side of the water pipeline ROW. The assessment also includes freshwater/ brackish water aquatic vascular plant vegetation in these areas. The size of the zone of influence depends on the effect. This buffer is considered to be the maximum extent to which noticeable effects on vegetation and habitat can reasonably expect as result of Project activities and Project components.

Temporal ecological boundaries encompass the entire year since interactions between vegetation/habitat and Project components or activities can occur year round. This applies to every year of all phases of the Project.

8.3.4.8 Wetlands

Wetlands act as a source of water and moderate hydrological conditions within watersheds. They provide valuable habitat for waterfowl, furbearers, and other aquatic species. Project construction will interact directly (through removal) and indirectly (through altered surface and groundwater flows) with wetlands. The Province has regulatory responsibility for wetlands.

The spatial ecological boundaries include all freshwater and marine wetlands located within the Project boundaries (see above). Wetlands that are hydrologically connected to wetlands in the footprint of Project infrastructure are also included in the ecological boundaries. All other wetlands are not included in the ecological boundaries.

Temporal ecological boundaries encompass the entire year, since interactions between wetlands and Project components, or effects of short term Project activities, can occur or extend year round. However, wetlands are less sensitive during the winter, when they are frozen. Wetlands are more sensitive during spring, summer and fall when they are susceptible to substrate disturbance and used by increased numbers of wildlife (e.g., breeding birds). The temporal boundaries extend over construction, operation and decommissioning phases.

With respect to the administrative and legislative boundaries, wetlands in NS are regulated under the NSEA, administered by NSE. Loss or alteration of wetlands as defined in the Nova Scotia Wetland Conservation Policy (NSE, 2011c) requires a Wetland Alteration Approval. If the loss or alteration of wetland is larger than 2 ha, an EA is required, including a formal evaluation of the wetlands following a process approved by NSE (NovaWET 3.0). As part of the approval application, a wetland evaluation has to be carried out following a multi-step process prescribed by NSE, which includes information on hydrology, vegetation and rare species. Wetlands are also subject to the federal wetlands conservation policy.

8.3.4.9 Terrestrial Fauna

Terrestrial fauna have ecological, aesthetic and recreational importance to the public and First Nations, primarily as a food source and as an economic and recreational resource. Project development will diminish or eliminate the productive capacity of some terrestrial habitat in the Project footprint. Other indirect interactions (airborne dust, emissions, noise, vibration, light, water extraction, and consumption) may affect species and habitat within the zone of influence

of the Project. Most terrestrial species and habitat are regulated by the Province. Migratory bird species are regulated at the Federal level.

The spatial ecological boundaries include all undeveloped environments within the footprint of the proposed Project. Also included are all undeveloped environments within 500 m of the Project site, and the shipping lanes offshore in habitats utilized by marine-associated bird species. This buffer is considered to be the maximum extent to which noticeable effects on birds, wildlife and SAR can be reasonably expected as a result of Project components and activities.

Temporal ecological boundaries encompass the entire year, since interactions between terrestrial fauna and Project components or activities can occur year round. This applies to every year of all phases of the Project. For terrestrial fauna, the breeding season is of particular concern. The breeding season for most bird species in NS is the period from 1st of May to 31st of August. Some species, such as owls, raptors and woodpeckers, generally breed earlier in the season from late winter to early spring (February to May). Most other wildlife breed in spring and summer.

With respect to the administrative and legislative boundaries, the *Federal Wildlife Act* and the MBCA are important regulatory mechanisms to protect terrestrial fauna and birds. The NSDNR administers the NSWA which provides mechanisms for the preservation of wildlife species diversity and abundance, including migratory birds. Further protection of migratory birds is also provided by the federal *Canadian Wildlife Act* which is administered by EC. The NSESA and the federal SARA offer legal protection to some rare species that have been proclaimed as endangered, rare or vulnerable under the Acts.

8.3.4.10 Freshwater Aquatic Species and Habitat

Aquatic species and habitat are important since many aquatic species, especially fish, provide food for people and wildlife. The Project will alter aquatic habitat and restrict fish movement within some watershed(s). Freshwater fish and fish habitat are addressed by federal legislation. Aquatic (freshwater) SAR are of concern due to their ecological functions, scientific and cultural value. SAR are protected under the federal SARA and could occur in or near the Project area. Project development may disrupt freshwater habitat and could affect SAR that may utilize these habitats. The protection of rare species is addressed by federal and provincial legislation.

The assessment area for the freshwater environment VEC includes the streams and water bodies with greatest potential to be impacted: Unnamed Watercourse, Dung Cove Pond, Betty's Cove Brook and Gold Brook tributary.

The temporal boundaries for this VEC are the same as those established for the overall Project. The temporal boundaries include the three phases of the Project; construction, operation, and decommissioning. The period during construction is of particular concern, as construction activities and heavy equipment use can potentially lead to erosion and sedimentation/siltation issues.

It is important to note that particularly sensitive times for fish populations include periods of migration and spawning (i.e., mid May to mid July, and October to December).

The ecological boundaries vary between freshwater species due to differences in distribution, behaviour/migration patterns, and life histories of freshwater biota that utilize habitats on-site. In addition to variation between species, ecological boundaries can depend upon the specific lifecycle stage of the organism.

With respect to the administrative and legislative boundaries, fish habitat is protected and regulated by the *Fisheries Act*, administered by DFO. The primary section of the *Fisheries Act* applicable to this proposed development is section 35(2), which states that fish habitat is protected from HADD. In this context, fish habitat refers to any spawning, nursery, rearing, food supply and migration areas on which fish are directly or indirectly dependent for their life processes. A habitat compensation plan will be developed, and an application for a HADD authorization will be submitted to DFO. The recently revised *Fishery Act (2012)* places particular importance on fish species supporting Commercial, Recreational, or Aboriginal (CRA) fisheries.

Further, in order to alter fish habitat or divert watercourses in NS, an application is to be submitted to NSE for approval. In coordination with DFO, the application is reviewed and a decision is made as to whether the Project can or cannot proceed. Should permission to proceed be granted, conditions of approval will be set which will include habitat compensation requirements. The protection of salmonid habitat is currently a priority for regulators in the province of NS, and the Proponent must be able to demonstrate that all reasonable efforts have been made to avoid habitat destruction through avoidance and/or redesign.

The Federal government has authority to protect the public right of navigation in navigable waters. This is accomplished pursuant to the NWPA, R.S.C. 1985, c. N-22 and is administered by TC. Watercourses to be re-routed or crossed by transportation infrastructure will be submitted to TC for a determination of navigability under section 5(1).

Approvals under the Provincial *Environment Act* and Regulations may also apply for any work conducted in or around watercourses including culvert installation, fording of watercourses, water withdrawal, and instream work.

CEPA is the primary component of a group of interrelated laws, policies and institutions which, taken together, give all Canadians a shared responsibility in protecting the Canadian environment. The key purpose of the Act is the prevention and management of risks posed by toxic and other harmful substances. In addition, the Act manages the impacts on health and the environment of the products of biotechnology, marine pollution, disposal at sea, fuels, emissions from vehicles, engines and equipment, hazardous wastes, environmental emergencies and other sources.

8.3.4.11 Marine Species and Habitat

Marine species and habitat are important since many species support commercial, subsistence, and recreational fisheries. During construction, marine habitat will be disrupted as a consequence of dock construction and associated marine traffic. During operations, marine traffic and cargo transfer at dockside will interact with the marine environment. SAR are of concern due to their ecological functions, scientific and cultural value. Marine SAR are protected under SARA and can be found in or near the Project area. Project development may disrupt some marine habitat and could affect SAR that may utilize these habitats. The protection of rare species is addressed by federal and provincial legislation. Marine fish and habitat is regulated at the federal level.

The ecological spatial boundaries vary between species due to differences in distribution, migration patterns, and life histories of the biota that utilize habitat at various levels depending upon the organism and the specific life cycle.

The ecological temporal boundaries for this VEC are identical with those established for the overall Project. Marine habitat is available year round to diverse population assemblages and some lifecycle stages of various species. It is important to note that benthic habitat and communities are present in the Project area year round and that particularly sensitive times for anadromous fish populations include periods of migration and spawning (e.g., mid May to mid July and October to December).

With respect to the Administrative and Legislative Boundaries, marine flora is a component of fish habitat and therefore is subject to regulations under the federal *Fisheries Act*. Sections of the *Fisheries Act* prohibiting the introduction of deleterious substances into marine waters are governed by EC. Protection of marine fauna is subject to the same regulations as described above for freshwater aquatic species and habitat.

8.3.4.12 Species at Risk (SAR)

SAR are of concern due to their ecological functions, scientific and cultural value. SAR are protected under SARA and can be found in or near the Project area. Project development may disrupt terrestrial habitat and could affect SAR that may utilize these habitats. The protection of rare species is addressed by federal and provincial legislation.

Spatial, temporal, and ecological boundaries for SAR are the same as for the relevant non-SAR wildlife group, unless indicated differently below.

Lichens

For lichen SAR the spatial ecological boundaries of the assessment have to be expanded beyond the naturally vegetated areas of the Project footprint. Lichens are sensitive to air pollution, and thus may be affected by emission from the Project components, such as the flare stack of the LNG facility, the power generation plant and exhaust fumes of the LNG tankers. Therefore, the spatial ecological boundaries should be extended beyond the LNG facility footprint to 500 m from the property boundary. The spatial ecological boundaries for the Meadow Lake water intake facility and the water supply pipeline ROW are limited to the 20 m

buffer as defined for the common terrestrial vegetation, because no air emission effects are expected.

Moose

Spatial boundaries for potential impacts to Moose are larger than for most mammals, as Moose have large (~25 square kilometre (km²)) home ranges.

Bats

Spatial boundaries for potential impacts to bats are considered to be 500 m. This is considered a generous buffer to determine that disturbances due to blasting activities will not affect hibernating bats.

With respect to the administrative and legislative boundaries, the federal SARA protects rare or endangered species. This Act applies to all federal lands in Canada, to all wildlife species listed as being at risk, and to their critical habitat. The objective of the Act is to prevent wildlife species from becoming extinct, to provide for their recovery, and to support an ongoing process of monitoring, assessment, response, recovery, and evaluation to be undertaken to improve the species status and ecosystem. DFO is responsible for aquatic SAR.

On provincial land, SARA is intended to complement existing laws and agreements to provide for the legal protection of wildlife species and conservation of biological diversity. The Province of NS provides species protection through its NSESA. Species listed provincially may or may not correspond to species listed under SARA; however, there is a reciprocity agreement built into SARA such that those SAR identified by each province will be protected on federal land in the province in which it is listed. Recently several species of bats have been listed under the Provincial NSESA.

SARA and the NSESA provide legal protection to rare species that have been proclaimed as endangered, threatened, special concern or vulnerable. In addition, NSDNR requires proponents to consider all species designated as Red (at risk) or Yellow (vulnerable to human or natural activities) to be SOCC by the Nova Scotia General Status of Wild Species.

8.3.4.13 Employment and Local Economy

Local, Regional, and Provincial economies are important for residents of the Province. Residents within the Project area rely on a traditional economy that includes primarily forestry and fisheries. Project revenues and expenditures may affect both traditional and wage economies. The Project will also benefit the municipal tax base.

Economic conditions at the regional level can affect the population size and demographics. Some people will be attracted by the economic opportunities and move into the area or choose to locate closer to the Project. Others may re-locate away from the Project site as a consequence of the land development. Property values, as part of a region's or municipalities economic conditions, can also be affected by large scale project development. For example, property values may stabilize or increase as a result of changes to the attractiveness of an area through improved infrastructure and services or improved employment opportunities.

Employment and business are valued by individuals who may benefit directly or indirectly from cash income generated by the Project. Changes in the level of employment and business activity affect the standard of living of individuals and can result in a change of the entire community.

The Project will require a large temporary labour force during construction, and a smaller but significant labour force during operations. In addition to direct hires, the Project will generate employment and economic activity through contracting for goods and services.

8.3.4.14 Fisheries, Aquaculture, and Marine Harvesting

An important, sustainable resource use in the region is fisheries (freshwater and marine), aquaculture, and marine harvesting. An industrial activity will impact an area of shoreline as represented by the Project jetty and marginal wharf. Marine traffic has the potential to interact with harvesting activities. In addition, less direct interactions can occur. Planned and unplanned discharges to the aquatic environment can alter water quality and physical habitat characteristics, which in turn can affect life-cycle stages of target species and their food supply. Increased employment opportunities can produce a shift in labour away from fisheries and potential aquaculture operations. Fish harvesting is regulated by the Federal Government under the *Fisheries Act*. Aquaculture operations are regulated by the Province. Both levels of government carry out research to support the industry.

8.3.4.15 Human Health and Safety (including Marine Safety and Security, and Navigation)

Protecting human health and safety is a priority for this Project. Humans that may be potentially affected by construction, routine facility activities, as well as accidents, malfunctions, and unplanned events are primarily those that work at the facility or live in or near the Project area. Through pathways, Human Health and Safety is also potentially affected by Project-related changes to other VECs such as air quality, groundwater, and surface water quality. Human health and safety is regulated directly and indirectly through federal and provincial legislation.

8.3.4.16 Visual Landscape

The development of a large scale industrial complex will change the visual landscape character in the site vicinity. This could reduce the attractiveness of the area for wilderness/nature oriented tourism. The expected overall improvement in the local and regional economy on the other hand is likely to improve the regional tourism infrastructure, which may have a positive effect on visitor numbers.

8.3.4.17 Existing and Planned Land Uses

A major development such as the proposed Project can affect existing as well as planned land uses. Obviously existing on-site land uses will be replaced by the proposed new use. Existing and planned land uses on adjacent properties or within the zone of influence of the Project can be affected because of such factors as visual intrusion, noise, air and water quality effects, and public perceptions.

Land use is regulated by the Province, with delegation to municipal governments. The municipal objectives and policies are typically defined in planning strategies and zoning by-laws. New developments will need to comply with these regulations. In addition, licenses and permits are issued for particular uses such as mineral exploration and wood harvesting.

8.3.4.18 Agriculture

Air emissions generated by the proposed facility could theoretically impact outdoor agricultural and horticultural productions (e.g., berry farms, vegetable farms). However, no agricultural businesses have been identified on-site and in the site vicinity. This VEC has nevertheless been included in the effects assessment as it has been explicitly mentioned in the TOR. Agriculture is regulated on provincial and federal levels.

8.3.4.19 Forestry

An important, sustainable resource use in the region is forestry. An industrial activity will impact an area of land as represented by the Project footprint. In addition, less direct interactions can occur. Increased labour demand for a Project can act to increase pressure to zone forestry land to supply residential needs. Increased employment opportunities can produce a shift in labour away from wood harvesting and milling. Forestry is regulated by the Province. The Federal Government carries out research to support the industry.

8.3.4.20 Tourism and Recreation

The land and water of the region provide opportunities for residents and visitors to pursue outdoor recreational activities (hunting, fishing, berry picking, hiking, and boating). For many outdoor recreational activities, attractiveness and enjoyment is linked to the rural nature of the region, i.e., the absence of extensive built up areas and large scale developments and industrial infrastructure. The presence of an industrial facility can influence perceptions through noise/activity levels and changes in the visual character of the landscape. Project infrastructure can affect recreational uses through changes in the navigability of waters (i.e., as a result of the jetty). Navigability of water courses and coastal waters is regulated by federal legislation.

8.3.4.21 Aboriginal Use of Land and Resources

Aboriginal culture is valued greatly in NS. Many Aboriginal people continue to pursue elements of a traditional lifestyle, spending time in the country harvesting fish, game, berries, and firewood. Aboriginal land/resource use and culture could be affected by the Project development through such effects as the loss or alteration of harvesting areas and reduced access to traditionally used lands. Aboriginal land claims can affect the establishment of clear title for land designated for industrial development and exclusive use. Both Federal and Provincial Governments have responsibilities with respect to Aboriginal peoples and the settlement of outstanding land claims. Consideration of Aboriginal interests is legislated by federal and provincial laws.

8.3.4.22 Transportation

A principal mechanism of transport is provided by a highway network throughout NS. This network enables the movement of goods and people for a wide variety of purposes. The quality and capacity of transportation services in a region contribute to the overall standard of living and quality of life available to residents. The Project will call on the existing road network to deliver

workers to the Project site and for the supply of an array of goods and services needed to support the construction and operation phases. Increased traffic associated with the Project can be expected to result in changes in traffic density and movement patterns in the area. These changes could affect adjacent residential and commercial areas. Highways are regulated and administered by the Province.

The spatial boundary for potential impacts on road transportation encompasses the approximately 77 km site access route that includes sections of Trunk 7, Route 276 and Route 316. With respect to temporal boundaries, impacts of construction phase site generated trips have been reviewed for horizon year 2017 (peak employment on-site) and impacts of operational phase trips have been reviewed for horizon year 2024, five years after the Project is expected to become operational.

8.3.4.23 Archaeological Resources

Historic Resources are important because of the information they reveal about past and contemporary ways of life, cultural identity, and relationships and interactions with other cultures and with the biophysical environment. Project development could result in the loss or alteration of historic resources. Historic resources in the province are protected under provincial legislation.

8.4 Impact Prediction

In accordance with the provisions of the Provincial TOR (NSE, 2013a) the environmental effects assessment was conducted in a step-wise fashion involving:

- prediction and evaluation of Project-related environmental effects;
- identification of necessary avoidance, mitigation, remediation, and/or compensation; and
- determination of residual effects and their significance.

8.4.1 Environmental Effects Assessment

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

8.4.2 Mitigation

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

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

For interactions where positive effects are anticipated, opportunities were determined for maximizing the positive effects.

8.4.3 Residual Effects and Determination of Significance

Residual impacts refer to those environmental effects predicted to remain after the application of all proposed mitigation measures. The predicted residual effects are considered for each Project phase (construction, operation, and decommissioning) and for potential accidental events.

In accordance with the Provincial EA regulations and the Agency’s guidelines (1994, 1997), the significance of the residual effects is evaluated for each VEC. For adverse impacts, significance is determined based on the following criteria:

- magnitude;
- geographic extent;
- timing, duration and frequency;
- reversibility; and
- ecological and socio/cultural context.

For magnitude a relative rating was established as defined in Table 8.4-1. The evaluation applied absolute values for the 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. The judgment about the reversibility was based on previous experience and research and stated as “reversible” or “irreversible.”

Table 8.4-1 Definitions for Levels of Magnitude

Rating	Magnitude*
High	An environmental effect affecting a whole stock, population, or definable group of people, or where a specific parameter is outside the range of natural variability determined from local knowledge over many seasons.
Medium	An environmental effect 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 determined from local knowledge over many seasons.
Low	An environmental effect affecting a specific group of individuals in a population in a localized area, one generation or less, or where there are distinguishable changes in a specific parameter; however, the parameter is within the range of natural variability determined from local knowledge over many seasons.
Nil	No environmental effect.
Unknown	An environmental effect affecting an unknown portion of a population or group or where the changes in a specific parameter are unknown.

*Note: Definitions for magnitude for air and water quality are specific and addressed separately in the respective section of Section 10.0.

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

- Major: Potential impact could jeopardize the long term sustainability of the resource, such that the impact is considered sufficient in magnitude, aerial extent, duration, and frequency, as well as being considered irreversible. Additional research, monitoring, and/or recovery initiatives should be considered.
- Medium: Potential impact could result in a decline of a resource in terms of quality/quantity, such that the impact is considered moderate in its combination of magnitude, aerial extent, duration, and frequency, but does not affect the long term sustainability (that is, it is considered reversible). Additional research, monitoring, and/or recovery initiatives may be considered.
- Minor: Potential impact 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.
- Minimal: Potential impact may result in a small, localized decline in a resource during the construction phase of the Project, and should be negligible to the overall baseline status of the resource.

An adverse impact was considered “significant” where its residual effects were classified as major; while they were considered “not significant” where residual effects were classified as medium, minor, or minimal.

Subsequently, those effects considered significant (i.e., “major”) would undergo an additional consideration of the likelihood of their occurrence and the level of confidence underlying the effects prediction.