Bear Head Energy Green Hydrogen and Ammonia Production, Storage and Loading Facility

Environmental Assessment Registration

Sections 5-14

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Prepared for:

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5.0 ENVIRONMENTAL ASSESSMENT SCOPE AND METHODS

5.1 OVERALL APPROACH

The assessment methods and approach used for this EA Registration document have been developed to meet the requirements of a Class I EA Registration under the Nova Scotia *Environment Act* and Environmental Assessment Regulations and reflect the methods and approaches used for the previously approved Bear Head LNG Project (JWEL 2004; SNC Lavalin 2015).

This EA Registration document:

- Incorporates applicable data and findings from past EAs (JWEL 2004; SNC Lavalin 2015)
- Focuses on issues of greatest concern, particularly new interactions not previously assessed (e.g., unplanned releases of hydrogen and ammonia)
- Addresses regulatory requirements
- Addresses issues and concerns raised by stakeholders and the Mi'kmaq of Nova Scotia
- Adopts the precautionary principle
- Incorporates Mi'kmaq ecological knowledge in baseline conditions and impact analyses, where possible
- Integrates engineering design and mitigative and monitoring programs into a comprehensive environmental management planning process

Once the scope of the project and valued components (VCs) for assessment are defined, potential environmental interactions are identified for all project phases, in consideration of effects pathways. Appropriate mitigation is identified and residual effects (i.e., post-mitigation) are evaluated. Follow-up and monitoring is proposed where there may be a need to verify mitigation effectiveness, validate effects predictions, fulfill regulatory requirements (e.g., compliance monitoring), and/or address stakeholder or Mi'kmaq concerns.

Effects of accidents and malfunctions are addressed in Section 7 and effects of the environment on the undertaking are addressed in Section 10. Potential impacts of the Project on Mi'kmaq of Nova Scotia, including potential impacts on Aboriginal and treaty rights and Project benefits, are described in Section 8.

5.2 SCOPE OF THE ASSESSMENT

5.2.1 Scope of the Project

The scope of the Project to be assessed includes the construction, operation and decommissioning of a green hydrogen and ammonia production, storage and loading facility as described in Section 2. Water and energy utilities for the Project are owned and operated by third parties and are not under the care and control of BHE. Upgrades to water and energy infrastructure, as required to service the Project, will be undertaken by these third parties and will be subject to separate permitting and environmental management processes outside the control of BHE. Therefore, these utilities are not evaluated as Project activities; activities associated with the provision of water and energy to the site are discussed in the context of Other Undertakings in the Area (Section 9).

5.2.2 Regulatory and Policy Setting

Section 1.4 presents the overall regulatory framework for the Project including key environmental approvals and regulatory authorities. The regulatory and policy setting section within each VC chapter is intended to provide context for the scope of the assessment specific to the VC. Applicable regulatory requirements, policies and guidance may influence assessment methods and/or be used to define effects significance thresholds. Examples of regulatory requirements, policies and guidance include the following:

- Generic provincial or federal guidelines for impact assessment
- Standards or objectives (e.g., Ambient Air Quality Objectives, CCME Water Quality Guidelines)
- Federal and/or provincial legislative provisions (e.g., *Fisheries Act* provisions for the harmful alteration, disruption or destruction of fish habitat; effluent regulations)
- Local government guidelines/requirements (e.g., municipal land use by-laws)
- Species -specific guidance documents (e.g., species recovery strategies)

5.2.3 Selection of Valued Components

Valued Components (VCs) upon which this assessment is focused were selected in consideration of the following:

- Technical knowledge about the Project
- Regulatory guidance from provincial and federal agencies including informal feedback obtained during a review of the Project Description
- Previous EAs conducted at the Bear Head site for the LNG Import Facility (JWEL 2004) and LNG Export Facility (SNC Lavalin 2015)
- Feedback from public stakeholders and the Mi’kmaq of Nova Scotia
- Professional judgement of the EA study team

Table 5.1 lists the biophysical and socioeconomic components to be addressed, along with the rationale for inclusion/exclusion as a VC.

Table 5.1 Scoping of VCs

Environmental Component	Scoping Considerations	Selected VC
Climate and Climate Change	Climate describes weather patterns and their variations. GHG emissions can affect climate change. Changes in climate can impact wildlife, vegetation and human health. Climate change can also cause changes in the environment which could potentially affect the Project. GHGs anticipated from the Project will be minor and are not predicted to affect climate change conditions. A key benefit of the Project is its contribution to global climate change efforts through the production of clean energy. GHG emissions are described in Section 2.11.1 and 6.1 (Atmospheric Environment VC). Effects of climate change on the Project are assessed in Section 10.	Assessment as a VC is not required.
Air Quality	Air Quality is regulated by ECCC under the *Environment Act*. The Project will emit air emissions including dust and criteria air contaminants. Dust and air emissions can affect human and ecological health.	Atmospheric Environment
Acoustic Environment	The Project will cause increases in noise levels. Noise can cause annoyance and/or negative health effects to people and can adversely affect birds and other wildlife. Noise (for public nuisance) is governed by provincial noise criteria and municipal by-laws.	Atmospheric Environment
Groundwater	Groundwater has potential to be a source of potable water and is important in maintaining ecological habitats by supporting surface water resources, vegetation, and wetlands. Project activities could interact with groundwater resources and result in changes to groundwater quantity and/or quality.	Groundwater Resources
Surface Water	Surface water provides habitat for fish, vegetation, and aquatic populations, and can be used as a potable water resource. Project activities could affect surface water quality through effluent releases, surface water runoff and process water management, and could also potentially result in changes to hydrological or hydrometric conditions in aquatic ecosystems.	Surface Water Resources
Vegetation	Although clearing is expected to be minimal given the site has been partially developed, Project activities could potentially affect vegetation including SAR or SOCC and potentially affect species biodiversity, unique species assemblages, and uncommon habitats.	Vegetation and Wetlands
Wetlands	Wetlands are valued resources, protected by the *Environment Act.* Although previous site preparation activities involved wetland alterations permitted under the *Environment Act*, and no new alterations are anticipated, Project activities have the potential to indirectly affect wetland habitat in the vicinity of the Project Area.	Vegetation and Wetlands

Table 5.1 Scoping of VCs

Environmental Component	Scoping Considerations	Selected VC
Wildlife	Project activities could potentially directly or indirectly affect wildlife and their habitat including SAR and/or SOCC. Protection of species biodiversity is administered through SARA, the ESA, and Nova Scotia *Wildlife Act*. Protection of migratory birds is mandated by the *Migratory Birds Convention Act, 1994*. Project effects on wildlife would be primarily limited to sensory disturbance given that the site has been substantially modified.	Wildlife and Wildlife Habitat
Marine Habitat	Marine water and sediment contribute to fish habitat protected under the *Fisheries Ac*t and provide habitat for a wide range of other species. Through the construction, operation and eventual decommissioning of the marine terminal, the Project will interact with the marine environment and could potentially affect marine habitat. Due to the direct linkage between marine habitat and marine animals, it is proposed that these effects are evaluated collectively for the marine environment. The assessment will focus on marine habitat in the BHE-owned water lot within which the marine terminal will be constructed and operated.	Marine Environment
Marine Animals	Through the construction, operation and eventual decommissioning of the marine terminal, the Project will interact with the marine environment and could potentially affect marine animals through changes in marine water or sediment quality, underwater noise, and/or collisions with vessels. Due to the direct linkage between marine habitat and marine animals, it is proposed that these effects are evaluated collectively for the marine environment.	Marine Environment
Land Use	The Project must abide by applicable land use plans and bylaws of the Municipality of the County of West Richmond. Although Project activities will occur on BHE-owned lands and is surrounded primarily by other lands designated for industrial use, it is important to consider potential effects of routine and non-routine (e.g., malfunctions or accidental events) Project activities on local communities and community infrastructure.	Land Use and Communities
Public Health and Safety	Public health and safety is of the utmost importance. Transportation of heavy equipment to site during construction and shipping of ammonia during operations may affect local traffic and navigation. Although likely to occur, an accidental event could also potentially affect public health and safety through air emissions or fire. Potential project-related effects on public health and safety will be evaluated through the related pathway of effect (e.g., Atmospheric Environment, Groundwater Resources, Surface Water Resources) and/or receptor (Land Use and Communities). Accidental events are addressed separately in Section 7. Navigation issues are addressed through the TERMPOL/Enhanced Navigation Safety Assessment Process, outside of the EA process.	Atmospheric Environment Groundwater Resources Surface Water Resources Land Use and Communities
Community Infrastructure	The Project may draw on local emergency response and support services in the event of an accidental event.	Land Use and Communities

Table 5.1 Scoping of VCs

Environmental Component	Scoping Considerations	Selected VC
Economic Development	Economic development is a fundamental determinant of socio-economic health. The Project is expected to have substantial economic benefits at the local and provincial level. These benefits are addressed in Section 12.	Assessment as a VC is not required.
Marine Navigation	Marine traffic will increase as a result of Project operations, although there will be fewer ships required for the Project than previously approved for the Bear Head LNG Project. Most aspects of shipping (except for when the vessel is docked at the terminal) is under the care and control of shippers and within the jurisdiction of port and/or federal authorities. Marine navigation is regulated and administered under the CNWA and *Marine Transportation Security Act*, the International Ship and Port Facility Security (ISPS) Code, and the TERMPOL/Enhanced Navigation Safety Assessment Process. The proposed marine terminal is located in an area of compulsory pilotage under the federal *Pilotage Act* and Atlantic Pilotage Authority Regulations (i.e., pilots are required for navigation into the Strait). The Project holds a valid authorization under the CNWA and the previous TERMPOL study will be updated for the updated Project. Marine navigation is therefore highly regulated and navigation risks are well managed outside the EA process. Effects on other marine vessel traffic related to fisheries, aquaculture and marine harvesting are addressed under the Fisheries, Aquaculture and Marine Harvesting VC.	Fisheries, Aquaculture and Marine Harvesting
Fisheries, Aquaculture and Marine Harvesting	Fishing and aquaculture are important to the economy of Cape Breton, as well as Nova Scotia. Fishing as a livelihood and as a recreational activity is also valued culturally and is of importance to the Mi'kmaq of Nova Scotia. These activities are regulated by the federal *Fisheries Act*, and the Nova Scotia *Fisheries and Coastal Resources Ac*t. Although the marine terminal design, construction and operation will not change from that previously assessed for the Bear LNG Project (SNC Lavalin 2015), potential changes in fisheries, aquaculture and/or marine harvesting since 2015 as reflected in Section 4.4 necessitates a re-evaluation of this VC.	Fisheries, Aquaculture and Marine Harvesting
Archaeological and Heritage Resources	The EA for the LNG Import Facility (JW 2004) identified a low potential for archaeological resources in the Project area, although several heritage resources were located in and around the Project Area. Given the importance of archaeological and heritage resources to the Mi'kmaq of Nova Scotia and the need for a contingency plan for chance encounters, this is being carried forward as a VC.	Cultural and Heritage Resources

Table 5.1 Scoping of VCs

Environmental Component	Scoping Considerations	Selected VC
First Nations Land and Resource Use	MEKS conducted in the past for the Bear Head LNG Project (CMM 2015) and Bear Paw Pipeline Project (MGS 2016) indicated current use of lands and resources by the Mi'kmaq in the vicinity of the Bear Head site (~ 5 km radius) (Section 4.4.5). Impacts and benefits to the Mi'kmaq of Nova Scotia are considered separately in Section 8. Potential effects related to Mi'kmaq fisheries, aquaculture and/or marine harvesting are also considered in the Fisheries, Aquaculture and Marine Harvesting VC.	Fisheries, Aquaculture and Marine Harvesting

The VCs selected for assessment in this EA Registration document therefore are as follows:

- Atmospheric Environment
- Groundwater Resources
- Surface Water Resources
- Freshwater Fish and Fish Habitat
- Vegetation and Wetlands
- Wildlife and Wildlife Habitat
- Marine Environment
- Land Use and Communities
- Fisheries, Aquaculture and Marine Harvesting
- Cultural and Heritage Resources

5.2.4 Assessment Boundaries

The scope of the assessment is defined by spatial boundaries (i.e., geographic extent of potential effects) and temporal boundaries (i.e., timing of potential effects). The spatial boundaries reflect the geographic range over which potential environmental or socio-economic effects may occur, whereas temporal boundaries identify when an environmental or socio-economic effect may occur throughout all phases of the Project.

The **Project Area** is defined as the anticipated area of direct physical disturbance associated with construction, operation and decommissioning of the Project and comprises the BHE-owned upland properties (PIDs 751205012 and 75189415) and the BHE-owned water lot (PID 75189423) (Figure 2.1).

The **Local Assessment Area (LAA)** encompasses the area within which project-related environmental effects can be predicted or measured for assessment. The LAA may vary by VC depending on the area of influence associated with Project pathways of effects and potential interactions.

The **Regional Assessment Area (RAA)** is the area established for context in determination of significance of Project-specific effects and consideration of other undertakings in the area. For this assessment, the RAA encompasses the Strait of Canso region incorporating portions of Antigonish, Inverness, Richmond and Guysborough counties from the Canso Causeway to Chedabucto Bay.

The temporal boundaries for assessment address the potential effects during the construction, operation and decommissioning phases of the Project over relevant timescales. The overall Project schedule is presented in Section 2.13.

Spatial and temporal boundaries for assessment are defined for each VC in Section 6.

5.2.5 Potential Project Interactions

Table 5.2 presents the potential interactions of Project construction, operation and decommissioning activities with the selected VCs.

Table 5.2 Project Interactions with Valued Components (VCs) During Construction, Operations, and Decommissioning

Phase	Activity	Atmospheric Resources	Groundwater Resources	Surface Water Resources	Vegetation and Wetlands	Wildlife and Wildlife Habitat	Freshwater Fish and Fish Habitat	Marine Environment	Land Use and Communities	Fisheries, Aquaculture and Marine Harvesting	Cultural and Heritage Resources
Construction	Site preparation (clearing, grubbing and grading majority of which is complete)	✓	✓	✓	✓	✓	✓	✓	✓		✓
	Construction and commissioning of land-based facilities	✓	✓	✓	✓	✓	✓		✓		
	Construction of marine terminal	✓						✓		✓	✓
Operations	Operation of hydrogen and ammonia facility (including wastes and emissions and water management systems)	✓	✓	✓	✓	✓	✓	✓	✓		
	Operation of marine terminal including shipping	✓						✓		✓	
Decommissioning	Effects expected to be similar to construction. Impacts to be determined with development of a decommissioning plan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

5.3 MITIGATION

Once potential effects are described for a VC, mitigation measures to reduce potential adverse environmental effects are identified and described. Mitigation may include best management practices as well as VC-specific measures to address VC-specific issues, such as habitat offsetting / compensation, or planned environmental management and response measures. Mitigation measures must be technically and economically feasible and effective at scale. Many of the proposed mitigation measures will be the same or similar to those for the previously approved Bear Head LNG Project. In some cases (e.g., fish habitat in the marine environment), habitat offsetting/compensation has already been implemented.

5.4 ASSESSMENT OF RESIDUAL EFFECTS

In consideration of potential interactions and effects, and proposed mitigation, residual effects are then predicted for each VC. Residual effects are generally characterized in terms of magnitude, geographic extent, duration, frequency, reversibility and ecological and/or socio-economic context. Table 5.3 defines descriptors used to characterize residual environmental effects.

Table 5.3 Characterization of Residual Effects

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	Positive— an effect that moves measurable parameters in a direction beneficial to the VC relative to baseline Adverse— an effect that moves measurable parameters in a direction detrimental to the VC relative to baseline Neutral— no net change in measurable parameters for the VC relative to baseline
Magnitude	The amount of change in measurable parameters relative to existing conditions	No Measurable Change— no measurable adverse effect anticipated Low— effect occurs that is detectable, but is within normal variability of baseline conditions Moderate— effect occurs that would cause an increase (or decrease) with regard to baseline, but is within regulatory limits and objectives High— effect occurs that would cause exceedances of objectives or standards
Geographic Extent	The geographic area in which an environmental, effect occurs	Project Area— residual effects are restricted to the Project Area LAA— residual effects extend into the LAA RAA— residual effects extend into the RAA
Duration	The period of time required until the measurable parameter returns to its existing condition, or the effect can no longer be measured or otherwise perceived	Short-term— residual effect restricted to construction or decommissioning, rehabilitation, and closure phases Medium-term— residual effect extends through the operation phase Long-term— residual effect extends beyond the operation phase Permanent— recovery to baseline conditions unlikely

Table 5.3 Characterization of Residual Effects

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Frequency	Identifies how often the residual effect occurs and how often during the project or in a specific phase	Single event— occurs once Multiple irregular event— occurs at no set schedule Multiple regular event— occurs at regular intervals Continuous— occurs continuously
Reversibility	Pertains to whether a measurable parameter can return to its existing condition after the project activity ceases	Reversible— the effect is likely to be reversed after activity completion and rehabilitation Irreversible— the effect is unlikely to be reversed

The significance of the residual effect is then determined based on pre-defined threshold criteria or standards. Thresholds are defined in consideration of federal and provincial regulatory requirements, standards, objectives, or guidelines, as applicable to the VC. Where thresholds are not set by guidelines or regulations, a threshold is developed using the measurable parameters established for the VC, along with professional judgement of the assessors. The thresholds define the limits of a change in a measurable parameter or state of the VC beyond which it would be considered significant, based on resource management objectives, community standards, scientific literature, or ecological processes (e.g., desired states for fish or wildlife habitats or populations).

5.5 FOLLOW-UP AND MONITORING

In cases where there may be uncertainty around effects predictions and/or effectiveness of mitigation, follow-up and/or monitoring programs may be proposed. Monitoring may also be required to demonstrate regulatory compliance. Recommended follow-up and monitoring programs are described as appliable for each VC.

6.0 VALUED COMPONENTS AND EFFECTS MANAGEMENT

As indicated earlier, previously approved EAs for the LNG Import Facility (JWEL 2004) and the Bear Head LNG Project (SNC Lavalin 2015) have been used to help inform, where appropriate, the assessment of the current Project, particularly with regard to construction impacts. The analysis that follows has therefore been adapted from the *Bear Head LNG Updated Registration Document* (SNC Lavalin 2015) to be relevant to the current Project.

6.1 ATMOSPHERIC ENVIRONMENT

Project activities and components could potentially interact with the atmospheric environment by releasing air contaminants and GHGs, as well as noise and vibration to the atmosphere. Thus, the assessment of the atmospheric environment includes consideration of air quality, GHG emissions, and the acoustic environment, as described below.

Air quality is characterized by the composition of the ambient (outdoor) air. The concentration of air contaminants in the ambient air, if high enough for long enough, could have adverse effects human or ecological health. Air quality is highly influenced by local sources of air contaminants, including heavy vehicle traffic or sources at industrial facilities. Local air quality can also be influenced by air contaminants that are transported from sources that are further away, often referred to as “long range transport” of air contaminants. These might include fine dust or ozone.

The release of GHGs, on a global scale, increases the concentration of GHGs in the global atmosphere over time and is a contributor to climate change (IPCC 2014; ECCC 2022c). Emissions resulting from the construction and operation of any single project would typically have a small but essentially negligible effect on global climate change. However, the contribution of a project’s GHG emissions to provincial and national GHG reduction targets can be assessed. The GHG species considered in this assessment include CO_2, CH_4 and N_2O; other GHG species are not included because emissions are not expected in significant amounts given the technology proposed for the facility. The GHG assessment considers emissions of GHGs expressed in the form of tonnes of carbon dioxide equivalent (t CO_2e), which is calculated by multiplying the amount of individual GHGs by their accompanying global warming potential (GWP). The GWP metric incorporates the ability of each GHG to trap heat in the atmosphere in comparison to CO_2 over time, usually a period of 100 years (IPCC 2014; ECCC 2022c).

The acoustic environment (i.e., sound quality, or noise), is characterized by the type, frequency, and duration of sound. Noise is unwanted sound that can cause annoyance and/or negative health effects to people and can adversely affect birds and other wildlife.

6.1.1 Scope of Assessment

6.1.1.1 Regulatory and Policy Setting

Air Quality

The Nova Scotia *Air Quality Regulations* under the *Environment Act* regulate air quality in the province. The Regulation provides maximum permissible ground-level concentrations of specified air contaminants in the ambient air, among other requirements. The provincial *Air Quality Regulations* are currently under review and consultation (NSECC 2022b). The updated regulatory changes will consider the new World Health Organization Global Air Quality Guidelines and the most current research (NSECC 2022a). For that reason, the updated ambient air quality standards will include several air contaminants that are not currently included in the existing *Air Quality Regulations*. However, both the existing values and these proposed values are considered in this assessment.

Federally, the main guidance available for managing air quality and air contaminants is the Canadian Ambient Air Quality Standards (also referred to as the CAAQS), developed by the Canadian Council of Ministers of the Environment (CCME 2022).

The provincial limits for air contaminants (current and proposed) and the federal CAAQS are presented in Table 6.1 and Table 6.2.

Table 6.1 Nova Scotia Air Quality Standards

Air Contaminant	Averaging Period	Current Ambient Air Quality Standard[1]	Proposed Ambient Air Quality Standard[2]
		µg/m^3	µg/m^3
Carbon Monoxide (CO)	1 hour	34,600	35,000
	8 hours	12,700	10,000
Hydrogen Sulphide (H_2S)	1 hour	42	-
	24 hours	8	-
Total Reduced Sulphur (TRS)*	24 hours	-	7
Nitrogen Dioxide (NO_2)	1 hour	400	200
	24 hour	-	25
	Annual	100	10
Ozone (O_3)**	1 hour	160	-
Sulphur Dioxide (SO_2)	1 hour	900	-
	24 hours	300	40
	Annual	60	-
Total Suspended Particulate (TSP)	24 hours	120	100
	Annual	70***	60

Table 6.1 Nova Scotia Air Quality Standards

Air Contaminant	Averaging Period	Current Ambient Air Quality Standard[1]	Proposed Ambient Air Quality Standard[2]
		µg/m^3	µg/m^3
$PM_{2.5}$	24 hours	-	15
	Annual	-	5
PM_{10}	24 hours	-	45
	Annual	-	15

Notes:

* TRS has been selected to replace H_2S as it is considered a better measure of the total impact of reduced sulphur compounds. TRS includes the measurement of H_2S but also includes other related compounds (NSECC 2022b).

** O_3 is no longer included in the proposed ambient air quality standards because no activity emits ozone; it is a secondary pollutant formed through photochemical reactions involving primary chemicals (NSECC 2022b).

*** geometric mean

µg/m^3 - micrograms per cubic metre

Source:

[1] Nova Scotia *Air Quality Regulations*, Schedule A

[2] Nova Scotia proposed ambient air quality standards (NSECC 2022b). There are additional air contaminants that are included in the proposed ambient air quality standards that are not shown above.

Table 6.2 Canadian Ambient Air Quality Standards

Air Contaminant	Averaging Period	parts per billion (ppb)	µg/m^3
Ozone (O_3)	8 hours	60	118
Nitrogen Dioxide (NO_2)	1 hour	42	79
	1 year	12	23
Sulphur Dioxide (SO_2)	1 hour	65	170
	1 year	4	10
Fine Particulate Matter	24 hours	-	27
	1 year	-	8.8

Note:

The CAAQS includes standards for 2015, 2020 and 2025; the 2025 standards are listed above, with the exception of fine particulate matter since there is no 2025 standard available. The 2020 standard for fine particulate matter is presented above.

Source: CCME (2022)

Greenhouse Gas Emissions

The government of Nova Scotia requires facilities and fuel suppliers in the province to verify and report GHG emissions under the *Quantification, Reporting and Verification Regulations* (QRV Regulation) under the following circumstances:

- A facility emitter releases more than 50,000 t CO_2e per in the calendar year

- A natural gas distributor who distributes natural gas for combustion within Nova Scotia, and the combusted natural gas would release 10,000 t CO_2e or more in the calendar year
- A petroleum product supplier who imports more than 200 L total of automotive gasoline, diesels, light fuel oils, heavy fuel oils, or propane, subject to the definitions in Table 2 of Schedule 2 of the QRV Regulation

At the federal level, industrial facilities that emit more than 10,000 t CO_2e per year are required to quantify and report GHG emissions to ECCC's Greenhouse Gas Reporting Program (ECCC 2019).

Acoustic Environment

Locally, the Municipality of the County of Richmond has developed a noise by-law that states no person shall engage in activities between the hours of 12 a.m. (midnight) to 7 a.m. which disturbs or tends to disturb the peace and tranquility of a neighbourhood to which the by-law applies. Exemptions are allowed by application (Municipality of the County of Richmond 2019). The Municipality of the District of Guysborough Noise Control By-Law prohibits noise that disturbs the peace and tranquility in the community. The by-law limits noise levels between 6 a.m. and 11 p.m. to 65 dBA and from 11 p.m. to 6 a.m. to 55 dBA (Municipality of the District of Guysborough 2011).

The province of Nova Scotia has a published noise guideline, *Guideline for Environmental Noise Measurement and Assessment* (NSEL 1990). This guideline includes noise criteria for different periods of the day (day, evening and night) and includes a measurement duration of a minimum of two continuous hours of data in one time period to be representative. The Nova Scotia noise guidelines are presented in Table 6.3. Although not explicitly stated, these values are interpreted to represent hourly averages measured at the property boundary of receptors (i.e., noise-sensitive locations such as residential properties). The document is currently under review (NSECC 2022a).

Table 6.3 NSE Noise Guidelines

Averaging Time Period	NSE Noise Guideline (dBA)
Day (7:00 to 19:00)	65
Evening (19:00 to 23:00)	60
Night (23:00 to 7:00)	55
Source: NSEL 1990	

Health Canada's *Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise* document (Health Canada 2017) provides guidance for assessing noise impacts from a variety of internationally recognized standards for acoustics. Health Canada considers the following to be noise-induced health effects: noise-induced hearing loss, sleep disturbance, interference with speech comprehension, compliance, and change in percent highly annoyed (%HA) (Health Canada 2017). Noise mitigation measures are recommended when a change in the calculations %HA at any given receptor location exceeds 6.5% (Health Canada 2017).

6.1.1.2 Boundaries

The Project Area is defined as the anticipated area of direct physical disturbance associated with construction, operation and decommissioning of the Project and comprises the BHE-owned site properties including the water lot (Figure 1.3).

A radius of 5 km around the Project Area is selected as a spatial boundary for the assessment of effects from routine Project activities on air quality. Beyond this point, the Project related emissions of air contaminants are expected to be indistinguishable from background levels.

Since climate change is a global effect, the spatial boundary for the assessment of effects from routine Project activities on GHGs is the global atmosphere.

A radius of 5 km around the Project Area is selected as a spatial boundary for the assessment of effects from routine Project activities on the acoustic environment. The Project Area is located in an area zoned for industrial use; the nearest residences are located across the Strait of Canso.

The temporal boundaries for the assessment of potential effects on the atmospheric environment include the time periods for construction, operations and decommissioning phases of the Project as outlined in the schedule presented in Section 2.13.

6.1.1.3 Significance Definition

A significant adverse residual effect on the atmospheric environment is defined as a measurable Project-related environmental effect that results in one or more of the following:

- For air quality, the Project-related maximum ground level air contaminants released plus the background levels result in frequent exceedances of applicable ambient air quality objectives, guidelines or standards. Frequent is defined as once per week for one-hour objectives and once per month for 24-hour objectives.
- The significance of Project GHG emission totals will be determined at the provincial and federal jurisdictional boundaries by comparing Project GHG emission totals to provincial and national GHG emission totals. Project emissions will be classified as low (10,000 tCO_2e or less per year), moderate (10,000 to 100,000 tCO_2e per year), and high (over 100,000 tCO_2e per year).
- For the acoustic environment, Project-related noise from construction and operation activities plus the background sound pressure levels would cause exceedances of applicable regulated noise limits and impacts to nearby residences (e.g., annoyance and sleep disturbance) and would result in %HA over 6.5% at any given receptor.

6.1.2 Project Interactions and Potential Effects

6.1.2.1 Construction

Air Quality and Greenhouse Gas Emissions

Most of the site preparation work has already been carried out; therefore additional construction related emissions due to land clearing will be minimal. The remaining construction activities will include the combustion of fossil fuels (i.e., gasoline and diesel) in stationary and mobile construction equipment (e.g., backhoes, bulldozers, trucks, cranes, and generators) and will result in the emission of air contaminants including NO_X, SO_2, CO, particulate matter, VOCs, and the emission of GHGs (primarily CO_2, and N_2O). Particulate matter and fugitive dust emissions may be generated from any earth moving activities, loading and dumping of materials, and from moving vehicles and equipment prior to paving and revegetation. These releases will be temporary and intermittent and can be controlled (see Section 2.11.1 for more information).

The GHG emissions associated with the combustion of diesel fuel during construction period (assumed to be 36 months) were estimated and are presented in Table 6.4, along with a comparison to the provincial and national GHG emissions in 2020 (most recently available data).

Table 6.4 Estimated Greenhouse Gas Emissions from the Construction of the Proposed Project

Activity	Volume of Fuel in Litres (L)[1]	Emission Factor (grams/L)	t CO_2e		
			BHE Project Construction Period GHG Emissions	Nova Scotia Annual GHG Emissions in 2020	Canada's Annual GHG Emissions in 2020[2]
Combustion of Diesel Fuel in Construction Equipment	24,000,000	2,728	65,478	14,600,000	672,000,000

Notes:

[1] The volume of fuel was estimated for the construction of the Bear Head LNG Project (SNC Lavalin 2015) and is used here as a conservative estimate of the potential GHG emissions associated with the proposed Project. GHG emissions from land clearing were not included in the estimate because the site has already largely been cleared and are therefore assumed to be marginal.

[2] Emission Factors and provincial/national GHG emissions were sourced from Canada's National Inventory Report (ECCC 2022c)

The Project's GHG emissions predicted for the 36-month construction period represent approximately 0.45% of Nova Scotia's total annual GHG emissions and 0.01% of Canada's total annual GHG emissions.

Acoustic Environment

Noise will result from the construction activities such as use of heavy mobile equipment (e.g., engines, back-up beepers, banging of equipment). The construction of the marine terminal will include pile driving. Noise levels depend on the number and type of equipment in operation, noise levels, and the distance/topography between the noise source and receptors. Construction, particularly marine terminal construction, is not anticipated to occur at night (i.e., later than 11 pm).

The *Bear Head LNG Updated Registration Document* (SNC Lavalin 2015) included an estimation of noise from the construction of the Bear Head LNG Project site on land, and from pile driving during construction of the marine terminal. Given that construction activities for the Project will be similar to those proposed for the Bear Head LNG Project (including marine terminal construction), the previous assessment (SNC Lavalin 2015) is valid to reference in this assessment.

For the assessment of construction of the Bear Head LNG Project, it was assumed all construction equipment would be operating at the same time, and the increase in sound pressure levels at the nearest receptors were predicted to be lower than the noise assessment criteria for the daytime (65 dBA). The increases in L_{dn} were predicted to be lower or equal to 3 dBA and the predicted change in the %HA was expected to range from 0.3% to 1.7% (SNC Lavalin 2015). The sound pressure level at the nearest receptors (Middle Mulgrave) during pile driving at the marine terminal, with the use of vibratory hammers to mitigate noise levels, was predicted to be lower than the provincial noise assessment criteria for the daytime (65 dBA). The increases in L_{dn} were estimated to be lower or equal to 2 dBA and the predicted change in the %HA was expected to range from 0.3% to 1.3%. Driving piles using the drop hammer method would generate highly impulsive noise levels; the predicted change in the %HA would increase to 10.4% (SNC Lavalin 2015), which exceeds the Health Canada threshold of 6.5%.

6.1.2.2 Operations

Air Quality and Greenhouse Gas Emissions

Power supply for the Project will be provided from renewable power via the grid and/or direct power connection from primarily new onshore and/or potential future offshore renewable energy projects. Renewable energy sources do not require the consumption of fossil fuels, and therefore do not emit air contaminants or GHGs to the atmosphere. The current Project's use of renewable power eliminates the need for gas-fired turbines during operations, thereby considerably reducing the generation of hydrocarbons during Project operations. Limited GHG emissions will be generated from fuel combustion associated with site vehicle/mobile equipment and occasional use of a diesel generator for back-up power supply. The exhaust gases from operation of the Project will primarily involve releases of oxygen, and water vapour to the atmosphere. Fugitive emissions of hydrogen could also result by leaking from equipment.

Hydrogen is a small molecule, meaning it can leak in small quantities from several points in processing or storage facilities and escape into the atmosphere. These fugitive emissions may occur from equipment including electrolyzers, compressors, storage tanks and pipelines (van Ruijven et al. 2011; Melaina et al. 2013; Cooper et al. 2022; Frazer-Nash Consultancy 2022; Ocko and Hamburg 2022). Since the design of

the Project is in the preliminary stages, the potential impact of fugitive hydrogen emissions from the Project is not easy to establish. However, leak detection of all fugitive emissions will be a major part of the ongoing operation and maintenance for the facility, mainly to keep product losses to an absolute minimum. The quantities of fugitive emissions released to the atmosphere during operation are therefore likely to be small and the associated impact is not likely to cause any ambient air quality standards to be exceeded. As the design process proceeds, the potential impacts of fugitive hydrogen emissions from the Project will be further assessed, and a monitoring program will be initiated, if there is a need to do so.

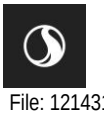
During emergency or upset (non-routine) conditions, the Project has the potential to release small amounts of air contaminants and GHG emissions from the combustion of diesel fuel in emergency equipment (e.g., generators, water pumps) as described in Section 2.9.2. These releases of GHGs would be smaller than the GHG emissions expected to be released during the construction period, described above in Section 6.1.2.1. A combination of hydrogen, ammonia and nitrogen would be combusted in the flares during emergency or upset conditions. As there are no hydrocarbons in the system, the emissions from the flares are anticipated to be water vapor and low levels of NO_x produced from the reaction of the nitrogen and oxygen (see Section 2.11.1).

The *Bear Head LNG Updated Registration Document* (SNC Lavalin 2015) included an inventory and modeling of air emissions for the operation of the Bear Head LNG Project, including flaring events. Maximum predicted concentrations were compared to and found to be in compliance with the current provincial air quality guidelines when considered alongside the ambient pollutant concentrations, both during normal operation and with an LNG vessel hoteling (SNC Lavalin 2015). The maximum predicted concentrations were also in compliance with the proposed provincial air quality guidelines, with the noted exception of the 1-hour modeling result for NO_2 at 235 µg/m³ versus the proposed limit of 200 µg/m³.

The total anticipated annual release of NO_x from the Bear Head LNG Project was estimated to be 1,167.8 tonnes per year. Intermittent flaring (approximated to be 192 hours/year for the Bear Head LNG Project) was predicted to contribute only 16.7 tonnes of NOx per year (1.4% of total NO_x emissions). Specifically, the flares were expected to contribute to a small portion of the maximum predicted concentration of NO_2 (less than 4 µg/m³ of the total 235 µg/m³) (SNC Lavalin 2015).

Current Project design has not yet been sufficiently developed to inform the design specifications of the flaring system. The final design and configuration of the flaring system will be confirmed during the next phase of engineering. The flares will likely be required to handle small flows during operation of the Project. While very preliminary, it is reasonable to assume that the frequency of emergency or upset conditions would require approximately 24 hours of flaring per year from the high-pressure flare and approximately 5 hours of flaring from the marine flare.

Under this assumption, the emissions from the operation of the proposed Project would be considerably less than predicted for the previously approved Bear Head LNG Project (i.e., approximately 29 hours of flaring per year compared to 192 hours of flaring per year). Considering the emissions and modeling predictions for the Bear Head LNG Project, and the much-reduced emissions of the proposed Project, the quantities of air contaminants released to the atmosphere from the operation of the proposed Project are not expected to result in an exceedance of the current or proposed Nova Scotia ambient air quality standards.



Acoustic Environment

During Project operations, noise emissions will result from the operation of the electrical substation transformers, hydrogen and nitrogen collection, ammonia production and process piping. Acoustic modelling was completed to predict sound levels at nearby receptors due to Project activities. The predicted sound pressure levels were added to measured baseline data and compared to applicable guideline levels to estimate the impact on in sound quality. Modelling was completed using CADNA/A, a commercially available environmental acoustic model that complies with the algorithms described in the ISO 9613-1 and 9613-2 standards for acoustic modelling. CADNA/A considers geometrical divergence (distance attenuation), barrier effects due to intervening structures, ground effects, atmospheric absorption, and topography.

The sound power levels for major equipment units associated with the Project were estimated based noise level data provided by BHE where available, and acoustic technical literature corresponding to appropriate equipment specifications (Bies and Hansen 2003). The hydrogen and ammonia facility is expected to operate continuously, 24 hours a day, 7 days a week, except during planned maintenance periods and unplanned outages. Two operating scenarios were modelled: daytime operations, and nighttime operations. Nearby receptors, located outside of the Bear Head Site fence line, were identified from site plans and aerial photos. A total of 20 receptors were included in the acoustic model. The Noise Assessment (Appendix E) includes more detail on the acoustic modelling, including the sound levels of the Project's primary noise producing equipment, mitigation measures assumed and included in the modelling, and locations of the receptors. Results of the modelling are presented in Table 6.5 and depicted on Figure 6.1.

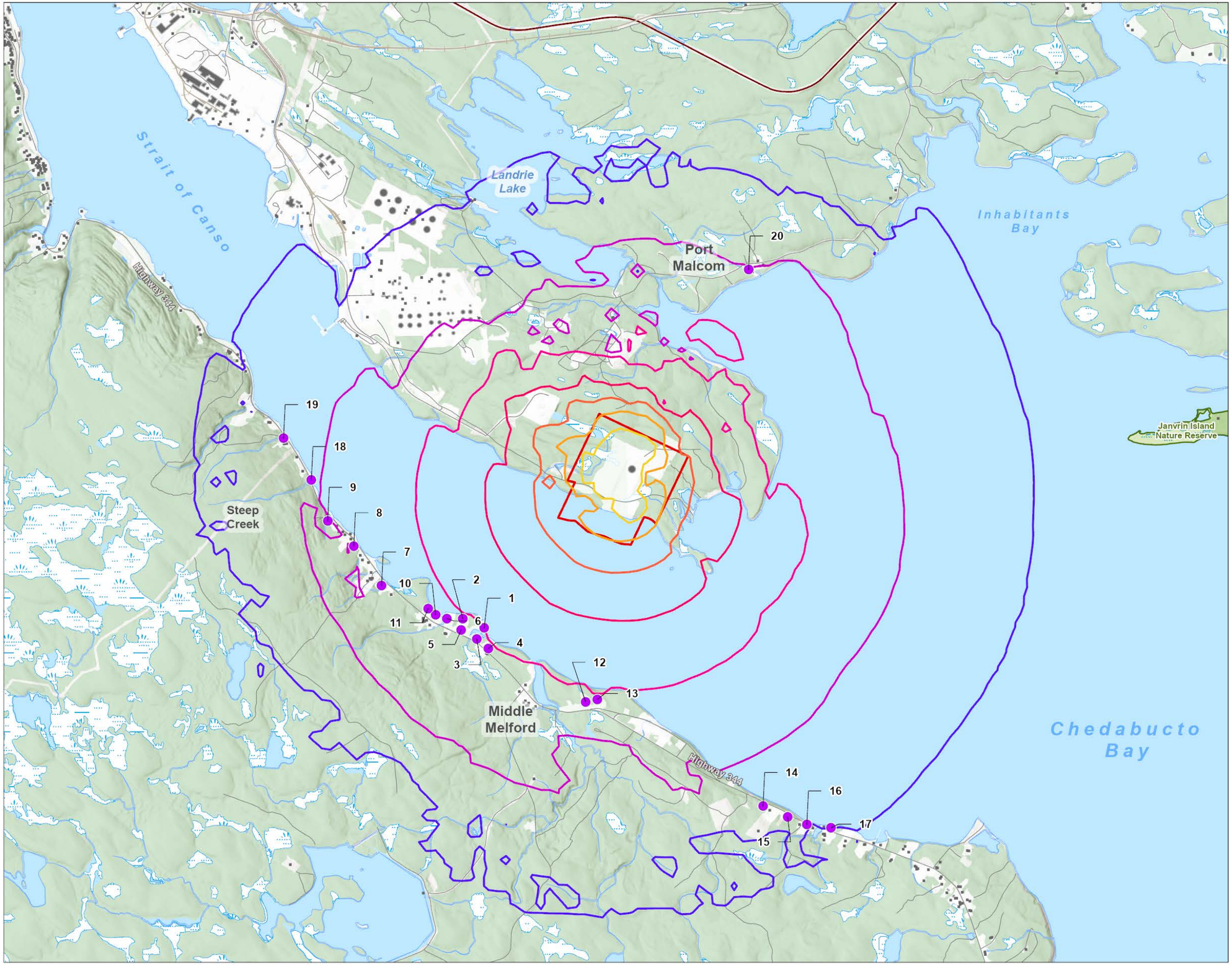


Figure No.
6.1

Title
Predicted Operation Sound Levels

Client/Project
121431287_048

Bear Head Energy
Regulatory Permitting Support

Project Location
Port Richmond
Richmond County, NS

Prepared by NW on 2022-11-30

N

0 0.5 1 Kilometres
(At original document size of 11x17)
1:45,000

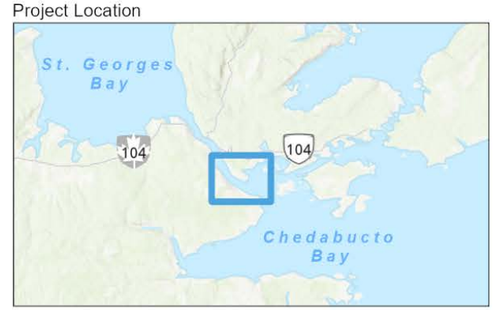
Legend

- Receptors within 5 km of Bear Head Facilty

Predicted Operation Sound Level
DB
- 30
- 35
- 40
- 45
- 50
- 55
- 60

- Project Area
- Highway
- Local Road
- Railway
- Buildings
- Wetlands
- Waterways (1:10k)
- Waterbody (1:10k)
- Nature Reserve

Project Location



Notes
1. Coordinate System: NAD 1983 CSRS UTM Zone 20N
2. Data Sources: Stantec, NS DNR, NS DOE, NSTB, NSODB, Service NS (Government of Nova Scotia)
3. Background: NSODB, Service NS (Government of Nova Scotia)

Stantec

Table 6.5 Modelling Results – Sound Levels at Nearby Receptors

Receptor Location	Day	Night	Ldn	Cumulative L_{dn}*	%HA	Expected Increase from Nearest Baseline Receptor
	(dBA)	(dBA)	(dBA)	(dBA)		(%HA)
1	40.2	40.2	46.6	56	4.47	0.32
2	38.7	38.7	45.1	55	4.38	0.23
3	38.6	38.6	45.0	55	4.37	0.22
4	38.6	38.6	45.0	55	4.37	0.22
5	37.9	37.9	44.3	55	4.34	0.19
6	38.0	38.0	44.4	55	4.34	0.19
7	36.1	36.1	42.5	54	3.80	0.14
8	35.9	35.9	42.3	54	3.79	0.13
9	34.3	34.3	40.7	54	3.75	0.09
10	37.7	37.7	44.1	55	4.33	0.18
11	37.9	37.9	44.3	55	4.34	0.19
12	37.3	37.3	43.7	55	4.31	0.17
13	38.8	38.8	45.2	55	4.38	0.23
14	32.0	32.0	38.4	55	4.20	0.05
15	31.2	31.2	37.6	55	4.19	0.04
16	30.1	30.1	36.5	55	4.18	0.03
17	29.7	29.7	36.1	55	4.18	0.03
18	34.6	34.6	41.0	54	3.75	0.10
19	32.2	32.2	38.6	54	3.71	0.06
20	35.2	35.2	41.6	47	1.41	0.27

Note:
*The cumulative L_{dn} represents the expected noise level at the receptors during the construction period; it is the modelled L_{dn} result at the receptor plus the baseline L_{dn} at the nearest receptor.

Predicted noise levels (L_{dn}) at the receptors do not exceed Nova Scotia noise assessment criteria (65 dBA during the day, 60 dBA in the evening, and 55 dBA at night). The predicted change in the percent highly annoyed (<0.32%HA at all receptors) in the community is lower than 6.5 %HA.

The results of noise modelling show that noise impacts from operations are not expected to significantly affect the sensitive receptors.

6.1.2.3 Decommissioning

Activities during the decommissioning phase of the Project are expected to present similar or less risks to the atmospheric environment as during the construction phase. Potential effects to the atmospheric environment during this phase will be considered and addressed in a decommissioning plan which would be developed prior to decommissioning and incorporate future relevant standards and regulations.

6.1.3 Mitigation

The following mitigation measures specific to air quality and GHGs have been identified for the Project:

- All vehicular equipment used on-site will be properly maintained to ensure exhaust emissions are typical for each piece of equipment
- Water or dust suppressants will be applied to disturbed areas, as necessary, to reduce vehicle traffic dust. Oil will not be used as a dust suppressant.
- Covering open hauling trucks with tarps, as necessary.
- Using best practices to limit track out onto paved sections.
- Limiting vehicle speeds as required, thereby reducing dust generation.
- Limiting unnecessary idling of vehicles and machinery. Diesel powered construction machinery will not be permitted to idle unless required.
- Responding promptly to any significant particulate emission concerns that occur during construction by evaluating the source of emissions and ensuring all practicable mitigation measures are being implemented.
- Activities resulting in dust will cease and immediate dust suppression actions will be taken if visible dust extends beyond the property boundary.
- Upon completion of construction activity, disturbed areas will be stabilized.
- A land based work plan, including dust control measures, will be updated as part of the EMP.
- A GHG Management Plan and a Flare Management Plan will be developed.

The following mitigation measures specific to the acoustic environment have been identified for the Project:

- Project activities will adhere to the Municipality of Richmond County Noise By-Law (By-Law # 65) and provincial *Guidelines for Environmental Noise Measurement and Assessment Criteria*. This may include implementing time of day restrictions to reduce nuisance.
- Vibratory hammers, rather than impact (drop) hammers, will be used to the extent feasible for pile installation at the marine terminal to reduce sound levels.
- Project vehicles will be equipped with appropriate noise muffling equipment and will be maintained to ensure they are working as intended.

6.1.4 Residual Effects

Air Quality and Greenhouse Gas Emissions

Project-related releases of air contaminants combined with background releases are not expected to exceed provincial or federal air quality objectives, guidelines or standards during construction or operation. Air contaminants are expected to be released by construction activities; however these releases will be temporary and intermittent and can be controlled. The release of air contaminants to the atmosphere during operation will be virtually eliminated by using renewable energy sources to power the facility. Small amounts of air contaminants may be released during emergency or upset conditions, mostly from flaring events. While very preliminary, the frequency of emergency or upset conditions with flaring releases is expected to be infrequent and short in duration. With the mitigation measures employed, the releases of air contaminants during construction and operation are not expected to contribute measurably to existing background levels and therefore are not likely to cause significant adverse impacts on air quality.

Project-related releases of GHG emissions during the construction period are expected to be moderate (less than 100,000 t CO_2e per year), temporary and intermittent. The GHG emissions released by the Project during operation are expected to be less than the GHG emissions anticipated to be released during the construction period, and these releases will be small in comparison to other industrial sources of GHG emissions in Nova Scotia.

The federal government has committed to achieving a 40-45% reduction in GHG emissions below 2005 levels by the year 2030. Canada's long-term plan is to achieve net-zero emissions by the year 2050 via the *Canadian Net-Zero Emissions Accountability Act*. Since the release of GHG emissions will be virtually eliminated by using renewable energy sources to power the facility during operation, the Project will assist Canada in meeting its commitments with regards to GHG emissions and climate change. With the mitigation measures employed, the release of GHG emissions is not expected to be substantive or contribute measurably to existing levels.

Acoustic Environment

Project-related noise is not expected to exceed provincial noise guidelines or Health Canada's noise recommendations. Noise will be generated by construction activities; however, construction noise will be temporary and intermittent. The most substantial contributor of Project-related noise will be pile-driving during construction of the marine terminal. This noise will be mitigated through the use of vibratory hammers to the extent feasible. The operation of Project's transformers, compressors, electrolysers, inlets and piping will also be a source of noise to nearby receptors. Nevertheless, the noise generated by construction and operation of the Facility is not expected to be substantive or contribute measurably to existing background levels.

6.1.5 Follow-up and Monitoring

A dedicated follow-up and monitoring plan is not required for the atmospheric environment to verify the environmental effects predictions of the assessment or to verify the effectiveness of mitigation.

6.2 GROUNDWATER RESOURCES

Groundwater plays a vital role in the hydrologic cycle. Interaction between surface water and groundwater can occur where the water table (upper surface of the saturated zone) meets the surface at springs, lakes, and streams. Groundwater flows through overburden aquifers and fractures in bedrock from areas of high elevation (recharge areas) to areas of low elevation (discharge areas) where it discharges from the sub-surface as springs, streams, and lakes.

Natural groundwater quality is directly influenced by the geochemical composition of the aquifer materials though which it passes, and the groundwater residence time in each aquifer system. Changes to groundwater levels can affect groundwater quantity and quality. Since groundwater is linked closely to surface water, changes to groundwater can affect surface water and other environmental components (e.g., freshwater fish and fish habitat, terrestrial habitat [particularly wetlands]). The Groundwater VC is therefore closely linked to Surface Water Resources (Section 6.3), Freshwater Fish and Fish Habitat (Section 6.4) and Vegetation and Wetlands (Section 6.5).

6.2.1 Scope of Assessment

6.2.1.1 Regulatory and Policy Setting

Provincial legislation applicable to the assessment of groundwater resources includes the *Water Resources Protection Act*, as well as the Activities Designation Regulations, Environmental Emergency Regulations and Well Construction Regulations (under the *Environment Act*). The Canadian Environmental Quality Guidelines published by CCME are applicable to the extent that groundwater enters aquatic systems (CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life) and the Guidelines for Canadian Drinking Water Quality (Health Canada 2022) are applicable to the extent groundwater is being used untreated as a drinking water source. Using or altering a water resource requires an approval or notification under the Activities Designation Regulations.

Process water for the facility will be supplied to the site by the LLWU. It is currently anticipated that potable water for the site would come from LLWU and that a new groundwater well will not be required. If a well is required to supply groundwater, a Water Withdrawal Approval will be obtained from NSECC in accordance with the Activities Designation Regulations under the *Environment Act*.

Should site characteristics permit the use of an on-site septic system for sanitary wastewater disposal, the On-Site Sewage Disposal Regulations under the *Environment Act* regulate the installation and maintenance of sewage disposal systems for the protection of groundwater. The on-site septic system will be installed and maintained as per these regulations.

6.2.1.2 Boundaries

Spatial boundaries for the assessment of groundwater resources are based on a combination of aquifer hydraulic properties, expected groundwater flow directions, and the distance to wells and ecological receptors (e.g., streams) that may be affected by Project activities. For example, the area of influence or capture area of a typical low yield domestic water well is usually less than about 100 m, and generally in a

direction hydraulically up-gradient of the well. Vibration damage due to any required blasting to a drilled or dug well is generally a function of distance between the energy source and the well, and seismic properties of the aquifer materials. With respect to rock type, risk is greater for wells completed in fractured crystalline bedrock than for wells completed in softer bedrock such the sandstone and shale found in the vicinity of the site. Based on experience, the risk of damage from blasting or major excavation is considered to be greatest within 50 m, moderate from 50 to 200 m, and is expected to be minimal beyond about 200 m from a well. The spatial boundaries for the assessment of groundwater resources are therefore defined as follows:

- The Project Area is defined as the anticipated area of direct physical disturbance associated with construction, operation and decommissioning of the Project and comprises the BHE-owned site properties including the water lot (Figure 1.3).
- To be conservative, the LAA for the assessment of groundwater encompasses a radius of 800 m around the Project Area. Potential effects of accidental spills (Section 7) would include all areas downgradient of the Project Area to the Strait of Canso. The actual extent of the area potentially affected depends on surface drainage and surficial geology and would likely be less than the conservative area considered in this study.

The temporal boundaries for the assessment of potential effects on groundwater include construction, operations and decommissioning phases of the Project as outlined in the schedule presented in Section 2.13.

6.2.1.3 Significance Definition

Thresholds have been established to define significant adverse residual environmental effects on quantity and quality of groundwater. A significant adverse residual effect on groundwater resources is defined as a measurable Project-related environmental effect that results in one of more of the following:

- Decrease in the yield from an existing and otherwise adequate groundwater supply well to the point where it is inadequate for its intended use
- Change in groundwater quality, such that the quality of groundwater from an otherwise adequate water supply well that meets applicable guidelines deteriorates to the point where it becomes non-potable or cannot meet the Guidelines for Canadian Drinking Water Quality (Health Canada 2022) for a consecutive period exceeding 30 days
- Physical or chemical alteration to an aquifer to the extent that interaction with local surface water results in streamflow or surface water chemistry changes that adversely affect aquatic life or a down-stream surface water supply

6.2.2 Project Interactions and Potential Effects

Other than an industrial well located on the Bear Head Site to supply water to a temporary trailer, there are no domestic water supply wells, surface water reservoirs or municipal supply wells located within 800 m of the Project Area. Water for the Project will be supplied to the site by the LLWU and no groundwater withdrawals are anticipated to be required for the construction, operation or maintenance of the Project. However, Project activities could potentially affect groundwater quantity or quality. The key potential

environmental interaction with groundwater resources would be through an accidental release of petroleum hydrocarbons (diesel, fuel oil, etc.) or other chemicals either during construction or through the life span of the Project. Accidental spills are assessed separately in Section 7.4.

6.2.2.1 Construction

Construction and site work may involve clearing, grubbing and stripping of topsoil. A large portion of this preparatory site work has already been performed, but the tasks remaining will likely require some additional grading work and the placement of excess material to temporary piles. Excavations and/or blasting (if required) could result in a localized lowering of water table. Stormwater runoff during construction may result in elevated turbidity and suspended solids that can change the water chemistry of recharge to groundwater system. Since all domestic wells are located more than 800 m from the Project Area (Figure 4.2), effects due to stormwater runoff are not anticipated.

The nearest offsite well is 1.37 km from the Project Area. This separation distance substantially minimizes any risk of damage from potential blasting (if required) or vibration during construction.

The main source of contamination during construction is associated with an accidental spill of petroleum, oils or lubricants during construction. However, as shown on Figure 4.2, there are no domestic or industrial wells within the depicted watershed. In the unlikely event that contaminants did enter the aquifer below the Project Area, there would be no impact on private wells (domestic or industrial) or community water supply. Accidental spills are assessed in Section 7.3.

6.2.2.2 Operations

Project interactions with groundwater resources during operations and maintenance are expected to be limited. Groundwater withdrawal is not anticipated to be required to supply potable water for the site. During operations, reject process water will be discharged daily from the water purification (RO) unit. BHE is seeking regulatory approval to discharge the reject process water to the marine environment, therefore interactions of the reject process water with groundwater resources are not expected to occur. If not properly managed, sanitary wastewater discharges (domestic effluent) could infiltrate the groundwater table through percolation and/or interaction with surface water resources and affect groundwater quality.

Should site soils and topography support the design an on-site septic system, approval will be sought from NSECC for onsite sewage disposal of domestic effluent generated on the site. If site characteristics preclude the installation of an on-site septic system, discharge to surface water will be required. To permit discharge to surface water, a wastewater treatment system will be installed as required and effluent streams will be treated to acceptable levels prior to discharge.

The main source of contamination during operations would be associated with an accidental spill or stormwater runoff. Accidental spills are assessed separately in Section 7.4 and stormwater will be managed with site erosion and sediment controls and a Stormwater Management Plan. Interactions with groundwater during routine Project operations are therefore expected to be minimal.

6.2.2.3 Decommissioning

Activities during the decommissioning phase of the Project are not expected to interact with groundwater resources except in the event of an accidental spill (Section 7.3). Potential effects to groundwater during decommissioning will be considered and addressed in a future Decommissioning and Reclamation Plan.

6.2.3 Mitigation

The following mitigation measures will be implemented to protect groundwater resources:

- In the event that any additional site grading activities require blasting, a blasting plan will be submitted to NSECC for approval. As part of EA conditions for the Bear Head LNG Project, a well survey confirmed there are no domestic or industrial wells are located within an 800 m radius of the Project Area. BHE will contact adjacent landowners to confirm there are no new unmapped wells, including monitoring wells within an 800 m radius of any proposed blasting. In the event of damage to monitoring wells on adjacent properties corrective action will be taken to remediate damage.
- Stormwater and wastewater management will promote the protection of groundwater, surface water, adjacent properties, and any wetlands encountered. Refer to Section 6.3.3 for mitigation details.
- Sanitary wastewater from the site will be managed by an on-site septic system installed and maintained as per the requirements of the On-Site Sewage Disposal Regulations.
- Handling of chemical and hazardous substances and hazardous wastes storage will be in accordance with manufacturers' recommendations and applicable federal and provincial regulations
- Project design will incorporate safety measures including leak alarms, emergency shutdown systems, and spill and leak control design provisions (including but not limited to impoundment areas around ammonia storage).
- On-site staff will receive training in chemical storage and handling.
- Equipment will be kept in good working order and inspected regularly for leaks.
- Storage, stockpiling and use of fuel, lubricant and other hazardous substances will be in designated areas outside of buffer zones designed to protect sensitive habitats including watercourses and wetlands.
- Development and implementation of a Spill Management Plan to include the immediate clean-up, containment and removal of impacted groundwater and the removal and proper disposal of impacted soil.

In the unlikely event that groundwater wells are established on site, the necessary authorizations will be sought from NSECC and the wells will be operated in accordance with accepted best management practices.

Any effects occurring during the decommissioning phase of the Project will be mitigated as prescribed in the Decommissioning and Reclamation Plan, which would be developed prior to decommissioning and incorporate the current standards and regulations.

6.2.4 Residual Effects

The Project is not expected to require major excavations, blasting or groundwater withdrawals. In the unlikely event that groundwater wells are required, the necessary authorizations will be sought from NSECC and the wells will be operated in accordance with accepted best management practices. With the implementation of the identified mitigation measures, residual effects on groundwater are predicted to be negligible and not significant.

6.2.5 Follow-up and Monitoring

Baseline monitoring will be performed prior to any additional site work, and a groundwater monitoring program to evaluate potential impacts to groundwater levels and groundwater quality will be maintained over the life of the Project in accordance with requirements stipulated by NSECC. Monitoring locations will be established down-gradient of hazardous materials storage areas and at the property boundaries. Monitoring wells will also be established upstream of the Project site to monitor background concentrations in groundwater.

6.3 SURFACE WATER RESOURCES

Surface water is a VC as it has the potential to influence and be influenced by Project activities. Surface water is an integral part of the natural environment given its contribution to the health of fish and fish habitat and wetlands, and its linkage to terrestrial and marine ecosystem components and groundwater. It can be an important source of potable water for surface water-supplied drinking water systems and provides groundwater recharge for groundwater-supplied drinking water systems. Changes to surface water flows, quantity or quality, could potentially affect groundwater recharge, aquatic life, terrestrial and marine ecosystems, and human health.

The Surface Water Resources VC is closely linked to the assessment of Groundwater Resources (Section 6.2), Freshwater Fish and Fish Habitat (Section 6.4), Vegetation and Wetlands (Section 6.5), and Marine Environment (Section 6.7).

6.3.1 Scope of Assessment

6.3.1.1 Regulatory and Policy Setting

Provincial legislation applicable to the assessment of surface water resources includes the *Water Resources Protection Act*, as well as the Activities Designation Regulations, and Environmental Emergency Regulations (under the *Environment Act*). The Project will require a Division V Industrial Approval under the Activities Designation Regulations of the provincial *Environment Act*. As part of the Industrial Approval, it is anticipated that NSECC will identify discharge criteria and monitoring requirements for discharges. The CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME WQG-PAL) establish accepted water quality parameters. CCME guidelines are often used to inform project-specific discharge criteria during the regulatory permitting process.

Where surface water resources are designated as municipal source water supply areas, municipalities can request that the source water supply area be designed as a protected water area under the *Environment Act*. The Port Hawkesbury Watershed (Figure 4.2), within which Landrie Lake is located, is a Protected Water Area under the *Environment Act*. The Port Hawkesbury Watershed Protected Water Area Designation and Regulations under the Act designate the boundaries of the protected area and specify activity restrictions within these boundaries. Although the source of water for the Project (Landrie Lake) is within the Port Hawkesbury Watershed Protected Water Area, the Project Area is located outside the designated boundaries and there is otherwise no predicted interaction with the Port Hawkesbury Watershed Protected Water Area or potential contravention of the regulations.

6.3.1.2 Boundaries

The land portion of the site is located on gently sloped terrain situated along the north coast of the Strait of Canso. Natural surface drainage tends to flow in a southerly direction. Two streams flowing to the south of the site receive surface water runoff. A stream located in the eastern portion of the Project Area receives approximately half of the site runoff. A second stream located in the west of the Project Area receives approximately one quarter of the site runoff. The remaining quarter of the site drains directly to the Strait of Canso. Civil works, including drainage ditches and culverts, have been previously constructed to control site and access-road runoff and to prevent erosion and associated sedimentation.

Spatial boundaries for the assessment of surface water resources are described below:

- The Project Area is defined as the anticipated area of direct physical disturbance associated with construction, operation and decommissioning of the Project and comprises the BHE-owned site properties including the water lot (Figure 1.3).
- The LAA for surface water resources encompasses the watershed area boundaries as shown on Figure 4.2 (within the primary watershed of Isle Madame [1:10,000 primary watershed]).

The temporal boundaries for the assessment of potential effects on surface water resources include construction, operations and decommissioning phases of the Project as outlined in the schedule presented in Section 2.13.

6.3.1.3 Significance Definition

A significant adverse residual effect on surface water quantity is defined as a measurable change in hydrological and/or sediment transport regime that:

- Does not meet established instream flow needs, or
- Contravenes a watershed management target

A significant adverse residual effect on water quality is defined as a measurable change in water quality that:

- Exceeds an implemented water quality objective or a site-specific water quality guideline for the protection of aquatic life
- Contravenes a watershed management target
- Causes acute or chronic toxicity to aquatic life

A significant adverse residual effect on water quality with respect to TSS is one that exceeds the generally accepted TSS monitoring guideline (the CCME WQG-PAL) applied for construction activities.

6.3.2 Project Interactions and Potential Effects

The development within the Project Area affects four catchment areas and two small surface water streams, namely Stream A (west) and Stream B (east). Surface runoff reaching the site from the northern (off-site) catchment area has been rerouted around the north side of the Project site using an open channel. This reconnects to a small wetland, Stream B, and the estuary. Rerouting off-site runoff away from Project activities minimizes the risk of any contamination to surface water bodies. The remaining site area drains primarily to the catchment area of Stream B and south to the strait. Previous site development has impacted the catchment area size to Stream A. Further impacts as a result of this Project are not anticipated. Surface runoff that is generated on-site and runs over the Bear HeadSite will be channeled to sedimentation ponds for treatment prior to discharge. Although the property borders the coast, Streams A and B extend beyond the property boundary downstream an additional 350 and 450 m respectively.

Project activities could result in changes to surface water flow, quantity and/or quality. Changes to surface water flows, quantity or quality, could potentially affect groundwater recharge, aquatic life, terrestrial and marine ecosystems, and human health.

6.3.2.1 Construction

Initial site work (i.e., clearing, grubbing and stripping of topsoil) has been largely completed. Additional site preparation will be limited but may include additional clearing and excavation. These activities may alter surface water flow patterns and/or cause erosion and sediment transport into surface waters.

Any impacts to on-site surface waters, including wetlands and streams, will most likely be a result of erosion, sediment transport or chemical contamination from stormwater runoff. There is also a risk of contamination from alkaline wastewater used to rinse concrete troughs.

Off-site surface water contamination from surface runoff is considered unlikely to occur as the site-grading directs runoff from the site to sedimentation ponds.

6.3.2.2 Operations

During operations, discharges of reject process water and stormwater could affect surface water quality if not adequately contained or treated to meet water quality standards prior to entering the receiving environment. Reject process water will not be discharged to the freshwater environment; BHE will seek regulatory approval to discharge reject process water to the marine environment, therefore interactions of the reject process water with surface water resources are not expected to occur. There may be increased stormwater flows resulting from a change in impervious surfaces on site.

6.3.2.3 Decommissioning

Effects of Project decommissioning are expected to be similar to those incurred during the construction phase. Potential effects to surface water resources during decommissioning will be considered and addressed in a future Decommissioning and Reclamation Plan.

6.3.3 Mitigation

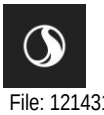
BHE does not anticipate any watercourse alterations in the Project Area. If watercourse alterations cannot be avoided, BHE will seek approval from NSECC in accordance with the Activities Designation Regulations and conduct work in accordance with applicable approval conditions.

The following mitigation measures will be implemented to protect surface water resources:

- A site-specific EMP and Stormwater Management Plan will be developed and include specific procedures to manage surface runoff and erosion and sedimentation during construction and operation of the facility. Details regarding ongoing maintenance, inspections and repair of erosion and sedimentation controls will be specified in the EMP. The Stormwater Management Plan will quantify potential increases in peak flow from site land use alterations and specify mitigation for associated quality and quantity impacts through the use stormwater best management practices. The existing site development includes sediment ponds and extensive surface water controls.
- On-site erosion and sediment control measures will be constructed, maintained and monitored to confirm they are working as expected. This may include the use of permanent check dams in conveyance channels and the use of sediment ponds. Inspections will take place before and after heavy precipitation events to identify whether erosion and sedimentation control measures have failed; if failure occurs, repairs will be immediately undertaken.
- Frequent inspection of surface water runoff controls will be made to ensure that they function efficiently and determine if routine maintenance is required. Inspections will take place before and after heavy precipitation events to identify whether erosion and sedimentation control measures have failed; if failure occurs, repairs will be immediately undertaken.
- The site shall be graded to drain stormwater away from buildings and equipment, and to prevent localized ponding. Site grading will be designed to direct surface runoff to conveyance channels and sediment ponds.
- Stormwater will be kept separate from process and sanitary wastewater streams to reduce the volume of wastewater to be treated prior to discharge. Surface runoff from process areas or potential sources of contamination will be prevented using diversion or secondary containment.
- Reject process water from the facility will be collected and conveyed in a fully dedicated piping network (excluding sanitary wastewater) and directed to an approved marine discharge location.

6.3.4 Residual Effects

Given that the site is substantially developed and additional clearing and grubbing will be limited, and given implementation of the mitigation measures outlined above (particularly management of site runoff and erosion and sediment control), residual environmental effects of the Project on surface water resources are predicted to be low in magnitude, limited in geographic extent to the Project Area,



continuous for the duration of Project activities and reversible. There are no effects predicted that would result in measurable changes in hydrological and/or sediment transport regime that would exceed water quality objectives, contravene watershed management targets, or cause acute or chronic toxicity to aquatic life. Residual environmental effects on surface water resources are therefore predicted to be not significant.

6.3.5 Follow-up and Monitoring

A quarterly surface water monitoring program will be undertaken to monitor the freshwater receiving environment at the site. Water quality testing will be conducted to detect and measure operational discharges from the Project to assess whether chemical contamination associated with routine or accidental releases are responsible for any changes in water quality. Sampling locations will provide a characterization of water chemistry entering and leaving the site. These locations will be used when construction commences. Once a final site stormwater management system has been commissioned, the number and location of sampling points will be reviewed and amended as necessary.

6.4 FRESHWATER FISH AND FISH HABITAT

Freshwater Fish and Fish Habitat is included as a VC because of the potential interactions that both may have with the Project and because both fall under regulatory protection.

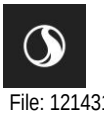
There are two streams within the Project Area. Stream A does not contain fish or fish habitat within the Project Area upstream of the settling pond (JWEL 2004) but has the potential to contain fish within its downstream most reaches. Stream B, does not contain fish or fish habitat upstream of the culvert on Bear Island Road but does contain fish habitat within its downstream reaches (SNC Lavalin 2015). The downstream portions of Streams A and B could potentially include fish species common to small streams such as, speckled trout, rainbow smelt, gaspereau, and small minnow or forage species such as banded killifish, stickleback species, American eel and Atlantic salmon. As noted in Section 4.4.5, trout, gaspereau, American eel and Atlantic salmon are fish species of interest to the Mi'kmaq of Nova Scotia.

Freshwater fish and fish habitat can be affected by changes in surface water quantity and quality and can also be affected by changes in associated wetlands. This VC is therefore closely linked to Surface Water Resources (Section 6.3) and Vegetation and Wetlands (Section 6.5).

6.4.1 Scope of Assessment

6.4.1.1 Regulatory and Policy Setting

Fish and fish habitat are protected under federal and provincial legislation. DFO's Fisheries Protection Policy Statement (DFO 2019) provides guidance on fish and fish habitat protection provisions. The federal *Fisheries Act* protects fish and fish habitat and addresses national interests in marine and fresh waters with the goal of protecting the long-term sustainability of aquatic resources. Section 34.4 of the *Fisheries Act* prohibits the destruction of fish by any means other than fishing. Section 35 protects fish habitat from HADD. HADD of fish habitat is defined under the *Fisheries Act* policies as "any temporary or permanent change to fish habitat that directly or indirectly impairs the habitat's capacity to support one or



more life processes of fish". Works can be authorized by and carried on in accordance with conditions established by the Minister of Fisheries, Oceans and the Canadian Coast Guard (Fisheries Minister) (Section 35(2)(b)). Any such work requires a Fisheries Act Authorization with an appropriate offsetting of residual adverse effects after avoidance and mitigation steps have been taken. Sections 36(3) and (4) of the Act prohibit the deposition of deleterious substances into waters frequented by fish in Canada unless authorized by regulation.

The CCME WQG-PAL has established accepted water quality guidelines for various parameters. These Guidelines are often used to inform project-specific discharge criteria during the regulatory permitting process.

With respect to provincial regulatory requirements, alterations to watercourses require approval or notification in accordance with the Activities Designation Regulations of the *Environment Act*.

6.4.1.2 Boundaries

The spatial boundaries for the assessment of potential effects on fish and fish habitat are defined as follows:

- The Project Area is defined as the anticipated area of direct physical disturbance associated with construction, operation and decommissioning of the Project and comprises the BHE-owned site properties including the water lot (Figure 1.3).
- The LAA for the assessment of fish and fish habitat encompasses the watercourses that intersect the Project Area and extends to the downstream portions of the watercourses where they drain into the Strait of Canso.

The temporal boundaries for the assessment of potential effects on fish and fish habitat include construction, operations and decommissioning phases of the Project as outlined in the schedule presented in Section 2.13. Interactions with fish and fish habitat could occur at any time of year, although streams and associated fish habitat are most sensitive to contamination during low flow periods (July-August) and to physical damage from extreme flows in the spring summer and fall. Although no in-water work is currently planned for Project construction, this type of work is generally scheduled to occur during DFO timing windows (June 1 to September 30) to avoid the most sensitive time for fish (October 1 to May 30).

6.4.1.3 Significance Definition

A significant adverse residual effect on freshwater fish and fish habitat is one that, following the application of avoidance, mitigation, and offset measures, results in a harmful alteration, disruption, or destruction of fish habitat or a change in fish abundance, health, growth, or survival that is likely to cause a measurable change in fish populations (beyond the range of natural variability), including fish of cultural or traditional importance.

6.4.2 Project Interactions and Potential Effects

As noted in Section 6.3.2, Project activities could result in changes to surface water quantity (e.g., changes in site hydrology) and/or quality which could affect fish and fish habitat. Previous construction at the site in 2005 and 2006 did not remove or impact the onsite fish-bearing portions streams, although there some alteration of wetland habitat at the site did occur (as approved by NSECC under the Environment Act). No watercourse alterations or additional wetland alterations are anticipated to be required for continued development of the site. Potential interactions and effects be will primarily linked to surface water management and sedimentation controls.

6.4.2.1 Construction

A considerable amount of the site has been developed, therefore clearing and grubbing in the Project Area is expected to be limited. These activities, as well as other general construction activities including excavation, could result in erosion and sedimentation of watercourses, potentially leading to adverse effects on fish and fish habitat, if activities are not properly managed or mitigated. Dustfall during construction activities could also potentially lead to siltation of watercourses. Sedimentation and siltation can affect fish habitat through changes in stream morphology and stream bed porosity, reduced biodiversity and abundance of bottom dwelling fish food organisms, and destruction of aquatic vegetation buried by sediments (DFO 2010, Sweka and Hartman 2001; Herbert and Merkens 1961; Kjelland et al. 2015).

Potential direct effects on fish can include temporary behavioural changes and physiological effects or reduction in food supply. Eggs and larvae may not be able to avoid exposure and can experience adverse physiological effects or mortality whereas mobile fish and benthic invertebrates may have the ability to reduce their exposure to sedimentation and siltation but experience health effects due to reduction in food supply (Anderson et al. 1996; Trow Consulting Engineers Ltd. 1996; Herbert and Merkens 1961).

6.4.2.2 Operations

During operations, interactions with freshwater fish and habitat would primarily be linked to ongoing surface water management at the site and potential accidental spills or failures of erosion and sediment control features. Accidental events are assessed separately in Section 7. Reject process water will not be discharged to the freshwater environment. On-site surface runoff will be managed through site drainage controls and will not be directly discharged to fish-bearing watercourses.

6.4.2.3 Decommissioning

Effects of Project decommissioning are expected to be similar to those incurred during the construction phase. Potential effects to freshwater fish and fish habitat during decommissioning will be considered and addressed in a future Decommissioning and Reclamation Plan.

6.4.3 Mitigation

Mitigation presented in Section 6.3.3 to protect surface water resources will also be protective of fish and fish habitat. No additional mitigation is proposed for fish and fish habitat. BHE does not anticipate any watercourse alterations or in-water work in the Project Area and will maintain a 30 m vegetated buffer around onsite streams in the Project Area. If watercourse alterations cannot be avoided, BHE will seek approval from NSECC in accordance with the Activities Designation Regulations and conduct work in accordance with applicable approval conditions.

6.4.4 Residual Effects

Given that the site is substantially developed and additional clearing and grubbing will be limited, and given implementation of the mitigation measures outlined in Section 6.3.3 (particularly management of site runoff and erosion and sediment control), residual environmental effects of the Project on fish and fish habitat are predicted to be negligible to low in magnitude, limited in geographic extent to the LAA, continuous for the duration of Project activities and reversible. There are no effects predicted that would result in a HADD of fish habitat or a change in fish abundance, health, growth, or survival that is likely to cause a measurable change (beyond natural variability) in fish populations, including those of cultural or traditional importance. Residual environmental effects on freshwater fish and fish habitat are therefore predicted to be not significant.

6.4.5 Follow-up and Monitoring

Refer to Section 6.3.5 for information on a follow-up and monitoring program for surface water resources. No additional follow-up and monitoring are proposed for fish and fish habitat.

6.5 VEGETATION AND WETLANDS

6.5.1 Scope of Assessment

6.5.1.1 Regulatory and Policy Setting

Wetlands in Nova Scotia are protected by the provincial *Environment Act*, where “wetland” is defined as:

> *land commonly referred to as a marsh, swamp, fen or bog that either periodically or permanently has a water table at, near or above the land’s surface or that is saturated with water, and sustains aquatic processes as indicated by the presence of poorly drained soils, hydrophytic vegetation and biological activities adapted to wet conditions.*

The Nova Scotia Wetland Conservation Policy (NSE 2011) provides context to legislation, regulations and operational policies designed to protect and guide management of wetlands in Nova Scotia. The policy establishes a specific goal of no loss of Wetlands of Special Significance and no net loss in area and function for other wetlands. The government considers the following to be Wetlands of Special Significance (NSE 2011):

- all salt marshes
- wetlands that are within or partially within a designated Ramsar site, Provincial Wildlife Management Area (Crown and Provincial lands only), Provincial Park, Nature Reserve, Wilderness Area or lands owned or legally protected by non-government charitable conservation land trusts
- intact or restored wetlands that are project sites under the North American Waterfowl Management Plan and secured for conservation through the Nova Scotia Eastern Habitat Joint Venture
- wetlands known to support at-risk species as designated under the federal *Species At Risk Act* or the Nova Scotia *Endangered Species Act*
- wetlands in designated protected water areas as described within Section 106 of the *Environment Act*.

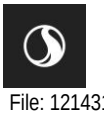
There are no provincially mapped Wetlands of Special Significance in the Project Area.

Any project with the potential to alter a wetland (filling, draining, flooding or excavating), including direct and indirect effects, requires an Approval from NSECC, pursuant to the Activities Designation Regulations, prior to starting the work. If alterations exceed two hectares of any wetland, the project is also subject to registration under the Environmental Assessment Regulations.

In 2004, prior to site development, NSECC (formerly NSEL) issued an Approval to Construct – Wetland Infill (Approval No. 2004-043228) to allow infilling of an unnamed wetland at Bear Head. Work was completed in accordance with this approval and wetland compensation requirements were fulfilled. No additional wetland alteration is anticipated to be required for the Project. However, if wetland alteration is required, it will require a new Approval under the Activities Designation Regulations.

There is both federal (SARA) and provincial (NS ESA) legislation for the protection of SAR (refer to Section 4.2 for a definition of SAR and SOCC and Section 4.2.4 for identification of relevant plant species). The occurrence of plant species of conservation interest (i.e., SAR or SOCC) within wetlands is also of concern with respect to provincial wetland policy and the permitting process.

Plant communities of conservation concern have not been similarly classified under provincial legislation or policy. Therefore, the identification of “uncommon plant communities” is based on general knowledge of the distribution of vegetation within the province and the occurrence of species assemblages. For the purposes of this assessment, an uncommon plant community is defined as an area that supports an assemblage of native vascular plants which are not commonly encountered within the province, and which occur as a result of unique natural processes and/or environmental conditions. Examples of uncommon plant communities within the province may include those associated with karst topography, old growth forests, eastern white cedar (*Thuja occidentalis*) stands, rich riparian forests, and alkaline fens. No uncommon plant communities have been identified in the Project Area.



6.5.1.2 Boundaries

As shown on Figure 4.5, there are wetlands north, east and west of the partially developed portion of the Project Area. Spatial boundaries for the assessment of vegetation and wetlands are described below:

- The Project Area is defined as the anticipated area of direct physical disturbance associated with construction, operation and decommissioning of the Project and comprises the BHE-owned site properties including the water lot (Figure 1.3).
- The LAA for vegetation and wetlands encompasses the watershed area boundaries as shown on Figure 4.5 (within the primary watershed of Isle Madame [1:10,000 primary watershed]). This LAA is established in recognition of potential indirect hydrological impacts to wetlands.

The temporal boundaries for the assessment of potential effects on vegetation and wetlands include construction, operations and decommissioning phases of the Project as outlined in the schedule presented in Section 2.13. The Project is expected to interact with vegetation and wetlands on a year-round basis, with these features being more sensitive to disturbance during spring, summer, and fall.

6.5.1.3 Significance Definition

A significant adverse residual effect on vegetation and wetlands is one that, following the application of avoidance and mitigation measures, threatens the long-term persistence or viability of plant communities or species, including those of cultural or traditional importance, or results in uncompensated loss of wetland function.

6.5.2 Project Interactions and Potential Effects

Potential Project effects on vegetation and wetlands may include changes in vegetation abundance and diversity, changes to species at risk or species of conservation concern, and/or change in wetland habitat and function.

6.5.2.1 Construction

Terrestrial habitats could be lost or altered because of physical works associated with construction activity. However, as assessed in the Bear Head LNG Project EA (SNC Lavalin 2015), the site is already substantially developed and there will be minimal clearing, grubbing and grading required at the site. Clearing and grubbing, if required, will result in loss of vegetation and could also result in erosion causing sedimentation of wetlands, which could potentially alter their hydrology. Excavation could also affect hydrology and/or require dewatering which could also affect vegetation and wetlands. Construction activities, including onsite transportation, may also generate dust. Deposition of dust on vegetation can reduce vegetation health and productivity and result in changes in vegetation abundance or diversity. Construction activities may also lead to the introduction of or increase in abundance of non-native and potentially invasive plant species. Effects of construction noise and lights may degrade quality of wetland habitat; these effects are assessed in Section 6.6 Wildlife and Wildlife Habitat.

Although BHE does not currently anticipate additional wetland alterations, changes to site plans and layouts could potentially require infilling or infringement of wetland habitat resulting in reduced wetland habitat and function. Indirect effects on wetland habitat could also occur as a result of erosion and sedimentation and changes to hydrology during construction, if not properly managed. As described in Section 4.2.3, during a 2022 site visit it was noted that wetlands have formed within the developed Project footprint. However, as described in the NS Wetland Conservation Policy (NSE 2019), "wetlands that develop as the unintended result of urban, commercial, industrial or agricultural construction projects completed less than 20 years before the current calendar year" do not require permitting approvals.

Additional site development during construction could also impact remaining southern twayblade plants previously recorded in Wetlands 3 and 6 indirectly through dustfall and/or changes in site hydrology, or directly through habitat loss if additional infilling is required within either wetland.

6.5.2.2 Operations

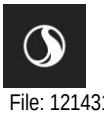
Project operation and maintenance activities, including vegetation maintenance around the developed areas, may result in the direct loss of vegetation, or create sedimentation and dust from onsite travel and result in indirect disturbance to vegetation. Site maintenance during winter operations may also involve application of road salt or other deicing agents to onsite roads and parking lots which could potentially affect adjacent wetlands and vegetation (including rare species such as southern twayblade) in the Project Area. Surface runoff and associated water management measures could affect site hydrology (and indirectly vegetation and wetlands). Process water discharges will not be released to the freshwater or terrestrial environment, therefore no interactions with wetlands are predicted with process water discharges. Light and noise emissions from Project operations may degrade the quality of wetland habitat; these effects are assessed in Section 6.6 Wildlife and Wildlife Habitat.

6.5.2.3 Decommissioning

Potential Project interactions with vegetation and wetlands during decommissioning could be similar to those experienced during construction, depending on the extent of site reclamation activities. Depending on future uses of the site after Project decommissioning, the site may be allowed to naturalize, thus restoring wetland and vegetative habitats on site. If hydroseeding occurs near wetlands this could potentially influence the plant composition of wetland communities and increase nutrient levels, potentially affecting wetland functions. Decommissioning/reclamation activities may also increase the susceptibility of wetland habitats to non-native and invasive plants through increased disturbances and proximity to anthropogenic infrastructure. Potential impacts to vegetation and wetlands will be addressed in a Decommissioning and Reclamation Plan to be prepared in advance of Project decommissioning.

6.5.3 Mitigation

BHE does not anticipate any further wetland alteration on site. Work will be planned to meet the objectives of the Nova Scotia Wetland Conservation Policy which includes a hierarchical mitigation of avoidance, minimization, and then ultimately, for unavoidable wetland alterations, compensation. If additional wetland alteration cannot be avoided, BHE will seek approval from NSECC in accordance with the Activities Designation Regulations and conduct work in accordance with applicable approval



conditions. Loss of wetland function will be compensated through the enhancement, restoration or creation of wetland habitat commensurate with the loss in consultation with NSECC.

The following additional mitigation will be implemented to avoid or reduce adverse effects on wetlands and vegetation:

- Minimal clearing and grubbing will be required to complete construction. Boundaries of areas to be cleared will be well marked prior to the start of clearing activities.
- Buffer zones (approximately 30 m) will be maintained around sensitive areas (e.g., watercourses. Wetlands, rare plant locations).
- Where ground disturbance is required within 30 m of a wetland, erosion and sediment controls will be implemented to prevent siltation of wetland.
- Erosion control methods will be applied to reduce potential for surface water runoff and protect slopes and erodible soils.
- The amount and duration of exposed soil will be kept to a minimum to prevent erosion at the source; this will reduce the amount of sediment to be managed.
- Mitigation to manage reject process water and stormwater effluent (Section 6.3.3), including implementation of a Stormwater Management Plan, will also be protective of wetlands and vegetation.
- Existing drainage patterns will be maintained to the extent feasible (e.g., through the use of culverts).
- Grading will be directed away from known occurrences of plant SAR and SOCC where feasible.
- Sedimentation ponds will be used to capture runoff from the site and allow for settling of solid particles. Whenever possible, sediment controls will prevent sediment from leaving the site.
- To reduce the risk of introducing or spreading non-native and/or invasive vascular plant species, equipment will arrive at the Project site clean and free of soil and vegetative debris.
- The requirement spraying of herbicide is not anticipated; however, spot-spraying may be required on occasion. If spraying of herbicides is required, it will not be conducted within 30 m of plant SAR or SOCC, wetlands, or waterbodies.
- Water (or other approved agent) will be applied as a dust suppressant as required during Project activities. Under no circumstances will oil be used for dust control.
- Speed limits will be implemented for Project-related traffic in the Project Area to reduce the overall displacement of dust.
- Maintenance and cleaning of mobile construction equipment will not be carried out within 30 m of a watercourse or wetland.
- Vegetation cover on the site will be maintained to the extent practicable throughout the operational phase of the Project to help to minimize the effects of erosion and potential sedimentation of sensitive habitats.
- Winter road maintenance procedures will be implemented to minimize the amount of road salt application.
- Revegetation of the site during reclamation, if required, will use an approved seed mix that is predominantly comprised of native species and does not include invasive species.

6.5.4 Residual Effects

Given that the site is substantially developed and additional clearing and grubbing will be limited, and given implementation of the mitigation measures outlined above (including maintaining buffer areas around wetlands and rare plant locations), residual environmental effects of the Project on vegetation and wetlands are predicted to be low in magnitude, limited primarily in geographic extent to the Project Area (particularly for vegetation communities and rare plants), but could extend to the LAA for indirect effects on wetlands, continuous for the duration of Project activities and reversible. There are no effects predicted that would threaten the long-term persistence or viability of plant communities or species, including those of cultural or traditional importance, or result in uncompensated loss of wetland function. Residual environmental effects on vegetation and wetlands are therefore predicted to be not significant.

6.5.5 Follow-up and Monitoring

Wetland surveys will be undertaken in summer 2023 to update wetland delineations and confirm no additional wetland alterations are required for continued site development. Field surveys will be undertaken in summer 2023 to verify the presence and extent of southern twayblade previously identified on the site. An ecologist will monitor the site of the southern twayblade population in Wetland 3, recording the number and conditions of the plants, if found. This survey will be conducted during the flowering period of the species (late June to early July) and will be conducted each year prior to further construction and for two years following construction. Lichen surveys will also be conducted within the Project Area to search for lichen SAR/SOCC which have been recorded as occurring within 5 km of the Project Area.

6.6 WILDLIFE AND WILDLIFE HABITAT

The Wildlife and Wildlife Habitat VC considers birds, mammal and herpetile species with a focus on migratory birds, SAR and SOCC and their habitat. This VC is closely linked to the Vegetation and Wetlands VC (Section 6.5) recognizing that wetlands can provide important habitat for various species. Much of the Project Area was cleared in 2005 to accommodate the roads and foundation infrastructure for the previously approved Bear Head LNG Project. The balance of the site, approximately 50% of the total area, is comprised of undisturbed features such as mixed forest, wetlands, abandoned farmland, streams and marine coastline.

6.6.1 Scope of Assessment

6.6.1.1 Regulatory and Policy Setting

Migratory birds are protected federally under the *Migratory Birds Convention Act, 1994* (MBCA) which states that “no person shall disturb, destroy or take a nest, egg, nest shelter, either duck shelter or duck box of a migratory bird” without a permit. The MBCA includes prohibition of “incidental take” of migratory birds or their nests as a result of activities such as those that may be required for the Project. Under the current Migratory Birds Regulations, no permits can be issued for the incidental take of migratory birds or nests caused by development projects or other economic activities. Section 5.1 of the MBCA describes prohibitions related to deposit of substances harmful to migratory birds. ECCC (2022d) also outlines standards to avoid and mitigate harm to migratory birds under MBCA. Other bird species (and other

wildlife) not protected under the federal act, such as raptors and cormorants, are protected under the provincial *Wildlife Act*.

Wildlife species that are protected federally under SARA are listed in Schedule 1 of the Act. Those species listed as “Endangered” or “Threatened” in Schedule 2 or 3 of SARA may also be considered as Species at Risk, pending regulatory consultation.

Certain wildlife species are also protected under the NS ESA. Species identified as seriously at risk of extinction in Nova Scotia are identified by a provincial status assessment process through the Nova Scotia Endangered Species Working Group. Once identified, they are protected under the NS ESA. The conservation and recovery of species assessed and legally listed under the NS ESA is coordinated by the Wildlife Division of the NRR.

6.6.1.2 Boundaries

The spatial boundaries for the assessment of wildlife and wildlife habitat are described below:

- The Project Area is defined as the anticipated area of direct physical disturbance associated with construction, operation and decommissioning of the Project and comprises the BHE-owned site properties including the water lot (Figure 1.3).
- The LAA for Wildlife and Wildlife Habitat encompasses the Project Area and a 1 km buffer around the Project Area in consideration of potential noise effects on wildlife beyond the Project Area boundaries.

The temporal boundaries for the assessment of potential effects on wildlife and wildlife habitat include construction, operations and decommissioning phases of the Project as outlined in the schedule presented in Section 2.13. The assessment also considers that interactions and species sensitivity to disturbance could change during certain times of the year depending on migratory patterns, seasonal movement/hibernation and/or mating/breeding seasons. Although the temporal sensitivities for some species may vary, this assessment will consider the potential effects of the Project on wildlife and wildlife habitat on a year-round basis.

6.6.1.3 Significance Definition

A significant adverse residual effect on wildlife and wildlife habitat is one that, following the application of avoidance and mitigation measures, causes or further contributes to the exceedance of a conservation-based threshold or threatens the long-term persistence or viability of species of management concern, or species of cultural or traditional importance.

6.6.2 Project Interactions and Potential Effects

Potential Project effects on wildlife and wildlife habitat could include changes in habitat quantity or quality, wildlife behaviour and/or movement, wildlife abundance and distribution, and/or wildlife mortality risk.

6.6.2.1 Construction

Terrestrial habitats could be lost or altered due to physical works associated with construction. This could include the loss of potential roost trees for bats. However, as assessed in the *Bear Head LNG Updated Registration Document* (SNC Lavalin 2015), the site is currently substantially developed and there will be minimal clearing, grubbing and grading required at the site so new habitat loss or fragmentation is expected to be minimal. Potential effects on wetlands as described in Section 6.5.2.1 could potentially adversely affect wildlife which depend on wetlands for all or a portion of their life processes (e.g., foraging).

Security fencing around the site may inhibit the movement of larger mammals. Although direct habitat loss or fragmentation is expected to be minimal, indirect effects on wildlife and wildlife habitat could occur through the generation of construction noise. Noise can result in changes in wildlife behaviour and/or displacement or avoidance of habitat. These changes can affect wildlife health and, in some cases, mortality risk, as species may leave the Project Area for less favorable habitat.

Site lighting during construction may impact birds and other wildlife. Lighting impacts are discussed in Section 6.6.2.2.

General construction activity will generate noise which could disturb birds and wildlife in the Project Area including a pair of osprey which have been observed nesting at the site since 2019.

Increased vehicle traffic associated with Project construction could result in increased wildlife mortality because of collisions with vehicles. It is expected that collisions would most likely involve small mammals, bird and herpetile species.

6.6.2.2 Operations

The operation of the facility will generate noise and light emissions which may affect wildlife in and around the Project Area causing habitat avoidance and/or other changes in behaviour.

The facility will be equipped with lighting for safety and security purposes and will be comparable to lighting proposed for the previously approved Bear Head LNG Project. The facility will include a high-pressure flare in the northern portion of the site to evacuate the process units, primarily the Haber-Bosch ammonia synthesis unit, if needed. This would occur only under safety-related conditions and only to the extent needed to reduce the pressure in the process units to a safe level. A second low-pressure flare will be installed at the marine terminal. These flares are not used regularly under normal operating conditions but are designed to dispose of streams released during start-up, shutdown and plant upsets or emergency conditions.

Structures, flares and lighting all pose a risk of attraction and possible collision to aggregations of birds, particularly to migrating birds. Lights attract birds, bats and insects. This effect may be even more evident during periods of poor visibility caused by fog, rain, snow or other climatic conditions (CBCL 2016b). Birds can be attracted to lights and can die either directly through collision or from exhaustion when circling them for an extended period. In the case of this Project, attraction effects on birds may be exacerbated by

the Point Tupper Wind Farm adjacent to the Project Area. Birds attracted to site lighting may fly through the arcs of nearby wind turbines. Waterfowl and shorebirds, which typically fly in relatively linear trajectories and have limited in-air agility tend to be more susceptible to mortality events caused by collisions with structures in poor visibility (CBCL 2016b).

Aggregation or attraction behavior exhibited by nocturnal migrants around lit towers and/or gas flares has been observed worldwide including Atlantic Canada. In 2013, approximately 7,500 songbirds migrating during foggy conditions were killed at the Canaport LNG Facility in Saint John New Brunswick when they flew into an operating gas flare. Another event, reported at the Thebaud natural gas platform off Nova Scotia, recorded the mortality of approximately 44 Blackpoll Warblers during fall migration in October 2008 when they became entrapped by the gas flare on the offshore platform (CBCL 2016b).

BHE developed an Avifauna Management and Monitoring Plan for the Bear Head LNG Project to address concerns raised by NRR and Canadian Wildlife Service (CWS), particularly with respect to flaring and lighting. The Avifauna Management and Monitoring Plan identified key factors that would influence the design and likelihood of adverse impacts to birds and bats at the LNG facility and explored management and monitoring options.

6.6.2.3 Decommissioning

Decommissioning activities are expected to present similar, but reduced risks to wildlife and wildlife habitat as during the construction phase. Noise associated with decommissioning could disturb wildlife. The potential effects to wildlife during decommissioning will be considered and addressed in a Decommissioning and Reclamation Plan which would be developed as the facility nears the end of its life. This plan would include references to the standards and procedures in place at the time. Depending on the future use of the site, the removal of security fencing and re-vegetation of the site could allow for the re-introduction and possible re-population of species that may then consider the site a suitable habitat.

6.6.3 Mitigation

- Surveys for mammals, amphibians and reptiles will be completed in 2023 during the appropriate seasons to update existing wildlife data for the Project Area and confirm absence of SAR and SOCC.
- The existing Bear Head LNG Avian Management and Monitoring Plan (CBCL 2016b) will be updated for the Project. This updated Plan will include a raptor management plan for nesting osprey observed at the site.
- During construction, the Project footprint and temporary work areas will be limited to the extent feasible, and clearing and grubbing will be restricted to the necessary areas.
- Vegetation clearing and grubbing will avoid the bird and bat breeding season (May 1 to August 31). Where this is not feasible, avoidance and mitigation measures will be developed in consultation with NRR and CWS and incorporated into the EMP. This may include nest searches, bat maternity roost surveys and established buffer zones.
- Dust prevention and abatement measures will be implemented as required.
- Construction and operations staff will maintain proper housekeeping practices and ensure that food and garbage items are properly disposed of in a designated location to avoid attracting predators that may disturb or cause injury to wildlife and birds.

- Project-related traffic will observe low speed limits to reduce risk of mortality with wildlife.
- Noise and light disturbance will be minimized and restricted to those areas where it is necessary.
- Artificial lighting will be limited to the amount required for safety and security purposes and will be side-shielded and directed downward to reduce attraction of birds where feasible.
- A flare management plan will be implemented to schedule planned flaring events (e.g., start-up and commissioning, planned maintenance activities and planned shutdowns) to reduce potential interactions with migrating birds.
- The on-site environmental coordinator/monitor will check regional avian migration forecasts, supplemented with nightly checks of local ECCC weather radar sites during migration seasons to inform the timing of planned flaring events.

6.6.4 Residual Effects

The Bear Head Site has been previously developed and additional clearing and grubbing will be limited; therefore, direct effects on wildlife habitat will be limited. Flares will only be operational in specific circumstances and detailed flare management procedures will be in place, so they are unlikely to have a significant adverse effect on migrating birds and bats. As part of decommissioning, site activities will cease and fencing will be removed. Areas of the site, previously excluded from large wildlife, may once again become habitable.

Because of the mitigation measures outlined above, including an updated Avian Management and Monitoring Plan which will include mitigation for migratory birds and raptors, residual environmental effects of the Project on wildlife and wildlife habitat are predicted to be low in magnitude, limited in geographic extent to the Project Area, continuous for the duration of Project activities and reversible. There are no effects predicted that would cause or further contributes to the exceedance of a conservation-based threshold or threatens the long-term persistence or viability of species of management concern, or species of cultural or traditional importance. Residual environmental effects on wildlife and wildlife habitat are therefore predicted to be not significant.

6.6.5 Follow-up and Monitoring

Various follow-up and monitoring programs will be implemented in accordance with the Bear Head Avian Management and Monitoring Plan (CBCL 2016b):

- Nocturnal acoustic monitoring will be conducted prior to construction to attain a better understanding of the scale and composition of the migratory movements that may take place over the headland. This would serve to augment the existing avian data base in the area.
- Additional acoustic monitoring in the post construction phase will be reviewed with NRR based on an adaptive management model to assess species and their concentrations in the immediate area of the facility during the migration periods.
- The on-site environmental coordinator/monitor will conduct regular checks under lighting structures during migration periods coinciding with night fog visibility less than 0.75 km for a period of two years. Bear Head LNG will provide a short report to NRR and CWS summarizing bird mortality monitoring efforts by the end of January in each calendar year monitoring occurred.

- Ground searches will be conducted for bird and bat carcasses in the vicinity of the open ground around the flare by the on-site environmental coordinator/monitor in the event that the flare was operated in either the spring or fall migration periods or during poor weather and visibility conditions. Bird and bat mortalities will be reported to NRR and CWS where five bird mortalities are observed on one given night or, where 10 or more bird mortalities are recorded within any seven-day calendar period.

6.7 MARINE ENVIRONMENT

The Marine Environment VC focuses on marine plants, marine fish and invertebrates, marine mammals, sea turtles and marine habitat (including water and sediment quality) in the Strait of Canso and Chedabucto Bay with a particular focus on marine fauna and habitat in the BHE-owned water lot within which the marine terminal will be constructed and operated. Special consideration is given to fish species targeted for commercial, recreational or Indigenous fisheries, marine species at risk, and habitats of high productivity/ecological sensitivity (e.g., eelgrass beds). It is recognized that the construction and operation of the marine terminal has been previously assessed (JWEL 2004, SNC Lavalin 2015) and approved to proceed with authorizations under the *Fisheries Act* and *Canadian Navigable Waters Act*.

The TERMPOL Review Process, which focuses on marine safety and accident prevention, was undertaken for the Bear Head LNG Project and will be updated for the current Project to help marine transportation components operate within acceptable risk levels consistent with Canada's regulatory regime, International Conventions and Codes, safety standards, and industry best practices. The terminal design and environmental interactions will be unchanged from the previously approved EAs and DFO applications. This VC is therefore included herein primarily for context and to help inform the assessment of Project effects on the Fisheries, Aquaculture and Marine Harvesting VC (Section 6.9) and the assessment of Project impacts on the Mi'kmaq of Nova Scotia (Section 8).

6.7.1 Scope of Assessment

6.7.1.1 Regulatory and Policy Setting

Marine fish, fish habitat, water quality and sediment quality are protected under federal and to some extent provincial legislation. DFO's Fisheries Protection Policy Statement (DFO 2019) provides guidance on fish and fish habitat protection provisions. The federal *Fisheries Act* protects fish and fish habitat and addresses national interests in marine and fresh waters with the goal of protecting the long-term sustainability of aquatic resources. Section 34.4 of the Fisheries Act prohibits the destruction of fish by any means other than fishing. Section 35 protects fish habitat from HADD. HADD of fish habitat is defined under the *Fisheries Act* policies as "any temporary or permanent change to fish habitat that directly or indirectly impairs the habitat's capacity to support one or more life processes of fish". Works can be approved by and carried on in accordance with conditions established by the Minister of Fisheries, Oceans and the Canadian Coast Guard (Fisheries Minister) (section 35(2)(b)). Any such work requires an authorization with an appropriate offsetting of residual adverse effects after avoidance and mitigation steps have been taken.

Sections 36(3) and (4) of the Act prohibit the deposition of deleterious substances into waters frequented by fish in Canada unless authorized by regulation.

In the context of the Marine Environment VC, the following definitions apply:

- Fish is defined in Section 2 of the *Fisheries Act* and includes: "(a) parts of fish, (b) shellfish, crustaceans, marine animals, and any parts of shellfish, or crustaceans, and (c) the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals".
- Fish habitat is also defined in Section 2 of the *Fisheries Act* 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 Marine Environment VC includes marine fish and their habitat located within the vicinity of the Project, with spatial boundaries defined in Section 6.7.1.2. Species of marine fish which are extirpated, endangered or threatened are protected under the federal SARA which generally limits exposure of listed endangered species or critical habitats for listed species to be interfered with, disturbed, or destroyed. General prohibitions include Section 32(1), which states that no person shall kill, harm, harass, capture or take an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species as listed in Schedule 1 of SARA and Section 59 critical habitat regulations. No approvals under SARA are likely required for marine species with respect to the Project.

In 2006, Fisheries and Oceans Canada (DFO) issued an authorization under s.35(2) of the *Fisheries Act* for a temporary wharf and work surface (Authorization # 05-G7-100). This authorization was extended in 2009 and 2012, and in 2016, the authorization was amended to permit construction of a permanent marine offloading facility and tug wharf, and marine terminal (jetty) and associated infrastructure in addition to a temporary wharf (DFO File: 16-HMAR-00088). The approval authorizes the following serious harm to fish as a result of the work: destruction of 6500 m^2 of marine fish habitat during construction and the permanent alteration of 1800 m^2 eelgrass habitat during operations. Incidental mortality of sessile or slow-moving species which may result from infilling activities is also covered by the authorization. At the time, DFO determined that an authorization for the main terminal structure was not required due to the limited disturbance to fish habitat offered by the pile construction (i.e., no infilling).

As noted in Section 2, the design and construction of the marine terminal for the Project will remain the same as was previously authorized by DFO and Transport Canada. The *Fisheries Act* authorization for the marine terminal was amended in 2023 to reflect the change in proponent name and project and extend the expiry date. All conditions of authorization remain the same (refer to Appendix A).

As partial fulfillment of habitat compensation conditions of the authorization, BHE (as BHLNG) contributed funds to enable work to be carried out to enhance the functionality of the outlet channel at St. Francis Harbour. In addition, as per the HADD authorization and *Offsetting Plan for the Bear Head LNG Marine Terminal*, during marine terminal construction, BHE will also place two rock rubble structures on site to fulfill the remaining habitat compensation requirements.

In addition to receiving authorizations under the *Fisheries Act* and *Navigable Waters Protection Act* (now *Canadian Navigable Waters Act*), the marine terminal was subject to a federal impact assessment under the *Canadian Environmental Assessment Act* (now *Impact Assessment Act*). Following a review of the Project Description, and with an understanding that the design and construction methods for the marine terminal remain the same as previously authorized, the Impact Assessment Agency of Canada has confirmed no additional assessment of the marine terminal is required under the *Impact Assessment Act*.

The Project will require a Division V Industrial Approval under the Activities Designation Regulations of the provincial *Environment Act*. As noted in Section 2.11.4, BHE is seeking regulatory approval to discharge to the marine environment. As part of the Industrial Approval, it is anticipated that NSECC will identify discharge criteria and monitoring requirements for discharges to the marine environment. Baseline receiving water quality and the CCME WQG-PAL establish accepted water quality parameter concentrations and will form the basis for developing discharge criteria for the site. BHE will design appropriate treatment processes to meet approval requirements.

6.7.1.2 Boundaries

The spatial boundaries for the assessment of the marine environment are described below:

- The Project Area is defined as the anticipated area of direct physical disturbance associated with construction, operation and decommissioning of the Project and comprises the BHE-owned site properties including the water lot (Figure 1.3).
- The LAA for the Marine Environment includes the Strait of Canso from the Canso Causeway to the waters of Chedabucto Bay.

The temporal boundaries for the assessment of potential effects on the marine environment include construction, operations and decommissioning phases of the Project as outlined in the schedule presented in Section 2.13.

6.7.1.3 Significance Definition

A significant residual adverse environmental effect on the Marine Environment is one that results in any of the following:

- The unauthorized destruction of fish as described in the *Fisheries Act*, by the Project through any means other than fishing
- An unmitigated or non-compensated net loss of fish habitat through physical, chemical, or biological means, such that natural recruitment would not re-establish the community to its original composition, density and extent in one generation
- An adverse change that threatens the long-term persistence of a fish, marine mammal or sea turtle species or population in the assessment area, including effects that are contrary to or inconsistent with the goals, objectives or activities of recovery strategies, action plans and management plans

6.7.2 Project Interactions and Potential Effects

The EA for the LNG Import Facility (JWEL 2004) assessed effects of the marine terminal construction and operation and maintenance on marine benthic habitat and communities, marine fish and fish habitat, and marine mammals. An abridged assessment was presented in the Bear Head LNG Project EA (SNC Lavalin 2015).

Potential interactions and effects on the marine environment include:

- Siltation from marine construction
- Loss and/or alteration of fish habitat through installation of marine infrastructure (i.e., pilings)
- Attraction of fish by subsurface structures (reef effect)
- Physical and/or behavioural effects to marine wildlife due to underwater noise
- Contamination of marine fish and their food sources due to stormwater and/or wastewater discharges
- Introduction of marine invasive species due to ship discharges
- Risk of collision of marine mammals and sea turtles with vessel traffic

An important interaction not previously assessed, however, is the addition of reject process water to the marine environment from the updated Project.

6.7.2.1 Construction

With the understanding that the jetty will be designed as a piled structure, dredging and infilling is not expected; therefore, widespread disturbance or destruction of the benthos will be avoided. As noted in Section 6.7.1.1, BHE has obtained authorization for benthic habitat loss under the *Fisheries Act* and already partially fulfilled habitat compensation requirements.

Underwater noise, particularly when pile driving during jetty construction, may result in potential physical effects (e.g., injury), habitat avoidance, changes in migration, and/or changes in reproductive or feeding behaviour. Continuous (i.e., non-impulsive) sound from vessels may also affect marine mammal communications through communication masking and changes in vocalization. Risk of vessel strikes with marine mammals and sea turtles will be low during construction given the slow vessel speeds and construction noise which is likely to displace animals from the immediate area.

The design of the piled structure will be relatively transparent to flow and will not impede circulation in the Strait of Canso. Increase in turbidity, siltation and contamination may result from Project construction and/or operation activities (e.g., piledriving, propwash). The addition of new or different substrate types associated with the marine structure (including the vertical habitat created by the steel piled structures) could provide opportunities for recolonization with different types of benthic communities compared with those currently resident (e.g., reef effect).

6.7.2.2 Operations

During operations, Project-related vessels will create underwater noise, although this noise will be continuous (i.e., non-impulsive) and less intensive as the pile driving noise and will be similar to existing shipping noise experienced in the Strait of Canso. Nonetheless, continuous underwater noise may still potentially result in physical effects (e.g., injury), habitat avoidance, changes in migration, and/or changes in reproductive or feeding behaviour. Continuous sound from vessels may also affect marine mammal communications through communication masking and changes in vocalization.

Marine mammals and sea turtles may be more susceptible to vessel strikes during operations, although vessel movement will still be relatively slow and vessels will observe standard vessel operating procedures.

Over time, hard substrate associated with the marine terminal (jetty and MOF) may be colonized by invertebrate species and consequently attract fish resulting in a “reef effect”.

BHE is seeking regulatory approval to discharge to the marine environment. Site water discharges (e.g., stormwater runoff, reject process water, sanitary discharge) will comply with applicable regulatory approvals and discharge criteria which will be protective of fish habitat, although there may be localized changes to water quality and fish habitat. The anticipated concentration of parameters in the reject process water, which is assumed to be three times the concentration of the raw water that is processed through the reverse osmosis units and discharged from a marine outfall at approximately 10 m water depth near the marine terminal, is provided in Appendix B. There are no metals exceeding CCME marine guidelines for the protection of aquatic life, and the warmer, lower salinity reject process water discharged will mix in the receiving marine environment and reach ambient conditions within 6 m of the outfall under summer and winter worst-case conditions (Appendix F). Installation of a discharge pipe on the seafloor may impact the benthic environment. BHE will share details on the proposed marine outfall with DFO to determine if a Letter of Advice or authorization will be required under the *Fisheries Act*. Depending on the design and installation of the pipeline, this could potentially create new habitat and result in a “reef effect” similar to the marine terminal itself.

Ammonia carrying vessels will comply with ballast discharge guidelines and will not discharge ballast water in Chedabucto Bay or the Strait of Canso, therefore no interaction of ballast waters with the study area (e.g., introduction of invasive species) is anticipated.

6.7.2.3 Decommissioning

Decommissioning of the Project, particularly the marine terminal, could potentially impact the marine environment through underwater noise and benthic disturbance associated with removal of the marine terminal (if removed as part of the Decommissioning and Reclamation Plan). Decommissioning of land-based facilities could potentially affect the Marine Environment if erosion and sedimentation is not properly managed.

6.7.3 Mitigation

BHE will adhere to the conditions of the existing *Fisheries Act* and *Canadian Navigable Waters Act* authorizations and will implement the following mitigation:

- Site water discharges (stormwater, domestic wastewater, reject process water) will be managed and discharged in accordance with applicable regulatory discharge criteria. BHE will work with NSECC and DFO to confirm appropriate discharge criteria and treatment design (if required) and obtain the necessary regulatory approvals prior to operations commencing.
- Design and installation of a discharge pipe in the marine environment will consider opportunities for placement in an area that will disturbed as part of the marine terminal construction, habitat creation (e.g., installation of riprap and protective rock berm) and will comply with applicable regulatory approvals.
- The discharge pipe will be placed so as to minimize scour (i.e., along relatively hard bottom if feasible) and with a diffuser and port above the seabed to reduce the mixing zone and the plume of any sediments suspended due to the turbulence of discharge. Additional scour protection (e.g., small amount of rock fill) will be added to protect the discharge pipe, if necessary.
- Frequent inspection of surface water runoff controls will be made to ensure that they function efficiently. Inspections will take place before and after heavy precipitation events to identify whether erosion and sedimentation control measures have failed; if failure occurs, repairs will be immediately undertaken.
- All materials imported to the site, including rock to be used in marine construction, will be free of excessive fines, non-acid generating, non-toxic (free of fuel, oil grease or other contaminants) and from a non-watercourse source.
- Prior to pile driving activities, various pile driving techniques will be evaluated with a focus on underwater noise reduction. If conventional pile driving is undertaken, a marine mammal monitoring plan for cetaceans will be submitted to DFO for review and approval prior to implementation.
- Project vessels will comply with applicable legislation, codes and standards of practice for shipping, including the Oil Pollution Prevention Regulations and Ballast Water Regulations under the *Shipping Act* to reduce risk of oil pollution and introduction of marine invasive species.
- Project vessels will operate in accordance with TERMPOL conditions which promote safe navigation and travel at reduced speeds near the marine terminal which will reduce underwater noise, potential for propellor wash, and potential for vessel strikes on marine mammals and sea turtles.

6.7.4 Residual Effects

Construction and operation of the marine terminal has been previously assessed and authorized under the *Fisheries Act* and *Canadian Navigable Waters Act*. The Strait of Canso is an industrial waterway and does not contain designated critical habitat for marine SAR. Loss of fish habitat has been authorized under the *Fisheries Act* and is being offset with habitat offsetting measures. Other effects on the marine environment associated with construction will be localized, short-term, and reversible. Effects on marine fish, mammals and sea turtles associated with underwater noise from shipping will be low magnitude, continuous for the life of the Project, and reversible. Marine discharges will be continuous throughout operations but changes in water quality are predicted to be very localized (i.e., not measurable beyond 6

m from the point of discharge). None of the predicted changes to the marine environment are expected to threaten the long-term persistence of fish, marine mammal or sea turtle species or populations in the assessment area, or cause effects that are contrary to or inconsistent with the goals, objectives or activities of recovery strategies, action plans and management plans. Residual environmental effects of the Project on the marine environment are therefore predicted to be not significant.

6.7.5 Follow-up and Monitoring

Monitoring will be implemented as per the *Fisheries Act* authorization, including eelgrass monitoring in the Project Area (pre-construction and during operations) and monitoring of offsetting measures to confirm effectiveness or identify the need for offsetting contingency. It is also anticipated that water quality monitoring will be conducted to meet approval conditions associated with a marine outfall.

6.8 LAND USE AND COMMUNITIES

Land Use and Communities is assessed as a VC in consideration of potential Project-related interactions with current and anticipated land uses in the vicinity of the Project. The Land Use and Communities VC considers existing land development (industrial, commercial, institutional, residential); settlement areas; recreation; areas of special community or social value; land ownership; and post closure land use.

This VC considers results of the assessment of Atmospheric Resources (Section 6.1) (e.g., dust and noise). Accidental events are assessed separately in Section 7.

6.8.1 Scope of Assessment

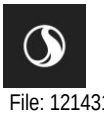
6.8.1.1 Regulatory and Policy Setting

The Project is in the Municipality of the County of Richmond and the West Richmond Planning Area. The West Richmond Planning Area includes Point Tupper, Port Malcolm, and Port Richmond. The West Richmond Planning Area Municipal Planning Strategy (MPS) (Municipality of the County of Richmond 2000a) includes policies to guide development and land use activities within the Plan area. The West Richmond Plan Area Land Use By-law (LUB) (Municipality of the County of Richmond 2000b) provides specific land use provisions and prohibitions in accordance with the MPS.

With respect to land use zoning under the MPS, the Project Area is primarily within the Port Industrial (I-2) zone with a smaller portion of the property in Heavy Industrial (I-3) zone. Land uses for Port Industrial development may include fuel bunkering, marine terminals, and other heavy industrial or port activities. The Project is consistent with this land use designation under the LUB. The Project will require development and building permits from the Municipality of the County of Richmond.

Regulatory requirements and guidelines pertaining to air quality and noise, which can affect land use and communities, are described in Section 6.1.1.1.

The Strategic Plan (2019-2024) for the Municipality of the County of Richmond provides direction on priorities for the Municipality and identifies three overarching priorities for achieving the overall vision and mission of the Strategic Plan: job creation, population growth, and increased revenue (MCR 2019).



Focused and strategic development, and industrial park development are two specific objectives for growing the economy (MCR 2019).

6.8.1.2 Boundaries

The Project is located in the Point Tupper Industrial Park in the Municipality of the County of Richmond. Residential development occurs in Port Hawkesbury and Port Malcolm, but the nearest residences to the Project Area are in Middle Melford, across the Strait of Canso (approximately 1.69 km).

The spatial boundaries for the assessment of land use and communities are described below:

- The Project Area is defined as the anticipated area of direct physical disturbance associated with construction, operation and decommissioning of the Project and comprises the BHE-owned site properties including the water lot (Figure 1.3).
- The LAA for land use and communities encompasses the Project Area and extends to the West Richmond Planning Area including Point Tupper, Port Malcolm and Port Richmond. In consideration of the nearest residential communities to the Project Area, the LAA also extends across the Strait of Canso to Middle Melford in Municipality of the county of Guysborough.

The temporal boundaries for the assessment of potential effects on the marine environment include construction, operations and decommissioning phases of the Project as outlined in the schedule presented in Section 2.13.

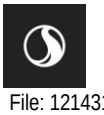
6.8.1.3 Significance Definition

A significant adverse residual effect on land use and communities is defined as a measurable Project-related environmental effect that results in one or more of the following:

- Non-compliance with established land use plans, policies or by-laws
- A change or disruption that restricts or degrades present land use capability to a point where the activities cannot continue at or near current levels and where compensation is not possible
- Exceedance of available capacity, or a substantial decrease in the quality of community infrastructure or services provided (including but not limited to emergency response and health care), on a persistent and ongoing basis, which cannot be mitigated with current or anticipated programs, policies, or mitigation measures
- deterioration of public safety over an extended period that cannot be managed or mitigated through adjustments to programs, policies, plans, or other mitigation

6.8.2 Project Interactions and Potential Effects

The Project is located on BHE-owned land within an area zoned for heavy industrial use. Adjacent land uses include a wind farm and the NSPI ash dump. There is no formal recreational land use in the Project Area; recreational trails are located in the Town of Port Hawkesbury with no predicted interaction with the Project. The nearest residential communities are greater than 1 km from the Project Area, with the closest residence located at an approximate distance of 1.69 km, across the Strait of Canso in Middle Melford. As noted in Section 6.1, construction of the marine terminal, particularly pile driving, is expected to be the



main contributor of noise emissions over the life of the Project (Section 6.1.2.1) and could potentially affect land use. Lighting will be similar to that proposed for the previously approved Bear Head LNG Project and isn't expected to substantially change the viewscape given other existing industrial land use in the area. As noted in Section 6.2, the nearest water supply well is 1.37 km from the Project Area and residual effects on groundwater resources are predicted to be negligible. Project interactions with land use and communities will primarily occur during the construction phase as a result of increased traffic in the Port Hawkesbury and Point Tupper areas, noise from marine construction (i.e., pile driving), and increased economic activity and increased demands on community services and infrastructure. Accidental events which may affect land use and communities are discussed in Section 7.

6.8.2.1 Construction

The Project is consistent with land use zoning and will be developed in accordance with applicable municipal land use planning requirements as well as applicable noise by-law requirements. The nearest residence is 1.69 km away. Access to the Project Area has been restricted since 2005 with the installation of security fencing. Additional fencing will be installed during Project construction to improve site security and reduce public health and safety risks.

Construction traffic will add to the volumes that currently use Industrial Park Road from Trunk 4; however, since industrial development has been a priority for the Strait region, the roads are capable of handling heavy and wide loads and the existing transportation system is able to accommodate anticipated construction traffic without posing an unwarranted burden on the road infrastructure. Project vehicles will adhere to posted speed limits, thereby reducing risks to public safety.

As indicated in Section 2.14, it is anticipated that up to 700 jobs will be generated through Project construction. This labour force will be drawn from a wide catchment in the local area with many employees able to drive to the site individually or in carpools. Some employees however, may originate from farther afield and may seek accommodation locally. Point Tupper and the neighbouring communities have accommodated construction labour forces of the same or greater numbers in the past. This labour force will place demands on local services including emergency and health care services; but overall, the impacts for the local community will be positive. The likely increase of population and activity in the area will increase demand on all services and may take up some of the slack resulting from fluctuations in the local economy (SNC Lavalin 2015).

As assessed in Section 6.1, with the exception of pile driving noise associated with construction of the marine terminal, noise from construction is not expected to affect the use and enjoyment of surrounding lands. The nearest residential community is located across the Strait of Canso, in Middle Mulgrave. Residents living in this area are already exposed to a view of industrial development in the Point Tupper Industrial Park and industrial operations. Most construction noise will not be audible across the Strait; however, pile driving activity associated with the construction of the jetty may be audible and cause a temporary nuisance.

6.8.2.2 Operations

The Project will operate in an industrial area and activities will be consistent with surrounding land uses. Given the site is already substantially developed and there are wind turbines and other industrial development adjacent to the Project Area, the viewscape from residential properties across the Strait (i.e., Middle Mulgrave) will not change substantially. However, there will be increased lighting at the site during operations compared to the current viewscape.

As noted above for construction, the labour force during operations will place demands on local services and infrastructure, although at a much lower level. It is also anticipated that the Project will contribute to direct and indirect revenue in the region. The Project will help strengthen the industrial profile of the Strait region. The marine terminal will add to the marine traffic that already uses the existing port in the Strait and will generate more business to those who provide services and goods to the vessels. The development and expansion of the commercial linkages that exist in an industrial area are essential to its success and further expansion. Project development could be an important catalyst for further investment in the region, benefitting not only Port Hawkesbury and the Municipality of the County of Richmond, but the Municipality of Guysborough County and the Province, as well. Additional local, provincial, national and global benefits associated with green hydrogen and ammonia development are described in Section 12.

As noted in Section 2.14, Project operations will generate approximately 45 to 70 permanent direct jobs and 175 permanent indirect jobs for 20 years or more. BHE is in active discussions with NSCC and the Mi'kmaq of Nova Scotia to initiate training courses to help develop skilled workers for various Project-related jobs. NSCC, BHE has made commitments to work with the Mi'kmaq of Nova Scotia, representative labour groups in the region, and other relevant stakeholders to ensure the success of their Project and to facilitate growth and maximize benefits to the communities of which they have become part.

Predictive noise modelling for Project operations show predicted noise levels (L_{dn}) at the closest receptors do not exceed Nova Scotia noise assessment criteria (65 dBA during the day, 60 dBA in the evening, and 55 dBA at night). The predicted change in the percent highly annoyed (<0.32%HA at all receptors) in the community is lower than 6.5 % HA (Section 6.1; Appendix E). Noise levels from operations are therefore not predicted to affect the use and enjoyment of lands in the LAA.

6.8.2.3 Decommissioning

The potential effects of decommissioning are expected to be comparable to those described in for the construction phase of the Project (except for a lack of pile driving) with the difference that mechanisms and advisory services may be required to support those who would inevitably lose their employment. During the development of a Decommissioning and Reclamation Plan, BHE will consult with the Mi'kmaq of Nova Scotia and public stakeholders to develop objectives for reclamation that align with future land use objectives in the region.

6.8.3 Mitigation

Various mitigation measures will be implemented to reduce or eliminate potential adverse effects on land use and communities:

- BHE will work collaboratively with the representatives of the local communities and key organizations to improve awareness of the services and skills that exist within the region and increase awareness of local providers of the opportunities presented by the proposed Project.
- BHE will monitor Project-related demands on local services and infrastructure and develop appropriate initiatives to mitigate potential adverse impacts associated with the Project demands. This may include but not be limited to, financial or in-kind contributions to local learning institutions.
- BHE has developed a dialogue with the key business groups including those that represent businesses throughout Cape Breton to ensure firstly that they are made aware of the services and skills that exist within the region, and secondly to ensure that local providers are aware of the opportunities presented by the proposed Project. BHE are also in the process of developing a Mutual Benefits Agreement with the ANSMC in recognition of the skills and attributes that they can bring to the successful execution and operation of the project. This outreach will continue as it is in the best interests not only of BHE, but the communities involved.
- Signage and fencing will be installed around Project facility to protect public safety.
- Project-related traffic will observe posted speed limits to reduce risk of traffic incidents.
- Noise and air (dust) emissions will be mitigated to acceptable levels (refer to Section 6.1.3).
- Vibratory hammers, rather than impact (drop) hammers, will be used to the extent feasible for pile installation at the marine terminal to reduce sound levels.
- Artificial lighting will be limited to the amount required for safety and security purposes and will be side-shielded and directed downward where feasible.

Additional measures will be implemented to protect human health and safety as described in Section 7.

6.8.4 Residual Effects

The Project is a conforming land use under the MPS and LUB and represents an opportunity to facilitate further growth and development in the region, helping to advance municipal planning objectives. Construction will generate noise and air (dust) emissions, although the noisiest of activities will be pile driving during jetty construction. These elevated noise levels associated with marine terminal construction may be audible outside the Project Area and extend to residential communities across the Strait of Canso (e.g., Middle Mulgrave), although this activity which will be short-term (less than eight months). Noise will be required to comply with the Municipality of Richmond County Noise By-Law (By-Law # 65).

Access to the Project Area has been restricted since 2005, therefore new Project construction and operational activities will not result in a change of land use for community members. Improved site security (i.e., additional security fencing and property surveillance) will help reduce public health and safety risks associated with potential trespassing. Additional measures to reduce public health and safety risks associated with accidental events are discussed in Section 7.

Given the industrial nature of adjacent lands, and separation distance from residential and recreational lands, the Project is not predicted to result in a change or disruption that restricts or degrades present land use capability to a point where the activities cannot continue at or near current levels and where compensation is not possible. The Project is also not predicted to result in an exceedance of available capacity, or a substantial decrease in the quality of community infrastructure or services provided on a persistent and ongoing basis, which cannot be mitigated with current or anticipated programs, policies, or mitigation measures.

6.8.5 Follow-up and Monitoring

BHE will continue to engage with local community officials and stakeholders throughout the life of the Project to help enhance Project benefits for the region and monitor and mitigate potential adverse environmental effects related to potential increased demands on services and infrastructure.

6.9 FISHERIES, AQUACULTURE AND MARINE HARVESTING

Fisheries, Aquaculture and Marine Harvesting VC is considered a VC due to potential interactions with the Project, regulatory protection of fish and fish habitat, the importance of fisheries to the region, and stakeholder concerns. This VC focuses on fisheries, aquaculture and marine harvesting occurring in the Strait of Canso and Chedabucto Bay, with a particular focus on fisheries occurring in proximity to the Project Area (i.e., BHE-owned water lot).

This VC is closely linked to the assessment of Marine Environment (Section 6.7) and helps to inform the assessment of potential impacts to the Mi'kmaq of Nova Scotia (Section 8).

6.9.1 Scope of Assessment

6.9.1.1 Regulatory and Policy Setting

The marine environment within the assessment area is located within NAFO Unit Area 4Wd. Other marine boundaries have been defined by DFO for the management of species, such as LFAs. The Strait of Canso is within LFA 29; LFAs 30 and 31A represent the approaches to the Strait (refer to Figure 4.25).

Provisions under the *Fisheries Act* protect fish and fish habitat including fisheries resources. Specific regulations under the *Fisheries Act* address fishery resources. The Maritime Provinces Fishery Regulations govern fishing activity in inland and adjacent tidal waters of the provinces of Nova Scotia, New Brunswick and Prince Edward Island. The Atlantic Fishery Regulations, 1985 provide for the management and allocation of fishery resources off the Atlantic coast of Canada. The administration of aquaculture, sea plant harvesting, seafood processing and recreational fisheries in the province is provided by the *Fisheries and Coastal Resources Act*.

Fish resources are protected by area closures, fishing quotas, fishing seasons and gear and vessel restrictions including, in the case of the lobster fishery, a maximum number of traps permitted per licensed fisher (275). Other broad mechanisms for the protection of marine resources are provided in the federal *Oceans Act*.

Marine navigation is regulated and administered under the federal CNWA and *Marine Transportation Security Act*, the International Ship and Port Facility Security (ISPS) Code, and the TERMPOL review process. Through the Oceans Protection Plan initiatives, Transport Canada led a review of the TERMPOL process. A new Enhanced Navigation Safety Assessment Process is being proposed to modernize the TERMPOL process; this initiative is currently underway (Transport Canada 2019). The proposed marine terminal is in an area of compulsory pilotage under the federal *Pilotage Act* and Atlantic Pilotage Authority Regulations (i.e., pilots are required for navigation into the Strait).

The Project holds a valid authorization under the CNWA and the previous TERMPOL study will be updated for the updated Project. BHE has approached the NSCC Strait Area Campus Nautical Institute to update the previous ship simulation studies for this Project (considering the smaller ships and fewer transits than previously assessed for the Bear Head LNG Project). Marine navigation and navigation risks are well managed outside the EA process.

6.9.1.2 Boundaries

The assessment of fisheries, aquaculture and marine harvesting considers fisheries within DFO Unit Area 4Wd focusing on the Strait of Canso (east of the Causeway) and Chedabucto Bay, and aquaculture operations and marine harvesting that may occur in these areas. More specifically, the spatial boundaries for the assessment are defined as follows:

- The Project Area is defined as the anticipated area of direct physical disturbance associated with construction, operation and decommissioning of the Project and comprises the BHE-owned site properties including the water lot (Figure 1.3).
- The LAA for fisheries, aquaculture and marine harvesting includes DFO Unit Area 4Wd, focusing on the Strait of Canso (east of the Causeway) and Chedabucto Bay and aquaculture lease holdings in the Strait of Canso and Chedabucto Bay.

The temporal boundaries for the assessment of potential effects on fisheries, aquaculture and marine harvesting include construction, operations and decommissioning phases of the Project as outlined in the schedule presented in Section 2.13. The assessment also considers that interactions could change during certain times of the year depending on seasonal changes in fishing activities (e.g., fishing seasons) as described in Section 4.4.4.

6.9.1.3 Significance Definition

A significant adverse residual environmental effect on fisheries, aquaculture and marine harvesting is defined as a Project-related environmental effect that results in an unmitigated or non-accommodated net financial loss to fisheries, aquaculture or marine harvesting as a result of the Project. This may consist of a residual environmental effect that alters those activities to an extent that results in any of the following and cannot be mitigated or reasonably accommodated:

- Displacement of fishers from the areas traditionally or currently fished for all or most of a fishing season

- Demonstrated net income loss from fishing activities due to Project-related environmental effects for at least one fishing season
- Loss in aquaculture production value due to Project-related environmental effects for at least one year

Mitigation can include provision of compensatory habitat for the commercial species and fishing activities affected by the Project. Reasonable accommodation for loss of access to fishing grounds would be negotiated in good faith between the Project and demonstrably affected fishers/marine harvesters.

6.9.2 Project Interactions and Potential Effects

6.9.2.1 Construction

Construction of the onshore facilities are not predicted to interact with fisheries, aquaculture or marine harvesting. As described in Section 6.7.2, construction of the marine terminal will generate underwater noise and siltation, affecting fish and fish habitat in the vicinity of the water lot where construction is occurring. These effects will be temporary but will extend beyond the Project Area to the Strait of Canso and could temporarily affect targeted fisheries resources. The construction of the marine terminal may also restrict commercial, recreational and/or Indigenous fisheries near the Project Area due to the terminal footprint and related increases in vessel traffic. However, fisheries activities in the immediate area are not intensive and the fish habitat in the Project Area is not specific or unique. Displacement of fishers is anticipated to be very limited, if any, given the physical footprint of the marine terminal which has been planned and communicated with fishers dating back to 2004 and availability of other fishing areas. Loss or damage to fishing gear related to Project construction is not anticipated to occur due to Project construction.

Interaction with commercial aquaculture activities is not expected as these activities do not take place in the Strait of Canso and are not within an expected zone of influence for underwater noise or discharges.

6.9.2.2 Operations

Operation of the marine terminal and the associated increases in marine traffic could potentially impact existing fishing activities in the Strait of Canso, although as noted in Section 4.4.4, fishing and harvesting activity in the Strait is limited compared to adjacent waters in Chedabucto Bay given the volume of existing vessel traffic. The addition of Project-related vessels could potentially affect the distribution of fish and impact fishing effort and decrease profitability (e.g., decreased landings, increased fuel costs). Loss of gear or vessel damage related to Project activities is unlikely to occur within the approach to the terminal given compliance with TERMPOL navigational requirements.

Hard substrate associated with the marine terminal and reject process water diffusion pipe may be colonized by invertebrate species and consequently attract fish. Although for safety purposes, a buffer zone will be established around the marine terminal within which fisheries and harvesting cannot occur. These effects will essential form a “reef” and “refuge” effect for fish. Wastewater discharges will comply with applicable regulatory approvals and discharge criteria which will be protective of fish habitat and not anticipated to impact fisheries or marine harvesting in the Strait.

Interaction with commercial aquaculture activities is not expected as these activities do not take place in the Strait of Canso and are not within an expected zone of influence for underwater noise or discharges.

6.9.2.3 Decommissioning

Project interactions with fisheries, aquaculture and marine harvesting during decommissioning would be similar to those described above for construction if the marine terminal is removed. A Decommissioning and Reclamation Plan will be developed as the facility nears the end of its life. As part of this process, BHE will evaluate reclamation options in consultation with the local community, including the Mi'kmaq of Nova Scotia, fisheries stakeholders, and applicable regulatory agencies. Options could include removal of structures or reuse by other parties.

6.9.3 Mitigation

Mitigation outlined above for the protection of the marine environment (Section 6.7.3) will also prevent or reduce adverse effects on fisheries, aquaculture and marine harvesting. In addition, the following mitigation measures will be employed:

- Communication and dialogue will be established with the Mi'kmaq of Nova Scotia and fisheries stakeholders to limit impacts to adjacent fishing grounds during construction and will continue liaising with these groups during operations to monitor potential impacts.
- Applicable navigation safety procedures will be followed during construction.
- A program to minimize the impact of gear loss or vessel damage sustained by fishers due to Project related activities will be determined through discussion with local fishers.
- During shipping operations, Project vessels will comply with applicable navigation safety procedures and use pilots and established shipping lanes where applicable.
- BHE will update the TERMPOL study for the updated Project and implement recommendations to ensure safe navigation.
- Notices to Mariners will be issued regarding the location and scheduling of activities and other potential hazards.
- Should construction activities result in gear or vessel damage, compensation will be available as established in the Fisheries Compensation Plan which will be developed by BHE in consultation with local fishers and the Mi'kmaq of Nova Scotia.

6.9.4 Residual Effects

Residual effects on fisheries, aquaculture, and marine harvesting are predicted to be commence during construction and occur continuously throughout operations for the life of the Project. Residual effects on fisheries, aquaculture, and marine harvesting are predicted to be of low magnitude and limited to the LAA because of current fishing activities in the Strait of Canso and relatively low fishing intensity near the Project Area, as well as implementation of the proposed mitigation measures outlined above, including ongoing liaison with local fishers and the Mi'kmaq of Nova Scotia. The marine terminal will be designed and constructed consistent with terminal design previously communicated to stakeholders and approved during the provincial EA process and subsequent federal permitting for the Bear Head LNG Project. The physical area impacted by the marine terminal is relatively small compared to the DFO licenced fishing

areas (e.g., NAFO Unit 4Wd, LFA 29) and impacts to fisheries species are predicted to be of low magnitude, with impacts to fish habitat compensated as per the *Fisheries Act* authorization (refer to Section 6.7).

The Project is not expected to result in non-mitigated displacement of fishers from the areas traditionally or currently fished or result in net income loss from fishing activities for at least one fishing season for all or most of a fishing season and no interaction with commercial aquaculture activities is predicted to occur. Residual effects on fisheries, aquaculture and marine harvesting are therefore predicted to be not significant.

6.9.5 Follow-up and Monitoring

Communications will be established with local fishers and the Mi'kmaq of Nova Scotia, (particularly those individual fishers who may fish or harvest resources in the vicinity of the Project Area), prior to construction. These communications will continue throughout the life of the Project.

6.10 CULTURAL AND HERITAGE RESOURCES

Cultural and heritage resources include physical remnants found on top of and/or below the surface of the ground that inform us of past human use of and interaction with the physical environment. These resources may be from the earliest times of human occupation, up to the relatively recent past and include both built and depositional resources.

Cultural and heritages resources are included as a VC in this assessment in recognition of the interest of the Mi'kmaq of Nova Scotia, the general public, and provincial and federal regulatory agencies assuring the effective management of these resources.

6.10.1 Scope of Assessment

6.10.1.1 Regulatory and Policy Setting

Archaeological resource impact assessments (ARIA) are conducted in accordance with a Heritage Research Permit issued under the Nova Scotia *Special Places Protection Act*, which is administered by Heritage Division of Nova Scotia Communities, Culture, Tourism and Heritage (NSCCTH). NSCCTH provides guidance for conducting professional ARIAs through the Archaeological Resource Impact Assessment (Category C) Guidelines (NSCCTH 2012).

6.10.1.2 Boundaries

The spatial boundaries for the assessment of cultural and heritage resources are described below.

- The Project Area is defined as the anticipated area of direct physical disturbance associated with construction, operation and decommissioning of the Project and comprises the BHE-owned site properties including the water lot (Figure 2.1). Previous construction activity in the Project Area did not encounter any cultural or heritage resources. No anticipated interactions with cultural and heritage resources are anticipated to occur beyond the Project Area boundaries.

- The LAA for the assessment of cultural and heritage resources is defined in consideration of previous ARIAs and MEKS that have been conducted for previous proposed developments at the Bear Head site and incorporates a 5 km buffer around the site.

The temporal boundaries for the assessment of potential effects on cultural and heritage resources include construction, operations and decommissioning phases of the Project as outlined in the schedule presented in Section 2.13, although it is noted that there is the most potential for Project interaction would occur during construction when any ground disturbance is most likely to occur.

6.10.1.3 Significance Definition

A significant adverse environmental effect on cultural and heritage resources is defined as an unauthorized disturbance or destruction of a cultural or heritage resource.

As noted in the MEKS for the Bear Head LNG Project (CMM 2015), Mi'kmaq archaeological resources are extremely important to Mi'kmaq as a method of determining Mi'kmaq use and occupation of Mi'kma'ki and as an enduring record of the Mi'kmaq nation and culture across the centuries. Archaeological resources are irreplaceable. Any disturbance of Mi'kmaq archaeological resources is significant.

6.10.2 Project Interactions and Potential Effects

Research and field investigations undertaken in 2004 indicated that there were no sites of archaeological potential within the Project footprint. Work was instigated and the greater part of the lands necessary for the proposed facility was cleared with no finds discovered.

As noted in the MEKS for the Bear Head LNG Project (CMM 2015), no archaeological sites were identified within the proposed project site; therefore, there is a low probability of interactions between cultural and heritage resources and the current Project.

Nevertheless, there is always a possibility that future ground disturbance activities could unearth something unexpected during construction. No interactions are anticipated to occur during Project operations or decommissioning. Given the cultural, spiritual, natural, and/or scientific value of cultural and heritage resources and importance to the Mi'kmaq of Nova Scotia, potential interactions and effects remain a possibility to be addressed through an Archaeological Contingency Plan.

6.10.3 Mitigation

If an archaeological site is encountered or suspected during work the following measures will be taken to protect the feature(s) from damage:

- Stop all work in the area as to not further disturb the site, isolate, and protect the area.
- Report the discovery to the Special Places Coordinator of NSCCTH. If finds are of a Mi'kmaq context, contact the KMKNO.
- Note the location and leave all discoveries in place.
- Work will not recommence in the immediate area until permission has been given to proceed by the Special Places Coordinator.

6.10.4 Residual Effects

Given the low archaeological potential of the Project Area, the ground disturbance work that has already been completed without encountering archaeological evidence, and the implementation of an Archaeological Contingency Plan in the chance encounter of an archaeological resource, no residual effects on cultural and heritage resources are predicted.

6.10.5 Follow-up and Monitoring

No follow-up and monitoring is proposed aside from that which would be required in the event of a chance encounter of an archaeological find.

7.0 ACCIDENTAL EVENTS AND MALFUNCTIONS

Chapter 6 of this EA Registration document evaluates potential environmental effects of planned Project activities. In this chapter, potential unplanned events (i.e., accidents and malfunctions) that could occur over the life of the Project are identified and evaluated. Design mitigation and preventative measures to reduce the likelihood of these events occurring, as well as response and contingency measures to reduce adverse consequences in the event the events do occur, are described. Residual adverse environmental effects of accidents and malfunctions are then characterized and evaluated in terms of their significance.

This assessment focuses on the most serious credible incidents with the greatest potential for affecting public safety and /or the environment. A risk-based approach is used which considers potential severity of consequences as well as probability of occurrence.

With public safety as a core Project principle, BHE is focused on designing the Project to enhance system reliability and reduce risk of accidents and malfunctions, particularly those that could result in adverse conditions for safety of workers and public as well as the environment. As discussed in Section 2.4, BHE has worked with Lloyds Register to develop a COP to help guide the design, construction, operation and abandonment of the Project in a manner which will protect the public and the environment. In addition to implementing appropriate preventative measures, BHE will develop and maintain a robust emergency response and contingency plan which will include resourcing appropriate personnel, training and equipment to quickly and effectively respond to any accidents that may occur.

7.1 IDENTIFICATION OF ACCIDENTS AND MALFUNCTIONS

Serious credible accidents and malfunctions that could occur over the life of the Project and potentially impact the public and/or the environment include the following:

- Unplanned release of hydrogen and/or ammonia
- Failure of water management controls
- Hazardous material spill
- Marine vessel incident

An unplanned release of hydrogen and/or ammonia could occur during Project operations potentially resulting in a fire/explosion or toxic hazard. A quantitative risk assessment (QRA) has been undertaken to review the public safety risk associated with an unplanned release of hydrogen and/or ammonia (Appendix H). Results of this QRA are summarized in Section 7.2.

A failure of water management controls could include a breach of erosion and sediment controls during construction, operations, and/or decommissioning or an unplanned release of reject process water during operations. Either scenario could potentially affect surface water, freshwater fish and fish habitat vegetation, wetlands, and/or the marine environment. Failure of water management controls are evaluated in Section 7.3.

A hazardous material spill could involve an accidental release of petroleum, oils or lubricants (POLs) through fuel storage or refuelling or accidental release of other on-site chemicals during any Project phase. Depending on the nature, quantity and location of the spilled material, the spill could result in adverse effects on groundwater, surface water, fish and fish habitat, vegetation, wetlands, wildlife and wildlife habitat, and/or the marine environment. Hazardous materials spills are evaluated in Section 7.4.

As indicated in Sections 5.2.3 and 6.9, most aspects of shipping (except for when the vessel is docked at the terminal) are under the care and control of shippers and within the jurisdiction of port and/or federal authorities. Marine navigation is regulated and administered under the federal CNWA and *Marine Transportation Security Act*, the International Ship and Port Facility Security (ISPS) Code, and the TERMPOL/Enhanced Navigation Safety Assessment Process. The proposed marine terminal is in an area of compulsory pilotage under the federal *Pilotage Act* and Atlantic Pilotage Authority Regulations (i.e., pilots are required for navigation into the Strait). The Project holds a valid authorization under the CNWA and the previous TERMPOL study will be updated for the updated Project. BHE has approached the NSCC Strait Area Campus Nautical Institute to update the previous ship simulation studies for the Project (considering the smaller ships and fewer transits than previously assessed for the Bear Head LNG Project). Marine navigation and navigation risks are being managed outside the EA process. Shipping-related accidents and malfunctions are therefore not specifically assessed as accident scenarios in this EA Registration document. Unplanned releases of ammonia into the marine environment are considered in Section 7.2.

7.2 UNPLANNED RELEASE OF HYDROGEN AND/OR AMMONIA

BHE retained Stantec to complete a QRA associated with accidental releases of hydrogen and ammonia during Project operations (refer to Appendix H). The objective of the QRA was to review the public safety risks from potential accidental releases of hazardous materials based on the likelihood and severity of these incidents. Various loss of containment (LOC) scenarios were identified from several processes including:

- hydrogen production
- ammonia reaction
- ammonia separation
- ammonia storage and piping to a marine terminal

Hydrogen is a colourless and odourless gas that is much lighter than air. Hydrogen is non-toxic but may act as an asphyxiant at close range if present in relatively high concentrations. Hydrogen is highly flammable.

Ammonia is a colorless, reactive gas that is lighter than air and dissolves readily in water. Ammonia has a distinctive, strong smell and can be toxic to humans and wildlife.

The primary hazards associated with accidental releases from the Project are through inhalation toxicity from ammonia gas. There are also flammability hazards associated with hydrogen and ammonia.

Accidents or malfunctions at the facility may result in hazardous events including:

- dispersion of an unignited toxic cloud, leading to exposure to toxic ammonia gas
- flash fires, jet fires, fireballs, or pool fires, leading to exposure to thermal radiation
- vapour cloud explosions or explosions from storage vessels or process containers, leading to exposure to overpressure damaging to humans or infrastructure

Consequence modelling was completed for potential hazardous events to provide the distances to selected endpoints and the expected consequence at a location away from the source. Consequence modelling was completed for a range of weather conditions, release scenarios and configurations. The results of this modelling can be used to inform emergency responders and assist in the development of emergency response plans and during engineering and design to identify areas of the process where additional mitigation might be beneficial in reducing off-site consequences. The consequence modelling was also used as input to the risk modelling.

Risk modelling was completed to evaluate the risk for harm at locations within the facility. The modelling was completed with consideration of both the potential consequences and their likelihood of occurrence. The results of the risk modelling were compared to risk criteria published by the Canadian Society for Chemical Engineering (CSChE).

7.2.1 Potential Environmental Effects

An unplanned release of hydrogen and/or ammonia could have serious consequences for the surrounding biophysical and socioeconomic environment. A QRA (Appendix H) was conducted to estimate the off-site risks to public safety resulting from potential release of hydrogen or ammonia. Some of the information presented in the QRA was also used to inform potential ecological risk due to an unplanned ammonia release. Marine dispersion modelling was conducted to predict the fate and behaviour of ammonia in the marine environment and infer potential risks to ecological receptors (Appendix L).

Impacts to Public Health and Safety

An unplanned hydrogen and/or ammonia release could result in fire, explosion and/or dispersion of a toxic vapour cloud that could potentially result in offsite property damage and/or public injury or fatality affecting land use and communities as well as fishers and other marine users within the affected zone of influence. The consequence endpoints considered in this assessment included:

- Flammability, based on the lower flammability of the gas
- Thermal radiation exposure of 5 kW/m^2 (ECCC 2021)
- Overpressure exposure of 1 psi (ECCC 2021)
- Acute Exposure Guideline Level (AEGL) of 160 ppm over 60 minutes (US EPA 2022), also known as the AEGL-2, for ammonia

In consideration of the probability of these accidental scenarios occurring, the probability of different meteorological conditions, and consequence of these scenarios should they occur, the QRA modelled individual risk using established public safety risk guideline criteria developed by the CSChE.

The CSChE has developed risk exposure guidelines for land use planning purposes in Canada specifically to review public safety risk from new industrial projects. These risk exposure guidelines relate a type of land use, such as industrial, or residential, to an acceptable level of risk. The risk exposure guidelines are shown in 7.1.

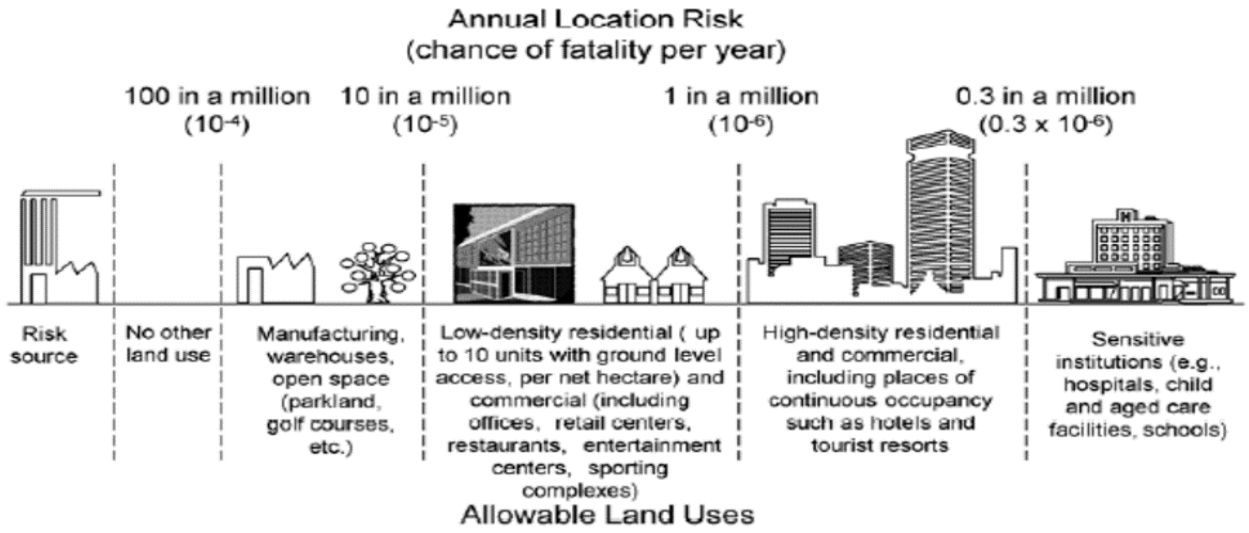


Figure 7.1 Individual Risk Exposure Guidelines used for Quantitative Risk Analysis (Canadian Society for Chemical Engineering 2008)

The risk involved with an industrial activity is considered broadly acceptable when the risk is at a value below 1 in 1,000,000 chance of a fatality per annum. The CSChE also provides additional risk criteria of 0.3 per in 1,000,000 chance of a fatality per annum for sensitive receptors such as hospitals, childcare centres, and nursing homes.

Liquid pool spill releases of ammonia led to the farthest maximum extents due to the toxic inhalation hazard of ammonia as it vapourizes into the atmosphere. The worst case credible scenarios that defined the public health and safety impacts were related to failures of an ammonia storage tank and subsequent vapourization of a liquid pool of ammonia. The likelihood of such an event is extremely low. For example, the failure frequency for a catastrophic release from a double-walled ammonia tank (i.e., a hole sufficient to drain the tank contents within 10 minutes) has been estimated by the UK Health and Safety Executive to be 5.00E-07 failures per year (one in every 2,000,000 years).

Total estimated individual risk from the Project (considering all scenarios) was calculated in consideration of consequence modeling results, failure probabilities, and meteorological conditions. The predicted results of the individual fatality risk analysis is shown in Figure 7.2. There are no residences or other sensitive receptors within the most stringent criteria of 0.3 chances in a million of a fatality. The results of the QRA indicate that the public safety risk from the project is low and that, from a public safety perspective, the facility is appropriately sited relative to adjacent land uses.

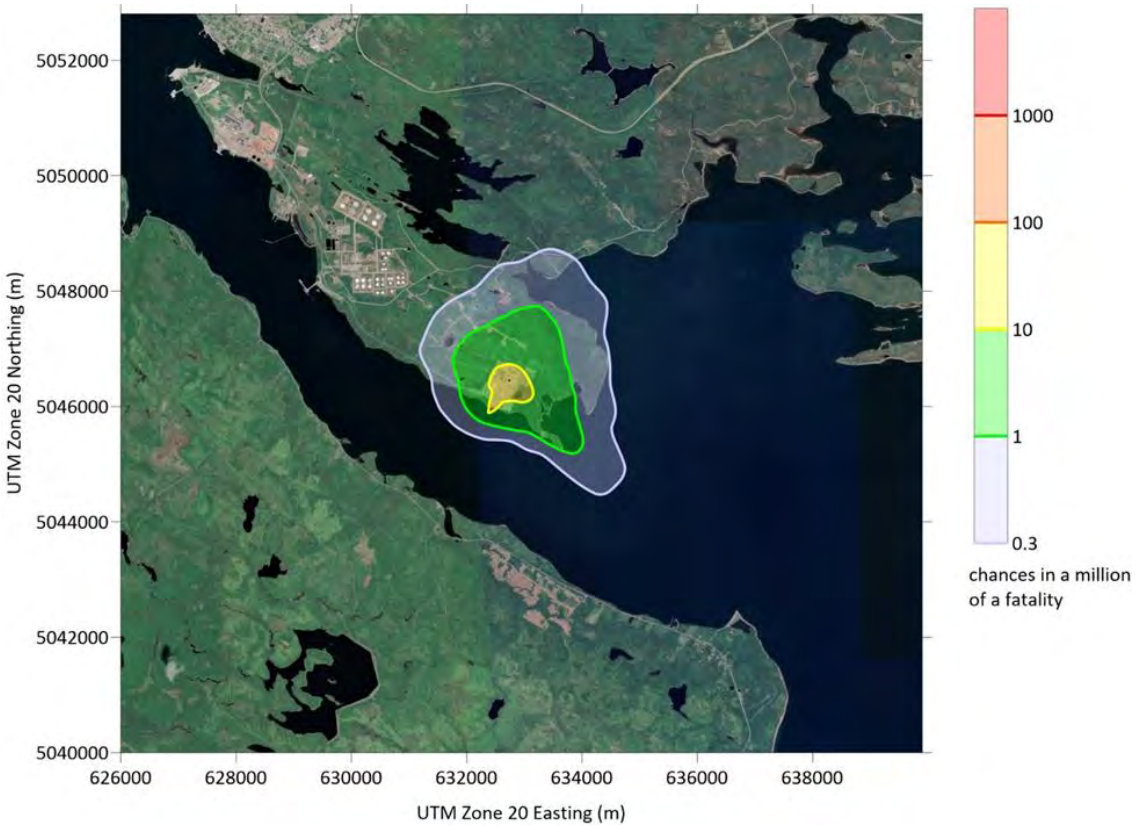


Figure 7.2 Predicted Individual Fatality Risk Contours of all Release Scenarios for the Project

Ecological Impacts

A release of liquid ammonia and subsequent vapourization and atmospheric dispersion could also have ecological impacts. Terrestrial ecological receptors (i.e., plants, animals) may come into direct contact with ammonia vapour which, depending on the concentration they are exposed to, could result in toxic effects. Atmospheric ammonia enters the leaves of plants and is converted to ammonium (NH_4+). Atmospheric ammonia can have acute toxic effects on vegetation such as foliar injury (e.g., leaf etching, chlorosis, and necrosis), reductions in growth and productivity, tissue content of nutrients and a higher susceptibility to abiotic and biotic stress (Fangmeier et al. 1994).

Atmospheric ammonia can also have acute effects on terrestrial birds and mammals such as respiratory injury, decreased respiratory immunity, decreased growth performance, and fatality (Wang et al. 2019; NRC 2007; Beker et al. 2004). In the absence of short-term air quality guidelines that are protective of birds and mammals specifically, human health guidelines can be applied to terrestrial ecological receptors. For example, Nova Scotia has an ambient air quality standard for ammonia of 0.1 mg/m^3. This standard is based on health effects and an exposure period of 24 hours.

A release of liquid ammonia in the marine environment (e.g., leak or rupture of piping at the marine terminal) could also have serious ecological consequences. Ammonia is a non-persistent and non-cumulative toxicant to aquatic life (ANZECC 2000). In water, an equilibrium exists between un-ionized ammonia (NH_3) and ionized ammonium (NH_4+)(CCME 2010). The proportion of the two chemical forms varies with the physicochemical properties of the water, particularly pH, temperature, and salinity (CCME 2010). The toxicity of ammonia is primarily attributed to un-ionized ammonia because it is a neutral molecule that is able to cross the epithelial membranes of aquatic organisms more readily than the ammonium ion (ANZECC 2000).

Fish are typically the most sensitive receptors to ammonia in water. Marine fish have much lower ion concentrations within their body fluids than seawater and to overcome osmotic water loss, they drink seawater. The acute toxicity of ammonia to marine fish is reported to be approximately 0.09- 3.35 mg/L depending on the species, temperature, and pH (Dawson et al. 2022). Aquatic invertebrates are generally more tolerant to ammonia than fish, while phytoplankton and aquatic vascular plants are more tolerant than invertebrates (ANZECC 2000). The toxicity of ammonia on marine reptiles, birds and mammals has not been well-studied. The majority of toxicological information for these receptors is based on direct contact/inhalation of ammonia vapour. In the event of a spill of liquid ammonia into the marine environment, the ammonia pool will interface with the water, mixing and dissolving into the ocean, and some of it will evaporate into the air. The toxicological effects for reptiles, birds, and mammals include physiological damage (e.g., irritation of the eyes, skin, and respiratory tract, cellular swelling, metabolic dysfunction, muscle wasting) and mortality. Indirect effects of ammonia in marine waters can include impacts on habitat quality and prey availability. Sessile receptors may be subjected to adverse effects such as reductions in growth and reproductive rate, as well as mortality.

The British Columbia Ministry of the Environment (BC MOE) provides long-term chronic and short-term acute water quality guidelines (WQG) for the protection of marine aquatic life from ammonia at various pHs, temperatures, and salinities. Long-term chronic WQGs are intended to protect the most sensitive species and life stages against sub-lethal and lethal effects for indefinite exposures. Short-term acute WQGs are set to protect against severe effects such as lethality or other equivalent measures to the most sensitive species and life stage over a defined short-term exposure period. To assess the potential risk to marine ecological receptors in the event of an ammonia spill into the marine environment at Bear Head Energy, temporal and spatial modeling was conducted (Appendix L). With consideration of the water properties in the Strait of Canso, the resulting chronic and acute guidelines are 1.1 mg/L and 7.3 mg/L respectively.

The plausible worst case scenario for an ammonia spill in the marine environment was considered to be a full rupture of the export pipeline from the ammonia storage to the export marine terminal, leading the direct discharge of liquid anhydrous ammonia into the marine environment. In this scenario, it was assumed that valves would isolate the release after 15 minutes. For this scenario, ammonia concentrations in the water were predicted to exceed the long-term WQG exposure limit of 1.1 mg/L over an area of approximately 60 m by 129 m. This area is expected to decrease rapidly in size after the 15-minute release event, and concentrations are predicted to decrease below the chronic WQG in less than 2 hours. Risks from chronic exposure to communities of aquatic receptors are likely negligible due to the limited area and duration of exposure. The area and duration of exposure for the short-term (acute)

exposure limit would be less than the chronic exposure limit, but could result in fish mortality within an area of approximately 60 m by 60 m. As noted in the QRA, the likelihood of such an accidental event occurring is very low with a predicted frequency of a full pipe rupture occurring approximately once in 50,000,000 years (refer to Appendix H).

7.2.2 Design Mitigation and Prevention

As noted in Section 2.4., Lloyds Register has been engaged by BHE to provide guidance on applicable design codes and standards for the facility and have prepared a Project-specific Code of Practice (COP) with the objective of the protection of the public and environment through the appropriate design, construction, operation and abandonment of the facility. The COP along with other codes and standards was used to inform the QRA and this assessment with respect to hazard identification to the public and the environment. In recognition of potential hazards and applicable codes/standards, the COP provides guidance for overall process design requirements including plant site provisions (e.g., equipment spacing, impoundment area design and siting, drainage systems, storage); piping systems and components (e.g., piping design and insulation, valves); buildings and structures (e.g., location, ventilation requirements); utilities (e.g., compressed air, cooling water); cryogenic systems and venting; instrumentation and electrical services; control systems; fire protection; communications and lighting; security; jetty and marine facilities; and operation, maintenance and training.

As part of the COP, requirements for process safety management elements are identified for the detailed design, and construction phases, including the requirement for a hazardous identification workshop (HAZID) and hazard and operability (HAZOP) studies to be led by an independent third party, based on the process safety information developed during full engineering design. The preliminary HAZOP study will then be updated based on the final detailed engineering design.

As outlined in Section 2.11.1, in upset conditions where safety requires the rapid depressurization of the facility, ammonia and hydrogen will be safely combusted in the flaring system. The flare will be specifically designed to minimize un-combusted ammonia. In the event of a vapor release or a liquid release resulting in a vapour cloud, a water fog, water jets, and/or fine water spray will be employed to knock down the ammonia. Given that ammonia is highly soluble in water, this will prevent or reduce the ammonia from escaping a controlled area.

Primary containment of liquid (and gaseous) ammonia comprises containment within suitably designed, constructed, tested and inspected systems manufactured from compatible materials to prevent escape and contact with personnel and the environment.

To reduce risk associated with accidental releases of ammonia, specific safety precautions will be developed as informed by the HAZID and HAZOP. In addition to designing facilities to appropriate standards and codes as well as the Project COP, preventative measures will include training of personnel and provision of personal protective equipment specific to ammonia exposure, production of plant-specific safety guidelines, automatic and remote safety systems (e.g., emergency isolation and shutdown valves), provision of ammonia-specific firefighting equipment, installation of ammonia vapor mitigation equipment, emergency procedures and drills, and installation of sensors and alarms.

7.2.3 Emergency Response and Contingency Planning

Emergency response procedures will be established to respond to gaseous releases of hydrogen or ammonia as well as liquid releases of ammonia. These procedures will be detailed in an ERP (refer to Section 2.13) and an annual tabletop exercise or drill will be conducted to test the ERP.

BHE will work with the local community and regulatory agencies to address resource gaps for emergency response planning at the facility. Local first responders, health care providers, and firefighters will be trained in conjunction with Project site emergency responders to jointly respond to potential emergencies.

7.2.4 Residual Environmental Effects

Compliance with engineering design standards, standard operating procedures, ongoing inspection, and monitoring of controls for condition and effectiveness will reduce the likelihood of an unplanned release of hydrogen and/or ammonia, especially a scenario that could result in a hazardous event such as those scenarios listed above and considered in the QRA. In the unlikely event of a hazardous event, even with the implementation of emergency response procedures, residual environmental effects on the atmospheric environment, surface water resources, freshwater fish and fish habitat, the marine environment, land use and communities, and fisheries, aquaculture and marine harvesting could be significant. This would occur if it results in an exceedance of an air quality or water quality criteria, acute, chronic toxicity to aquatic life, contravention of the *Fisheries Act*, or serious public health consequences.

7.3 FAILURE OF WATER MANAGEMENT CONTROLS

Water management infrastructure will be installed at the site to manage site runoff, reduce risk or erosion and sedimentation, and direct reject process water to the marine environment. Current onsite infrastructure includes various ditches, culverts, berms, and water management ponds. Additional water management controls will added during Project construction to control site runoff and manage reject process water during operations. Failure of these controls could result in unintended release

7.3.1 Potential Environmental Effects

Malfunction or failure of water management controls could result in unintended release of reject process water and/or erosion and/or sedimentation, potentially adversely affecting surface water, freshwater fish and fish habitat, vegetation, wetlands, and/or the marine environment.

7.3.2 Design Mitigation and Prevention

Given the extent of site preparation that has already occurred for the previously approved Bear Head LNG Project, the amount of earthworks (and exposed soils subject to erosion) will be limited. Mitigation measures presented in Section 6.3.3 to protect surface water resources will reduce the likelihood of unintended release of reject process water and/or erosion and/or sedimentation.

The EMP will include an Erosion and Sediment Control Plan that will include design features and methods to control surface runoff, reduce the potential for erosion and prevent offsite siltation of any receiving waters. Site inspections will be conducted to monitor the effectiveness of and maintain/repair sediment and erosion control measures (e.g., remove accumulated sediment at pre-determined levels). Inspections will be undertaken before and after forecasted heavy precipitation events.

Reject process water from the facility will be collected and conveyed in a fully dedicated piping network (excluding sanitary wastewater) and directed to an approved marine discharge location. Regular inspection of piping will be conducted to confirm integrity of the piping and testing of the discharge will be conducted to confirm compliance with applicable water quality criteria.

7.3.3 Emergency Response and Contingency Planning

In the unlikely event of a failure of a water management control, procedures from the ERP will be implemented. Materials, including but not limited to, pumps, hoses, rock, sediment control fence, and hay bales will be available on site to enable a timely response to sediment laden runoff. Equipment and personnel would be mobilized to the area to reduce releases and an assessment would be made to determine appropriate repairs, remediation, and future mitigation to prevent future incidents.

7.3.4 Residual Environmental Effects

In consideration of compliance with engineering design standards, ongoing inspection, and monitoring of controls for condition and effectiveness, emergency response procedures, and if, required, environmental remediation, residual environmental effects on surface water, freshwater fish and fish habitat, vegetation, wetlands, and/or the marine environment are predicted to be not significant.

7.4 FUEL AND HAZARDOUS MATERIAL SPILL

As noted in Section 2.9, hazardous material storage on site will primarily be limited to ammonia, hydrogen or diesel fuel. Accidental releases of ammonia and hydrogen are discussed in Section 7.2. This section focuses on hydrocarbon spills that could occur during storage, refuelling, or leak from equipment/machinery at the site (e.g., hydraulic line break). Diesel fuel will be used in large mobile equipment; other petroleum-based and non-petroleum-based liquids will be used for equipment maintenance.

7.4.1 Potential Environmental Effects

Depending on the quantity and location of the fuel spill (e.g., proximity to watercourse, wetland or other environmentally sensitive area), the spill could contaminate soil, groundwater, and/or surface water, and affect fish and fish habitat, vegetation, wetlands, wildlife and wildlife habitat, and/or the marine environment. Given that fuel storage will be located at least 30 m from wetlands and watercourses, the worst-case scenario of a fuel spill would be a transportation-related accident on site resulting in a fuel spill near an environmentally sensitive area.

7.4.2 Design Mitigation and Prevention

The Project EMP will detail best management practices to prevent leaks and spills. This may include but not be limited to the best management practices listed below.

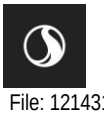
- Construction and operations equipment will be frequently inspected for possible fuel and hydraulic system leaks and leaks detected will be repaired immediately where possible. If the repair cannot be completed immediately, drip pans or alternative containment will be put in place to prevent loss of petroleum, oils, lubricants (POLs) or other hazardous materials to the environment.
- Lubricants and other petroleum products will be stored according to provincial regulations, and waste oils will be disposed of in accordance with provincial regulations.
- Any hazardous materials will be transported in compliance with the Transportation of Dangerous Goods Act and Regulations, and any requiring disposal will be disposed of at an approved facility.
- Storage of all hazardous materials will comply with WHMIS requirements, and appropriate material safety data sheets will be located at the storage site.
- Equipment refuelling and maintenance will be conducted at designated sites and not within 30 m of a watercourse or wetland.

7.4.3 Emergency Response and Contingency Planning

In the event of a spill, implementation of the Emergency Response and Contingency Plan will help to reduce the spill volume and extent.

Should a hydrocarbon spill occur, the primary goal is to ensure safety, and if safe to do so, contain the material. Actions that will be taken in the event of hydrocarbon spills or leaks will include the following measures:

- Spills or releases that occur and remain on site will be the responsibility of BHE; additional assistance from off-site resources will be available to respond to larger or more serious spills.
- Spills that exceed the minimum reportable quantity as specified by the Environmental Emergency Regulations under the provincial *Environment Act* will be reported to NSECC via the Environmental Emergencies Regional Spill Reporting Number (902) 426-6030 or 1-800-565-1633.
- All construction and operational staff will be trained to handle, store, and dispose of hazardous materials.
- Spill containment kits will be kept onsite and relevant site personnel will be trained in kit use. Only personnel with specific training in spill containment may attempt to respond to a release of a hazardous material.
- The necessary personal protective equipment and other safety measures compatible with the nature of the spill will be used.
- The initial steps will involve the prevention of further spillage followed by confinement of the spilled materials. If the release cannot be controlled or contained, secondary containment of the materials may be performed possibly involving the transfer of materials to other containers.



- Spills that occur along the ground surface may be controlled by the use of absorbents if the spill is fairly small. Larger spills may require the use of soil, sand or other relatively inert material to dam the spill. All attempts will be made to intercept and contain the spill to reduce the possibility of discharge into sensitive areas including wetlands and watercourses.
- Once the spill is under control, the spill material must be transferred to appropriate storage containers. Clean-up will consist of collecting as much of the spill material as possible to avoid any future contamination of the wetland or waterways. Absorbents used, and any contaminated soil, sand or gravel, are to be placed in appropriate labelled waste containers. Spill materials will be similarly placed in appropriate containers with the proper WHMIS labels. Care should be taken to avoid mixing spilled material with incompatible materials.
- Monitoring and follow-up activities will take place to return the environment to its previous state; for example, a spill affecting a wetland may require provision of habitat restoration or creation.

7.4.4 Residual Environmental Effects

Depending on the quantity and location of a fuel spill (e.g., proximity to watercourse, wetland or other environmentally sensitive area), this could potentially result in a significant adverse environmental effect on groundwater resources, surface water resources, fish and fish habitat, vegetation and wetlands, wildlife and wildlife habitat and/or the marine environment. However, with the implementation of best management practices in the EMP to reduce risk of hydrocarbon spills or leaks, a spill of high magnitude would be unlikely to occur. If a spill did occur, with the implementation of response measures in the ERP, including remediation as necessary, the duration of effects would be limited and effects would be unlikely to extend outside the Project Area. Significant adverse environmental effects on groundwater resources, surface water resources, fish and fish habitat, vegetation and wetlands, wildlife and wildlife habitat, and the marine environment are unlikely to occur.

7.5 SUMMARY

In summary, an unplanned release of hydrogen and/or ammonia could have significant adverse environmental effects on the biophysical and socio-economic environment, including potentially serious consequences for public health and safety. However, with the implementation of design mitigation to prevent unplanned releases and/or reduce consequences should an unplanned release occur, and emergency response measures to respond to an emergency event, a significant adverse environmental effect is unlikely to occur.

A failure of water management controls or fuel spill could result in adverse environmental effects on ecological VCs, although these effects are not expected to extend beyond the Project Area and in most scenarios would not result in a significant adverse effect. Depending on the quantity and location of a fuel spill (e.g., proximity to watercourse, wetland or other environmentally sensitive area), this could potentially result in a significant adverse environmental effect on groundwater resources, surface water resources, fish and fish habitat, vegetation and wetlands, wildlife and wildlife habitat and/or the marine environment, although a significant environmental effect is unlikely to occur.

8.0 POTENTIAL IMPACTS AND BENEFITS TO THE **MI'KMAQ OF** NOVA SCOTIA

Indigenous communities across Canada are seeking opportunities to share and participate in the benefits of renewable energy development. Project proponents and government policies are responding to this interest. BHE recognizes that the Project is being proposed in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq People, and will work to develop the land in the accordance with the vision expressed by the Mi'kmaw Nation. Maintaining a strong and cooperative relationship with the Mi'kmaq of Nova Scotia will be priority at all stages of the Project and BHE will strive to integrate Netukulimk (traditional Mi'kmaq management) with traditional and conventional ways of understanding.

As noted in Section 4.4.5, a MKS was completed in 2004 by Mi'kmaq Environmental Services Ltd. for the proposed LNG Import Facility. In 2015, a MEKS was completed by the Confederacy of Mainland Mi'kmaq (CMM) to augment the 2004 MKS. A MEKS was also conducted by Membertou Geomatic Solutions in 2016 for the proposed Bear Paw Pipeline. A summary of findings from these previous studies is provided in Section 4.4.5. In addition, feedback received during ongoing engagement with the Mi'kmaq of Nova Scotia will continue to inform impacts on Aboriginal and treaty rights and appropriate accommodation if applicable.

Consideration of potential impacts to the Mi'kmaq of Nova Scotia focuses on the interactions among changes to related biophysical and socio-economic VCs and change in conditions, attributes, sites, lands, resources, or structures of relevance for the Mi'kmaq. The interrelationship among various related biophysical and socio-economic VCs plays an important role in how changes to the environment may affect the conditions and material circumstances for the Mi'kmaq. For example, changes in surface water quality may influence fish health, which could in turn affect country foods and Mi'kmaq health conditions. The identification of potential impacts, therefore, relies on the effects assessments of the biophysical and socio-economic VCs, presented in Chapter 6.

As noted in Section 6, the Project is predicted to have negligible to low magnitude effects on groundwater resources, surface water resources, freshwater fish and fish habitat, vegetation and wetlands, and wildlife and wildlife habitat, with most effects limited to the Project Area or within a 1 km radius of the Project Area. Adverse effects related to construction noise are predicted to extend beyond the Project Area boundaries, although this noise will be temporary and is not expected to result in a change in land use or result in species injury or mortality. These elevated noise levels, could, however, affect the behaviour of marine fish and wildlife species and therefore affect availability of resources which may be harvested by the Mi'kmaq. As noted in the MEKS for the Bear Head LNG Project, snow crab, shrimp, tuna, lobster and groundfish were noted to be commercially fished in the Canso Strait and Chedabucto Bay (CMM 2015). Underwater noise during marine construction (e.g., pile driving) may temporarily affect fish species behaviour and habitat use in the marine environment, potentially affecting fisheries occurring in the Strait of Canso

The Project has the potential to remove areas historically or currently used by the Mi'kmaq for traditional purposes, such as hunting, fishing or gathering. As reported in the initial MKS for the Bear Head LNG Terminal Project (CMM 2004), Mi'kmaq land and resource use within the 5 km radius study area from the Bear Head property at that time included marine harvesting, deer hunting and trapping, firewood harvesting, camping and a burial site. The updated MEKS (CMM 2015) reported trapping, overnight site and group camp site as current land and resource use sites in the MEKS study area. Since 2005, access to the Project Area has been partially restricted through the use of security fencing around parts of the site. As site development continues, additional fencing will be installed to improve site security and protect public health and safety, thereby further reducing site access. Restricted access to the Project Area will remain throughout the life of the Project.

Given that the Project Area has been substantially developed already and additional clearing and grubbing will be limited, direct effects on wildlife habitat will be limited, and associated effects to traditional land use are also anticipated to be limited. Mitigation implemented to eliminate or reduce adverse effects on biophysical resources will also serve to reduce adverse effects on Mi'kmaq land and resource use.

BHE will continue to engage the Mi'kmaq of Nova Scotia not only to understand potential concerns and mitigate adverse effects, but also optimize positive effects of the Project. An important aspect of benefits planning is to ensure that the Mi'kmaq of Nova Scotia can share fully in the benefits that the Project will bring. BHE has and will continue to work with Mi'kmaq communities to develop and implement MOUs and benefit agreements for the Project to address protection of Aboriginal Rights and Title, ecological knowledge and traditional use access, procurement and employment opportunities, training and education, and ongoing communications. BHE will also seek opportunities for cross-cultural learning and knowledge exchange with Mi'kmaq communities.

9.0 OTHER UNDERTAKINGS IN THE AREA

Under section 12 of the Environmental Assessment Regulations, the Minister must consider other undertakings in the area of a proposed project registered as a Class 1 Undertaking. The proposed Project is in the Point Tupper Industrial Park on the Strait of Canso. Existing activities in the business park include power generation, industrial waste management facilities, coal storage and handling, transshipment terminals, storage of dangerous goods and management of bulk petrochemicals. Adjacent land uses include NSPI's coal ash disposal facility to the west of the Project Area and the Point Tupper Wind Farm adjacent to the Project Area (northeast). Existing industrial undertakings within approximately 5 km of the Project Area (Point Tupper/Port Malcolm area) are presented in Table 9.1.

Table 9.1 Industrial Undertakings Near the Project Area

Project/Undertaking	Proponent	Location
Point Tupper Wind Farm	Renewable Energy Services Limited	Port Malcolm Road, Point Tupper, County of Richmond
Existing Point Tupper Terminal – Oil/Gas Retail/Manufacturer (formerly NuStar Energy Liquid Bulk Terminals)	EverWind Fuels LLC	Port Malcolm Road, Point Tupper, County of Richmond
Point Tupper Generating Station	NSPI	Industrial Park Road, Point Tupper, County of Richmond
Coal ash disposal facility	NSPI	Bear Island Road, Bear Head, County of Richmond
Pulp and paper mill and terminal	Port Hawkesbury Paper L.P.	Pulp Mill Road, Port Hawkesbury, County of Richmond
Waste management facility	GFL Port Hawkesbury	Heavy Water Road, Point Tupper, County of Richmond
Marine construction facility	McNally	Henry Paint Street, Point Tupper, County of Richmond
Gypsum wall board manufacturing and export facility	Cabot ULC	Henry Paint Street, Point Tupper, County of Richmond
Port Hawkesbury pier and marine shipping terminals (service vessel, fishing boat, tugboat, barge, patrol vessel, pleasure craft, and cruise ship berthage)	Strait Superport	Water Street, Town of Port Hawkesbury, County of Richmond
Concrete supplier	Ideal Concrete Ltd.	Heavy Water Road, Point Tupper, County of Richmond
Coal terminal, storage, and rail loading	Savage Coal/NSPI	Industrial Park Road, Point Tupper, County of Richmond

In December 2022, Everwind Fuels Company filed an EA Registration document for a proposed green hydrogen/ammonia project approximately 3.4 km northwest of the Project Area, adjacent to the existing Everwind Fuels Point Tupper Terminal in the Point Tupper Industrial Park. Also, as indicated in Section 2.10, the Project will require water and power services which are expected to require new infrastructure development in the area. BHE is working with the LLWU to ensure that the amount of water required for the Project will not impact the availability of water to the local residents and industrial users and the related costs for such water. BHE is also working closely with LLWU to have a positive impact on the water resources and delivery of water to all users, including the local residents, through investment in new infrastructure. BHE and LLWU are jointly reviewing options to update LLWU's current infrastructure and rebuild and bring online prior infrastructure to enhance the safe yield and increase the deliverability of water to all users.

While the Project can result in adverse environmental effects, as described in Chapter 6, these effects will be managed through the implementation of mitigation measures identified in this assessment. Land use associated with the Project is consistent with nearby land uses and the land use designation (i.e., Port Industrial and Heavy Industrial). The Project is therefore predicted to not affect any of the existing undertakings described in Table 9.1 (refer to Section 6.8 for an evaluation of Project effects on land use and communities). With the construction and operation of a new marine terminal, the Project will increase the volume of ship traffic in the Strait of Canso. However, navigation and shipping will be implemented in accordance with applicable navigation requirements and is not anticipated to adversely affect existing shipping activities.

While the Project, and other undertakings in the area (including future proposed undertakings), may place demands on local services, overall the impacts for the community will be positive. BHE has made commitments to work with the Mi'kmaq of Nova Scotia, representative labour groups in the region, other relevant stakeholders to ensure the success of their Project and to facilitate growth and maximize benefits to the communities of which they have become part. The Project will help strengthen the industrial profile of the Strait region. Project development could be an important catalyst for further investment in the region, benefitting not only Port Hawkesbury and the Municipality of the County of Richmond, but the Municipality of Guysborough County and the Province, as well.

10.0 EFFECTS OF THE ENVIRONMENT ON THE UNDERTAKING

Environmental conditions could affect or damage Project infrastructure resulting in failures, malfunctions, or accidental events, which in turn, could result in adverse effects to the environment. The assessment of effects of the environment on the Project relies substantially on the assessment conducted for the Bear Head LNG Project (SNC Lavalin 2015) with updates, where applicable. This assessment is closely linked to the assessment of Accidents and Malfunctions (Section 7).

10.1 POTENTIAL ENVIRONMENTAL EFFECTS

10.1.1 Climate and Climate Change

The Prairie Climate Centre's Climate Atlas of Canada (2019a) predicts climate change in Canada using climate science, mapping and modelling. Based on general climate change predictions, it is expected that future climate change could result in increased air temperatures, increased frequency and intensity of precipitation, an increase in the frequency and magnitude of storm events, increased incidence of flooding and erosion, and sea level rise. The municipalities of Port Hawkesbury and Canso are expected to experience future increases in precipitation, temperatures, number of very hot days per year, and number of frost-free days per year (Prairie Climate Centre 2019b and 2019c). Potential effects of climate change associated with extreme temperatures, heavy precipitation, winds, and storms could include delay and/or interruption of Project activities; loss of electrical power; and damage to site access, infrastructure, and equipment.

A study by Beaumont et al. 2011 examined the impact of climate change on some of the world's most exceptional ecoregions. It determined that of the 132 terrestrial and 53 freshwater ecoregions examined, 86% of terrestrial and 83% of freshwater ecosystems will be exposed to climactic conditions considered extreme in 1961 – 1990 (greater than two standard deviations in average monthly temperature). Extreme weather events have shown increases in Nova Scotia, with greater increases predicted. This includes a warmer and wetter future climate with increased storm activity (Richards and Daigle 2011). Extreme weather includes cases of extreme temperatures, precipitation, winds and storm events. Extreme weather can occur at any time of the year in Nova Scotia with little or no time to prepare (NSECC n.d.).

The closest weather station to the Project with the most recently available data (1981 – 2010) is Deming station, located approximately 40 km south of the Project, on Deming Island. Historical temperatures recorded at the Deming station vary from -25 ˚C to 31 ˚C. Typical of Nova Scotia coastal regions, this temperature range is wide. Average annual precipitation is 1440.5 mm, with an extreme daily rainfall and daily snowfall of 115.6 mm and 28.2 cm, respectively (Section 4.1.4).

Wind data is not available for the Deming Station. At Port Hawkesbury, which is approximately 6.5 km northeast from the Project, the prevailing terrestrial wind direction is from the southwest and from the northwest (Figure). The average wind speeds between 2013 and 2017 at Port Hawkesbury were between 3.6 and 8.8 metres/second (Hersbach et al. 2017). Extreme winds can produce high waves, stormy seas, blowing sea spray/foam and cause reduced visibility. Frozen sea spray which can cause

unsafe working conditions is also an issue during colder months, with February being the worst for ice build-up on marine vessels. Storm surge accompanying strong storms can increase water levels, potentially causing issues with loading and unloading procedures. Strong currents can impact vessel navigation and docking.

The Project is located in a coastal area and is therefore susceptible to increases in storm events (CCNS 2014). Hurricanes Dorian (2019) and Fiona (2022) are examples of hurricanes that hit the Maritimes in recent years, causing massive damage to local infrastructure. The possibility of damage due to more frequent and severe storms is a possibility given the Project location in a coastal region.

Heavy precipitation events can cause delays in construction activities and increase the risk of erosion and sedimentation (e.g., on fish habitat or wetlands) particularly when site soils are exposed and have not been fully stabilized. Heavy rains or snow can temporarily restrict construction activities. These delays could have short term implications for Project schedule but are not expected to cause environmental effects. Given the site is already substantially developed, including stormwater management systems, the risk from erosion and sedimentation from heavy precipitation is reduced.

Reduced visibility can occur throughout the year due to fog; however, it is most likely to occur in late spring and early fall when the greatest difference between the coastal water and air temperature exists. Reduced visibility can cause marine navigation issues and increase the risk of accidents.

The Project will be designed to withstand instances of extreme weather as described above. Wind loads, harshest recorded conditions, and predictions of future conditions will be factored into Project design and engineering. The Project will be designed with a safety factor that accounts for variability. Weather forecasts will be monitored regularly and Project activities will be modified when extreme weather is forecasted. For example, this will include but will not be limited to, setting operational limits for vessel docking and ensuring work areas are secured to the extent possible in advance of predicted extreme weather events.

10.1.2 Sea Ice

The Strait of Canso is an extremely deep and ice-free harbour. Prior to the construction of the Canso Causeway in 1955, sea ice was prevalent. Construction of the Canso Causeway created a barrier between ice packs on the north side and the south side remains ice free year round (Strait of Canso Superport Corporation n.d.). Sea ice is expected to decrease in eastern Canada in thickness, concentration and duration, with volume likely to be reduced by more than 95% by the end of the 21st century (Savard et al. 2016). Sea ice is therefore not expected to impact Project construction or operations.

10.1.3 Sea Level Rise

Sea level rise is defined as the vertical change in the sea surface relative to the Earth's centre (Savard et al. 2016). In 2021, the Geologic Survey of Canada published projected sea level change across Canada (James et al. 2021). The study predicts that by 2100, the median sea level rise in the Guysborough County, Canso Harbour area could be in the range of 0.6 to 0.8 m (in the median-emissions scenario) (James et al. 2021). Upper estimates put these values at 1.4 to 1.6 m by 2100 (in the high-emissions scenario) (James et al. 2021). Another study published by the National Oceanic and Atmospheric Administration (U.S. National Ocean Service) predicts that sea level rise in Sydney, NS could range from 0.09 to 1.13 m by 2050, and 0.18 to 3.47 m by 2100 (NOAA 2017 and US Army Corps of Engineers 2022).

This rise in sea level could potentially impact the marine terminal, if not accounted for in engineering design. The design of the marine terminal (Appendix C) has taken into account metocean conditions and potential sea level rise. Sea level rise is therefore not expected to adversely affect the Project over the course of its design life (approximately 30 years).

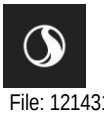
10.1.4 Seismic Activity

Seismic activity (earthquakes) in Nova Scotia have been rare. The Geologic Survey of Canada assesses the relative hazard for the province of Nova Scotia to be low, meaning there is a one percent chance that significant damage from seismic activity will occur every 50 years) (Geologic Survey of Canada 2015). There are no important historical earthquakes listed for Nova Scotia (NRCan 2021a). The closest important earthquake was a magnitude 5.7 earthquake in Miramichi, New Brunswick in 1982 and a 7.2 magnitude earthquake that occurred offshore south of Newfoundland in 1929 (NRCan 2021a). No major damage was caused by the 1982 earthquake in New Brunswick, although many people were woken up, it was felt outdoors and small and unstable objects were overturned or moved (Bashman et al. 1984). The Grand Banks earthquake occurred approximately 250 km south of Newfoundland. It was felt as far away as New York and Montreal and generated a tsunami that resulted in 28 deaths in Newfoundland. Vibrations were felt in Cape Breton that caused minor landslides and knocked down or cracked chimneys (NRCan 2021b). Historically, most seismic shocks recorded in Atlantic Canada are below magnitude 5, except for those mentioned above (Rast et al. 1979).

10.1.5 Wildfires

Between 2016 and 2021, there were a total of six wildfires in Richmond County. There were no fires in 2016, 2018 or 2021. Collectively, wildfires in 2017, 2019 and 2020 burned a total of 2.5 ha of land in Richmond County (NRR 2021). In this same time period (2016-2021), there were a total of 935 wildfires in the province, averaging 187 wildfires a year (CCFM 2022). A total of 2,611 ha of land was burned in the province over this period (CCFM 2022).

The likelihood of a wildlife near the Project is relatively low. Nova Scotia has a forest fire control program in place to identify and control fires and reduce potential magnitude and extent of wildfires. Brush will be controlled within the perimeter of the facility which will further reduce the chances of a wildfire from damaging Project infrastructure. Project structures will be constructed primarily of concrete and steel,



which are not typically affected by fire. Ammonia, hydrogen and oxygen are flammable and if ignited could result in significant environmental and public health effects. However, the facility will be built to control environmental exposure of these components and will have fire and gas detection systems in place as well as fire water systems.

10.1.6 Security

Although unlikely to occur, a terrorist attack on the facility could have significant effects on the Project and surrounding environment. Security is therefore another “environmental factor” to be addressed. BHE will prepare a security plan based on the requirements of a facility security assessment conducted in accordance with the Marine Transportation Security Regulations of the *Marine Transportation Security Act*. Security personnel, protocols, and design features (e.g., surveillance equipment, protective enclosures) will be established to meet site requirements and reduce risk associated with a breach of security.

10.2 MITIGATION

The Project will be designed and constructed to meet the COP and other applicable engineering codes and applicable guidelines, standards and best management practices. This includes, but is not limited to CSA Z276-18 (LNG – Production, storage and handling) which considers environmental factors including fire and seismic events and IEC 62305-2, Protection against lightning – Part 2: Risk management.

In accordance with the COP, a site study, climatology study, and seismic review will be conducted to inform detailed design. The seismic review will inform design of ammonia and hydrogen tanks, impoundments and other critical structures or systems as applicable.

The site study will consider the following aspects:

- a site survey and soil survey that includes a geotechnical survey to define the geomechanical, geological and tectonic characteristics of the subsoil and any other features relevant to the development
- a study of terrain to assess the dispersion of liquid and gas clouds
- a study of vegetation to identify, in particular, vegetation fire risks
- groundwater tables
- sea water quality and temperature (if sea water is used for cooling or fire water then the sea water quality will need to be determined in order to select the proper materials of construction, filtration equipment and means for control of micro-organisms and molluscs)
- tidal conditions
- shock waves and flooding (such as tsunami or failure of dams),
- a survey of the surrounding infrastructure (e.g., industrial sites, built up areas, communications).

The climatology study will consider:

- prevailing wind direction
- maximum wind velocity and gust duration, and hurricane and tornado frequencies
- lightning frequency
- maximum and minimum temperature data and max and min design temperatures to be used for equipment and buildings
- atmospheric stability
- wind rose
- relative humidity
- corrosive nature of the air (e.g., salt)
- rainfall (max, yearly and seasonal averages)
- snow loads and potential for freezing rain or ice build-up on equipment
- frost line depth
- site elevation and standard atmospheric pressure, as well as the rate of change of barometric pressure

The following mitigation measures will also be implemented to reduce adverse effects of the environment on the Project:

- Weather forecasts will be regularly monitored and Project activities will be scheduled in consideration of seasonal conditions and weather forecasts. Activities may be modified when extreme weather is forecasted. This may include a delay of activities due to poor weather.
- BHE will update the previous TERMPOL study for the Project.
- Vessels operating in the area will follow the directions of the Canadian Coast Guard Marine Communications and Traffic Services during severe weather events. Vessels will not dock and, if docked, will undock and depart should the weather exceed the design criteria.
- Prior to extreme weather events, appropriate preventative measures will be taken to reduce the risk of damage to the Project. This will include general inspections for facility integrity as well as inspection / maintenance of sediment and erosion control measures prior to and following precipitation events.
- Back-up power generation for orderly plant shutdown will be installed in case of long-term power outages.
- Fire protection systems will be in place in accordance with applicable codes and standards. Fire water networks will be provided around all sections of the facility containing flammable fluids.
- The ERP will describe emergency response measures, training requirements, roles and responsibilities, and reporting procedures in the event of a fire at or near the site. The ERP will also address cooperation with other local emergency response providers including local municipal and NRR firefighting forces.
- On-site fire prevention and response equipment will be provided and maintained, and BHE will have employees / teams that will be trained in safe fire response for a fire at the facility.

- Water management structures will be designed to attenuate the design storm event, thus preventing flooding. The design storm events consider climate change. Overflow weirs are constructed in water management pond embankments to facilitate safe discharge of flows exceeding the design flows of the ponds.
- A facility security assessment will be conducted and a security plan will be prepared and implemented to maintain required levels of site security and reduce risk of trespass and acts of destruction.

10.3 SUMMARY OF RESIDUAL EFFECTS

Potential adverse effects on the Project by the physical environment including extreme weather, sea ice, climate change and sea level rise, seismic activity, and security will be important considerations throughout the planning, engineering, and implementation of the Project. Effects of the environment are largely addressed through Project planning and engineering design. The Project will rely on design standards and proven methods and technologies that have been tested and proven successful in similar climates. BHE will also follow industry standards and best practices in designing for and preventing adverse effects of the environment on the Project including, but not limited to, the COP developed for the Project.

A significant effect of the environment on the Project would be defined as one that results in any of the following:

- damage to Project infrastructure resulting in an increase to public health and safety risk
- damage to Project infrastructure requiring repairs that cannot be technically or economically implemented
- substantial loss of the Project schedule (e.g., extended delays in construction) or a shutdown of the operation

In consideration of project design to accommodate extreme environmental conditions and other mitigation measures, effects of the environment on the Project are predicted to be not significant. Adverse environmental effects from accidental events and malfunctions are assessed in Section 7.

11.0 FUNDING

To date, no government funding has been secured for the Project. Ultimately, the Project will likely be primarily or entirely privately funded.

12.0 BENEFITS OF THE PROJECT

Green hydrogen and green ammonia can play a critical role in regional, national and global efforts to transition to a low-carbon economy and achieve net-zero targets, particularly in hard-to-decarbonize sectors such as energy, steel and fertilizer production as well as marine and long-haul transport. Canada is well positioned to be a leader in the emerging green hydrogen economy, and Nova Scotia is taking steps to be at the forefront of this transition, tapping into the province's many advantages including access to abundant wind power, existing infrastructure, and proximity to markets in Europe and the USA.

BHE intends to be a leader in this transition, as the Project will service as concrete step in the development of a green hydrogen and green ammonia economy in Atlantic Canada. The transition will create many new economic, social and environmental opportunities for the region. Some of the potential direct and indirect regional benefits that are anticipated during the development, construction, and operational phases of the Project are summarized below.

Economic Benefits

According to McKinsey (2022), the net-zero transition will require trillions of dollars of global annual capital investment through 2050, according to estimates in their January 2022 report on the net-zero transition. BHE is among those seeking to help Nova Scotia and Cape Breton capture a meaningful share of this immense global investment, and the follow-on commercial benefits this investment will provide. The specific local economic benefits of the Project could include:

- The creation of 45 to 70 permanent direct jobs for 20+ years plus 175 permanent indirect jobs for 20+ years during operations of the Project
- The creation of 600 to700 jobs during the construction and commissioning of the Project
- An increase in economic prosperity within First Nation communities via training and employment opportunities
- Increased revenue to local businesses due to commercial activities associated with the construction, operation, and eventual decommissioning of the Project, including increased demand for food services, health care, retail trade, short-term accommodations, etc.
- Potential for increased tourism and recreation-seeking
- New housing construction related to the incremental permanent employment
- An increase in property values due to increased demand for housing
- A significant new addition to the local property tax base
- An increase in tax revenues for the regional economy

Social / Community Benefits

In addition to the anticipated economic benefits, the Project will have a positive impact on the local population and the social, professional and educational opportunities that are available to them. Specifically, the social and community benefits could include:

- Influx of new residents, or repatriation of former residents, to the community as they seek new employment opportunities
- New opportunities for skill and educational enhancement via development of ongoing training programs in partnership with Nova Scotia Community College and other training organizations
- Opportunities for local youth to engage and excel in meaningful careers
- Opportunity for communities and local government to build awareness and education on clean energy, hydrogen safety and application (Zen et al. 2020)
- Investment in local infrastructure, including power and water infrastructure
- Further participation by BHE in the community as a committed corporate citizen

Environmental Benefits

The environmental benefits associated with the Project will be both regional and global. With the use of large-scale renewable power, the Project can directly support both Nova Scotia and Canada to achieve their climate objectives while also having a positive impact on global emissions. Specifically, the anticipated environmental benefits include:

- Production of emission-free energy, which will displace energy produced by fossil fuels globally
- Production of emission-free chemical inputs and feedstocks, which can be used to displace raw materials produced by fossil fuels globally
- Contribution to the development of incremental local renewable energy sources which will assist Nova Scotia and Canada in meeting the target of 80% renewable energy set in the Renewable Electricity Regulations made under Section 5 of the *Electricity Act*
- Support the federal government's climate goals, including Canada's 2030 greenhouse gas emissions reduction targets, its 2050 net zero emissions goals and the ambition of transforming Canadian industry for the future net-zero economy by adopting or commercializing new low or zero-carbon intensity products, processes, or methods of production
- Support Nova Scotia's objective of achieving a 53% reduction in GHG emissions by 2030 and becoming net-zero by 2050
- Contribute to the development of Nova Scotia's world-class wind resources via the creation of a significant new offshore wind industry, and its associated supply chains and support functions, as reflected in the province's objective of developing 5 GW of offshore wind energy by 2030
- Support the development of secure hydrogen supply chains and establishment of a transatlantic Canada–Germany supply corridor, as agreed by Canada and Germany in August 2022 to demonstrate their intent to collaborate in the export of clean Canadian hydrogen to Germany via multiple initiatives

Incremental Direct Investment Benefits

The Project may also serve as a catalyst for other direct investments beyond the contemplated green hydrogen and ammonia Project. Although the Project will at first produce ammonia to be shipped to world markets versus supplying local energy needs, it may also act as a pillar for the local hydrogen sector and support the transition from resource extraction and heavy industry employees in Nova Scotia to clean energy (Zen et al. 2020). The Project can serve to anchor a growing domestic green hydrogen economy in Nova Scotia and potentially act as a catalyst for additional green energy investments in adjacent industries, such as:

- Use of green hydrogen and green ammonia as a feedstock for activities such as steel-making, cement and fertilizer production and
- Production and distribution of zero emissions transportation fuels based on green hydrogen and green ammonia

13.0 SUMMARY AND CONCLUSIONS

BHE proposes to construct and operate a green hydrogen and ammonia production, storage and loading facility at the site of the previously approved, but not fully constructed, Bear Head LNG Project in the Point Tupper Industrial Park on the Strait of Canso. At full build-out, the Project will be capable of producing 2 mtpa of green ammonia using renewable energy. The facility would include electrolysis units for green hydrogen production, air separation unit(s) for nitrogen generation, Haber-Bosch ammonia synthesis unit(s), ammonia bulk storage tank(s), and a marine terminal. The proposed marine terminal includes a jetty platform, ship berthing and trestle structure, loading facilities and MOF to be developed within the water lot owned by BHE. The design of these marine facilities will be the same as previously approved for the Bear Head LNG Project.

Approximately 15 million litres of water/day on average (4 million US gallons of water/day) will be required by the facility and will be supplied to the site via pipeline from the LLWU. Power supply for the Project will be provided from renewable power via the grid and/or direct power connection from primarily new onshore and/or potential future offshore renewable energy projects. Water supply and energy production and storage will be permitted (as required) separately by the proponent(s) of these utilities/projects.

This EA Registration document was developed to meet the requirements of a Class I EA Registration under the Nova Scotia *Environment Act* and Environmental Assessment Regulations and reflects the methods and approaches used for the previously approved Bear Head LNG Project (JWEL 2004; SNC Lavalin 2015).

The EA Registration document focused on potential interactions with the following VCs:

- Atmospheric Environment
- Groundwater Resources
- Surface Water Resources
- Freshwater Fish and Fish Habitat
- Vegetation and Wetlands
- Wildlife and Wildlife Habitat
- Marine Environment
- Land Use and Communities
- Fisheries, Aquaculture and Marine Harvesting
- Cultural and Heritage Resources

Residual effects from routine Project activities are predicted to be not significant for all VCs (Section 6). A considerable amount of site preparation work has already been performed, with a large part of the Project footprint having been established, thereby limiting the potential for effects on the terrestrial and freshwater environments. No new wetland or watercourse alterations are anticipated to be required for Project development. The development and implementation of an EMP will help to avoid or reduce adverse environmental effects of the Project. Follow-up and monitoring programs have been proposed for vegetation and wetlands, wildlife and wildlife habitat, and the marine environment. Ongoing consultation and engagement with the Mi'kmaq of Nova Scotia and stakeholders will help to reduce adverse socio-economic effects and optimize Project benefits.

Accidents and malfunctions were evaluated separately (Section 7) and included consideration of the following scenarios: hydrogen and ammonia releases; failure of water management controls; and fuel and hazardous material spills. Provided that the prevention and response mitigation outlined in the EA Registration document is implemented, environmental effects associated with a failure of water management controls and/or fuel and hazardous material spills are predicted to be not significant. As informed by the Quantitative Risk Assessment (Appendix H), residual environmental effects of an unplanned release of hydrogen or ammonia could potentially result in a significant adverse effect on most VCs with the exception being the Cultural and Heritage Resources VC. However, significant adverse effects would be unlikely to occur given the low likelihood of such an event occurring.

BHE has engaged the Mi'kmaq of Nova Scotia, and regulatory and public stakeholders in order to provide Project information and obtain feedback on potential issues and concerns to be addressed during Project design and planning. Consultation and engagement efforts have included one-on-one meetings, revitalization of the CLC previously established for the Bear Head LNG Project, and community open house meetings in several communities in Guysborough and Richmond Counties.

The Project has the potential to remove areas historically or currently used by the Mi'kmaq for traditional purposes, such as hunting, fishing or gathering. Given that the Project Area has been substantially developed already and additional clearing and grubbing will be limited, direct effects on wildlife habitat will be limited, and associated effects to traditional land use are also anticipated to be limited. Mitigation implemented to eliminate or reduce adverse effects on biophysical resources will also serve to reduce adverse effects on Mi'kmaq land and resource use.

BHE will continue to engage the Mi'kmaq of Nova Scotia not only to understand potential concerns and mitigate adverse effects, but also optimize positive effects of the Project. BHE has and will continue to work with Mi'kmaq communities to develop and implement MOUs and benefit agreements for the Project to address protection of Aboriginal Rights and Title, ecological knowledge and traditional use access, procurement and employment opportunities, training and education, and ongoing communications. BHE will also seek opportunities for cross-cultural learning and knowledge exchange with Mi'kmaq communities.

Environmental factors which could potentially affect the Project include climate and climate change; sea ice; sea level rise; seismic activity; wildfires; and security (e.g., vandalism/terrorism) issues. All facility components and operations will be designed to all relevant engineering codes and standards (including the COP developed for the Project) with the full knowledge of potential environmental conditions on the site including extreme weather events as well as predicted parameters due to changing global climate. Therefore, effects of the environment on the Project are predicted to be not significant and will be managed primarily through engineering design and operational planning (including contingency plans).

The Project represents a commercial scale energy export project that will provide a non-GHG emitting fuel source and allow Nova Scotia to become a leader in the global energy transition. Building the Project to supply green ammonia to the international market provides cost advantages, including increased investment and higher production rates with decreased unit costs. A large-scale export project encourages the development of expertise and experience of local equipment and service providers, facilitating opportunities and growth to service future local markets as they evolve.

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