

5.10 Summary of Assessment of Potential Environmental Effects

5.10.1 Air Quality

5.10.1.1 Summary of Project Residual Effects on Air Quality

The Project residual effect on air quality is a change in ambient air quality in the Kitimat airshed or along the marine access route. Table 5.10-1 summarizes Project residual effects on air quality.

Table 5.10-1: Summary of Project Residual Effects on Air Quality

Valued Component ¹	Potential Effects	Key Mitigation Measures ²	Significance Analysis of Residual Effects
Facility Activities and Works			
Air quality (O)	Change in ambient air quality in the Kitimat airshed	<ul style="list-style-type: none"> ▪ Manage, through Project engineering design and operational procedures, the continuous NOx emissions associated with the gas turbine exhaust to meet regulatory requirements (Mitigation 5.2-5). ▪ Adhere to the Air Quality Management Plan (Mitigation 5.2-6). 	Not significant. With implementation of the mitigation and environmental protection measures, the residual effects of the Project are assessed to be not significant.
Shipping			
Air quality (O)	Change in ambient air quality along the marine access route	<ul style="list-style-type: none"> ▪ Construction vessels, supporting tugs, and LNG carriers and assist tugs will use low-sulfur fuel in compliance with applicable marine emission standards (IMO 2008) (Mitigation 5.2-8). 	Not significant. With implementation of the mitigation and environmental protection measures, the change in ambient air quality along the shipping LSA is assessed to be not significant.

NOTES:

¹ Construction Phase = C; Operation Phase = O; Decommissioning Phase = D

² See Section 20 (Summary of Mitigation Measures) for a full list of mitigation measures.

5.10.1.2 Summary of Cumulative Effects on Air Quality

Cumulative effects are characterized as high in magnitude. The RTA facility is largely responsible for predicted exceedances of objectives beyond the Project boundaries, hence the high magnitude rating. Cumulative effects are confined largely to the RSA, long-term, and continuous over the operation phase. Cumulative adverse effects (high predicted concentrations) occur sporadically over time.

Cumulative effects are moderate in magnitude because the Project is not responsible either singly or as a substantial contributor in combination with other sources for causing exceedances of AAQO beyond the Project boundaries. The contribution from the Project to the overall cumulative effect is moderate in magnitude. The cumulative effects occur in a moderately resilient environment; however, they are reversible after emissions decrease or cease.

With implementation of the mitigation and environmental protection measures, the cumulative effects are assessed to be not significant.

The shipping cumulative effects are characterized as moderate in magnitude. Cumulative effects are confined largely to the RSA, long-term, and multiple regular over the operation phase (. Cumulative adverse effects (high predicted concentrations) do not occur.

The shipping cumulative effects are moderate in magnitude because the Project is not responsible either singly or as a substantial contributor in combination with other sources for increasing existing levels of CACs. The contribution from the Project to the overall cumulative effect is moderate in magnitude. The cumulative effects occur in a moderately resilient environment; however, they are reversible after emissions decrease or cease.

5.10.1.3 Summary of Project Residual Effects on Greenhouse Gas Emissions

The Project residual effect is the increase in global GHG emissions. Table 5.10-2 summarizes Project residual effects on GHG emissions.

Table 5.10-2: Summary of Project Residual Effects on Greenhouse Gas Emissions

Valued Components ¹	Potential Effects	Key Mitigation Measures ²	Significance Analysis of Residual Effects
Facility Activities and Works and Shipping Activities			
GHG emissions (C)	GHG emissions	<ul style="list-style-type: none"> ▪ Implement industry best practice for mobile construction equipment (i.e., regular maintenance, speed restrictions, correct sizing of equipment, modernizing of fleet, reduce idling, driver behaviour, etc.) (Mitigation 5.3-1). ▪ Use existing roads as main access points to the LNG facility to limit area of new disturbance, where practicable (Mitigation 5.3-2). ▪ Use buses, where feasible, instead of personal transportation at the facility and workforce accommodation centre(s) to reduce traffic emissions (Mitigation 5.3-3). ▪ Footprint for LNG facility and temporary construction facilities will be sized to allow safe and efficient construction. Existing cleared areas will be utilized, where practicable, to limit area of new disturbance (Mitigation 5.3-4). ▪ Avoid burning of biomass where practicable (Mitigation 5.3-5). 	<p>Not significant.</p> <p>Project GHG emissions during construction will represent a <0.0001% increase in total global GHG emissions relative to 2010 levels. This nominal change to global GHG levels from the Project alone are assessed as not significant.</p>
GHG emissions (O)	GHG emissions	<ul style="list-style-type: none"> ▪ Use efficient aero-derivative gas turbine technology to drive the refrigeration compressors in the liquefaction process (Mitigation 5.3-6). ▪ Use BC Hydro power for LNG facility auxiliary electricity supply (Mitigation 5.3-7). ▪ Operate combustion sources at optimal efficiency settings to reduce fuel consumption (Mitigation 5.3-8). 	<p>Not significant.</p> <p>Project GHG emissions during operation will represent a 0.009% increase in total global GHG emissions relative to 2010 levels. This contribution will cause a small material change to global GHG levels. In this</p>

Valued Components ¹	Potential Effects	Key Mitigation Measures ²	Significance Analysis of Residual Effects
		<ul style="list-style-type: none"> ▪ Adhere to existing flaring and venting reduction guidelines. Minimize flaring or venting, except as required to maintain safe operations and LNG train start up (Mitigation 5.3-9). ▪ Conduct preventative maintenance of facility and equipment as per schedule in the maintenance management system (Mitigation 5.3-10). ▪ Reuse heat recovered from gas turbine exhausts to reduce fuel consumption in other processes (Mitigation 5.3-11). ▪ Recover boil-off gas during storage and loading processes, and re-inject the recovered gas into the fuel/feed gas system (Mitigation 5.3-12). ▪ Implement a fugitive emissions survey program with the aim to measure, control and manage fugitive emissions (Mitigation 5.3-13). ▪ Develop and adhere to a GHG Management Plan that would incorporate Best Achievable Technology (BAT) in current project design and implement best industry practice to manage Project GHG emissions (Mitigation 5.3-14). 	<p>context, the potential effects of the Project alone on GHG emissions are assessed as not significant.</p>

NOTES:

¹ Construction Phase = C; Operation Phase = O

² See Section 20 (Summary of Mitigation Measures) for a full list of mitigation measures.

5.10.1.4 Summary of Cumulative Effects on Greenhouse Gas Emissions

GHG emissions generated from the Project will contribute to global atmospheric GHG concentrations. However, because cumulative GHG emissions are acting at a global scale it is not possible to single out the potential cumulative effects of this Project in combination with other regional projects and activities, as identified in the Project and Activities Inclusion List (Section 4). In accordance with section 4.5 of the AIR (BC EAO 2014), the cumulative effects assessment relies on a comparison of estimated Project GHG emissions to recent provincial, national and global emission inventories.

Project GHG emissions will increase provincial and national levels by 6.6% and 0.57% respectively. The contribution will be small in the global context (0.009%). Since the Project-related releases of GHGs are acting cumulatively with other global sources of GHG on an already serious effect, the Project's contribution to GHG emissions is assessed as significant.

As mentioned in the industry profile, LNG Canada is designed to achieve a low emission intensity when compared to other currently available data and it is their goal to reach best-in-class performance.

At a global scale, there is a possibility that LNG will facilitate the displacement of higher carbon fuels (such as oil and coal) for energy generation. Replacement or displacement of higher carbon fuels with natural gas in power plants can potentially reduce GHG emissions globally. The most recent IPCC report on mitigation of climate change also states that GHG emissions from the energy sector could be substantially reduced if coal-fired power plants are replaced with natural gas power plants. The report also states that natural gas power plants could act as a bridge technology and that natural gas could hence play an important role as a transition fuel (IPCC 2014).

The Project is in line with LNG Canada’s goal to supply affordable and cleaner burning LNG to Asia that could help transition away from higher GHG fuels such as coal. LNG can also contribute to reductions in the use of more carbon intensive fossil fuels by providing a reliable base load of peaking fuel or to supplement peak power for renewable energy such as wind and solar power. LNG Canada also recognizes, at the corporate and project level, the need to mitigate excess anthropogenic GHG emissions to prevent a level of global warming considered to be unacceptable by international scientific authorities, and towards this end engages in a wide variety of approaches to reducing its corporate GHG footprint.

5.10.2 Acoustic Environment

5.10.2.1 Summary of Project Residual Effects on the Acoustic Environment

The Project effects on the acoustic environment are change (increase) in overall noise levels and increase in low-frequency noise during LNG facility construction and operation. Table 5.10-3 summarizes Project residual effects on the acoustic environment.

Table 5.10-3: Summary of Project Residual Effects on the Acoustic Environment

Valued Component ¹	Potential Effects	Key Mitigation Measures ²	Significance Analysis of Residual Effects
Facility Activities and Works			
Acoustic environment (C)	Change (increase) in overall noise levels and increase in low-frequency noise during facility construction and operations	<ul style="list-style-type: none"> ▪ Most construction activities, including pile installation, will be planned to occur between the daytime hours of 7 a.m. and 10 p.m. Night shifts will be required to complete specific activities or meet schedules (Mitigation 5.4-1). ▪ Vibro-hammer piling equipment will be considered for use where conditions permit for land-based piling operations (Mitigation 5.4-2). ▪ Fit gas or diesel engine exhausts with noise mufflers, where available (Mitigation 5.4-3). ▪ Rubber-wheeled equipment will be used instead of steel-tracked equipment, where practical (Mitigation 5.4-4). ▪ Construction equipment will be turned off when not in use, where practical, to minimize idling (Mitigation 5.4-5). 	Not significant. With mitigation, noise effects from construction and operation of the LNG processing facility and marine terminal will comply with provincial noise guideline and federal noise guidance. Therefore, residual effects are not significant.
Acoustic environment (O)			

Valued Component ¹	Potential Effects	Key Mitigation Measures ²	Significance Analysis of Residual Effects
		<ul style="list-style-type: none"> ▪ Develop and implement a Traffic Management Plan (Mitigation 5.4-6). ▪ Equipment enclosure doors will be kept closed unless safe operations require otherwise (Mitigation 5.4-7). ▪ LNG Canada will develop a notification protocol with input from the local community and other stakeholders for advance notification of planned substantial noise-causing activities at the LNG facility (Mitigation 5.4-8). ▪ A process will be implemented to address all noise complaints in a timely manner (Mitigation 5.4-9). ▪ A Noise Management Plan will be developed and implemented (Mitigation 5.4-10). ▪ Regularly maintain all machinery and equipment to ensure that air and noise emissions are within range set by manufacturer when available (Mitigation 5.4-11). ▪ Ensure that project related noise generated during operation complies with the OGC Noise Control Best Practices Guidelines at sensitive receptor locations (Mitigation 5.4-12). 	
Shipping Activities			
Acoustic environment (O)	Change (increase) in overall noise levels and increase in low-frequency noise during facility construction and operations	<ul style="list-style-type: none"> ▪ No Project specific mitigation measures are required to meet regulatory limits during the operation phase. 	Not significant. Noise effects from marine shipping activities are expected to comply with provincial noise guidelines and federal noise guidance. Therefore, residual effects on the acoustic environment during marine shipping are not significant.

NOTES:

¹ Construction Phase = C; Operation Phase = O; Decommissioning Phase = D

² See Section 20 (Summary of Mitigation Measures) for a full list of mitigation measures.

5.10.2.2 Summary of Cumulative Effects on the Acoustic Environment

Residual effects on the acoustic environment from past and present OGC-regulated projects and activities in the RSA, in combination with those of the Project, will not overlap in such a way as to exceed OGC regulatory thresholds on a persistent basis. In addition, residual effects of reasonably foreseeable OGC-regulated projects and activities in the RSA, in combination with those of the Project, are expected to comply with regulatory guidelines. Cumulative effects are therefore predicted to be not significant.

5.10.3 Vegetation Resources

5.10.3.1 Summary of Project Residual Effects on Vegetation Resources

The Project effects on vegetation resources are change in abundance of plant species of interest, change in abundance or condition of ecological communities of interest, and change in native vegetation health and diversity due to emissions. Table 5.10-4 summarizes Project residual effects on vegetation resources.

Table 5.10-4: Summary of Project Residual Effects on Vegetation Resources

Valued Component ¹	Potential Effects	Key Mitigation Measures ²	Significance Analysis of Residual Effects
Facility Activities and Works			
Vegetation resources (C)	Change in abundance of plant species of interest	<ul style="list-style-type: none"> ▪ The approved clearing boundaries will be clearly delineated (flagged) prior to site preparation to keep clearing activities within the designated Project footprint (Mitigation 5.5-1). ▪ For the identified occurrences of blue-listed rock sandwort and red-listed long-leaved aster located in the Project footprint, a pre-construction salvage and translocation program to outside the Project footprint will be implemented (Mitigation 5.5-2). ▪ Incorporate traditional use plants, where appropriate and technically feasible, in wetland compensation measures and reclamation of temporary construction areas (Mitigation 5.5-3). ▪ Any temporary workspace will be reclaimed as soon as practicable as per measures stated in the EMPs (Mitigation 5.5-4). 	<p>Not significant.</p> <p>With mitigation measures in place, the change in abundance of plant species of interest is assessed to be not significant. The viability of the listed plants and traditional use plants in the terrestrial RSA is not anticipated to be impaired.</p>
Vegetation resources (C)	Change in abundance or condition of ecological communities of interest	<ul style="list-style-type: none"> ▪ An Erosion and Sediment Control Plan will be developed and implemented to manage surface water and avoid sedimentation in adjacent vegetation communities (Mitigation 5.5-5) ▪ The approved clearing boundaries will be clearly delineated (flagged) prior to site preparation to keep clearing activities within the designated Project footprint (Mitigation 5.5-1). ▪ An Invasive Plant Management Plan will be incorporated into the Project's EMP that will describe the control of invasive species. Where invasive species have been discovered on site, action will be implemented as soon as possible to eradicate them (Mitigation 5.5-6). ▪ Topsoil will be salvaged, stockpiled and/or reused on site where practicable. Remaining topsoil will be sent to other locations to be stockpiled or used for reclamation (Mitigation 5.5-7). ▪ Any temporary workspace will be reclaimed as soon as practicable as per measures stated in the EMPs (Mitigation 5.5-4). ▪ Develop and implement a Wetland Compensation Plan to address loss of wetland habitat function for breeding and foraging terrestrial mammals, amphibians, and birds (Mitigation 5.5-10). 	<p>Not significant.</p> <p>The residual effect on abundance or condition of ecological communities of interest is assessed as not significant. This determination takes into account the mitigation measures for all measurable parameters and the implementation of the Wetland Compensation Plan that will compensate for the loss of ecologically important wetlands and their associated functions. All measurable parameters are prevalent in the terrestrial RSA, as measured by the PEM or by the TEM extent; therefore, the Project is not anticipated to interfere with the regional persistence of these communities.</p>

Valued Component ¹	Potential Effects	Key Mitigation Measures ²	Significance Analysis of Residual Effects
Vegetation resources (O)	Change in native vegetation health and diversity due to emissions	<ul style="list-style-type: none"> ▪ Manage, through Project engineering design and operational procedures, the continuous NOx emissions associated with the gas turbine exhaust to meet regulatory requirements (Mitigation 5.2-5). ▪ Adhere to the Air Quality Management Plan (Mitigation 5.2-6). ▪ Diesel fired equipment will be powered by low sulphur fuel (Mitigation 5.2.7). 	<p>Not significant.</p> <p>All ecological communities potentially affected from emissions will continue to persist in the emissions RSA, although their health may be reduced within the areas where critical levels or loads for sulphur dioxide, nitrogen, sulphate and acid are exceeded during the period of operation. With these considerations, residual effects from sulphur dioxide fumigation and nitrogen, acid, and sulphate deposition are assessed as not significant.</p>

NOTES:

¹ Construction Phase = C; Operation Phase = O

² See Section 20 (Summary of Mitigation Measures) for a full list of mitigation measures.

5.10.3.2 Summary of Cumulative Effects on Vegetation Resources

The Project is located in a designated industrial zone and the removal of 292 ha of vegetation from the Project footprint accounts for less than 1% of the terrestrial RSA (Stantec 2013). With mitigation, the regional sustainability of listed and traditional use plant populations will be managed; residual effects from invasive species will be negligible, given adherence to well understood management approaches. The overall sustainability of ecological communities of interest will be maintained in the terrestrial RSA. The Wetland Compensation Plan will result in no net loss of wetland functions associated with wetlands designated as ecologically important to the region. Overall, cumulative effects on vegetation resources will not impair the regional viability and sustainability of any of the measurable parameters and are, therefore, assessed as not significant.

Similarly, although the residual effects of sulphur dioxide and nitrogen, sulphate, and acid deposition attributable to emissions from the Project will interact cumulatively with present and future projects in the emissions RSA:

- The air quality modelled deposition values for sulphate and acid are close to the critical loads in the base case, therefore, only a slight increase in sulphate and acid deposition in the application case is required to exceed critical loads for the more sensitive soil map polygons (Stantec 2014d).

- The areas of exceedance above critical loads for acid and sulphate deposition remained unchanged from the application case to the cumulative case.
- The areas of exceedance above the sulphur dioxide critical level and nitrogen deposition are a relatively small percentage (less than or equal to 1%) of the total vegetated communities in the emissions RSA.

Residual effects of the Project and cumulative effects are not anticipated to interfere with the regional persistence of ecological communities that are sensitive to air emissions.

5.10.4 Wildlife Resources

5.10.4.1 Summary of Project Residual Effects on Wildlife Resources

The Project effects on wildlife resources are loss or change in habitat, sensory disturbance or behavioural alterations, and risk of injury and mortality. Table 5.10-5 summarizes Project residual effects on wildlife resources.

Table 5.10-5: Summary of Project Residual Effects on Wildlife Resources

Valued Component ¹	Potential Effects	Key Mitigation Measures ²	Significance Analysis of Residual Effects
Facility Activities and Works			
Wildlife resources (C)	Loss or change in habitat (Terrestrial Wildlife)	<ul style="list-style-type: none"> ▪ Develop and implement a Wetland Compensation Plan to address loss of wetland habitat function for breeding and foraging terrestrial mammals, amphibians, and birds (Mitigation 5.5-10). ▪ Clearly delineate (flag) vegetation clearing limits to avoid damage to important wildlife habitat features (e.g., large boulders, nurse logs, raptor nests, mammal dens, ungulate mineral licks) in the facility LSA but outside of the Project footprint or the areas of temporary construction disturbance. Major game trails will be cleared of equipment, brush piles, and felled trees to maintain their use as movement corridors for wildlife, where practicable (Mitigation 5.6-1). ▪ Develop and implement an approved raptor management plan (Mitigation 5.6-2). ▪ A Wildlife Management Plan will be developed and will include requirements for reporting wildlife sightings, including bat or bird collisions. Reporting will include information such as species, location, and weather conditions (Mitigation 5.6-3). ▪ Develop and implement a Decommissioning Plan before decommissioning to allow habitat recovery and wildlife movement to proceed as soon as possible (Mitigation 5.6-4). 	<p>Not significant.</p> <p>The loss or change in effective habitat of 12.7 to 119.9 ha ($\leq 0.003\%$ of facility RSA) is a single occurrence that will have residual effects over the life of the Project. With application of mitigation and environmental protection measures, the loss or change in habitat on key species occurring within the facility LSA is assessed as not significant.</p>

Valued Component ¹	Potential Effects	Key Mitigation Measures ²	Significance Analysis of Residual Effects
Wildlife resources (C, O, D)	Risk of injury and mortality (Terrestrial Wildlife)	<ul style="list-style-type: none"> ▪ Design of the LNG loading line corridor will consider and incorporate, where practicable, ways to maintain tidal flow and wildlife passage (Mitigation 5.5-8). ▪ Construction activities will account for applicable bird breeding periods: ▪ end of March to mid-August for migratory birds (Environment Canada 2014b) ▪ January 1 through September 5 for raptors (BCMOE 2012) <p style="margin-left: 40px;">Clearing activities that need to occur during bird breeding periods will incorporate measures to protect birds and their eggs as per federal and provincial regulations. These measures will be detailed in the Wildlife Management Plan (Mitigation 5.6-5).</p> <ul style="list-style-type: none"> ▪ Bear-proof fences will be installed around the workforce accommodation centre(s) and Project site boundary to reduce potential for on-site interactions with wildlife (Mitigation 5.6-6). ▪ If clearing of open water wetland habitats within the Project footprint occurs during the amphibian breeding period (March 1 to August 15) an amphibian salvage program will be implemented. Details on an amphibian salvage program and measures to protect amphibian species will be detailed in the Wildlife Management Plan (Mitigation 5.6-7). ▪ If clearing of vegetation occurs during the bear denning period (October to March), pre-clearing bear den surveys will be required. Identified bear dens will be protected by a 200 m no-disturbance buffer during the denning period (Linnell et al. 2000) (Mitigation 5.6-11). 	<p>Not significant.</p> <p>With the application of mitigation and environmental protection measures, the risk of injury or mortality will not affect the sustainability of regional terrestrial wildlife populations. The residual effect on terrestrial wildlife in the facility LSA, due to potential risk of injury or mortality, is assessed as not significant.</p>
Wildlife resources (C, O)	Risk of injury and mortality (Marine Birds)	<ul style="list-style-type: none"> ▪ Supervisory staff on berthed vessels will be alerted to the hazards and potentially high-risk periods for bird strikes caused by deck lighting, particularly on nights when visibility is poor. Staff will be informed of the applicable seasonal and daily migratory periods. Facility staff will report bird collisions to a member of the Project environmental team, including information on bird species and weather conditions. Vessel personnel will be provided with information on how to treat and release marine birds that become grounded on vessel decks (Black 2005) (Mitigation 5.6-12). 	<p>Not significant.</p> <p>With mitigation, the Project will result in a low risk of injury or mortality to marine birds. The residual effect will occur over the long-term, although will be sporadic and rare, and will be more likely to occur during nights of poor visibility at the LNG facility and during peak migratory periods (i.e., spring and fall). The number of individuals affected will be low to negligible in the context of the regional marine bird populations. The magnitude of residual effect is low. The potential risk of injury or mortality to marine birds in the facility RSA is assessed as not significant.</p>

Valued Component ¹	Potential Effects	Key Mitigation Measures ²	Significance Analysis of Residual Effects
Wildlife resources (C, O, D)	Sensory disturbance or behavioural alterations (Terrestrial Wildlife and Marine Birds)	<ul style="list-style-type: none"> ▪ Implement industry best practice for mobile construction equipment (i.e., regular maintenance, speed restrictions, correct sizing of equipment, modernizing of fleet, reduce idling, driver behavior, etc.) (Mitigation 5.3-1). ▪ Develop and implement a Traffic Management Plan (Mitigation 5.4-6). ▪ Design of the LNG loading line corridor will consider and incorporate, where practicable, ways to maintain tidal flow and wildlife passage (Mitigation 5.5-8). ▪ Develop and implement a Decommissioning Plan before decommissioning to allow habitat recovery and wildlife movement to proceed as soon as possible (Mitigation 5.6-4). ▪ During construction, operation, and decommissioning, drivers will maintain slow (specified) speeds on all roads in the Project footprint and be extra diligent during amphibian migration periods, especially when adjacent to wetlands, in order to reduce the potential for collisions with wildlife (Mitigation 5.6-13). 	<p>Not significant.</p> <p>There is a low probability that the loss or change in effective key species habitat will affect the sustainability of regional wildlife populations. The potential for sensory disturbance or behavioural alterations of terrestrial wildlife in the facility LSA is assessed as not significant.</p> <p>With application of the mitigation and environmental protection measures, the risk of sensory disturbance or behavioural alterations of marine birds in the facility LSA is assessed as not significant.</p>
Shipping Activities			
Wildlife resources (C, O, D)	Risk of injury and mortality (Marine Birds) Sensory disturbance or behavioural alterations (Marine Birds)	<ul style="list-style-type: none"> ▪ Supervisory staff on berthed vessels will be alerted to the hazards and potentially high-risk periods for bird strikes caused by deck lighting, particularly on nights when visibility is poor. Staff will be informed of the applicable seasonal and daily migratory periods. Facility staff will report bird collisions to a member of the Project environmental team, including information on bird species and weather conditions. Vessel personnel will be provided with information on how to treat and release marine birds that become grounded on vessel decks (Black 2005) (Mitigation 5.6-12). 	<p>Not significant.</p> <p>With application of the mitigation measures, the potential for sensory disturbances and the risk of injury or mortality will be reduced for marine birds. Residual effects on local populations will recover through natural recruitment (breeding and immigration); therefore, the sustainability of regional populations will not be adversely affected. Consequently, the potential for sensory disturbance or behavioural alterations, and risk of injury or mortality, are assessed as not significant. The combined residual effects of shipping during all Project phases are assessed as not significant.</p>

NOTE:

¹ Construction Phase = C; Operation Phase = O; Decommissioning Phase = D

² See Section 20 (Summary of Mitigation Measures) for a full list of mitigation measures.

5.10.4.2 Summary of Cumulative Effects on Wildlife Resources

The Project's contribution to cumulative effects related to loss or change in habitat, risk of injury or mortality, and sensory disturbance or behavioural alterations for terrestrial wildlife and marine birds will be primarily local and affect a few individual animals of the regional populations (see Section 5.6, Table 5.6-15). Consequently, the Project's contribution to cumulative effects will not affect the long-term sustainability of key species or local or regional wildlife populations. Accordingly, the Project's contribution to cumulative effects is assessed as not significant.

Cumulative effects on terrestrial wildlife and marine birds from all past, current and foreseeable future project, including the Project's contribution, from loss or change in habitat, increased risk of mortality, and sensory disturbance or behavioural alterations are not anticipated to adversely affect the long-term viability of populations of terrestrial wildlife or marine birds and therefore are assessed as not significant.

5.10.5 Freshwater and Estuarine Fish and Fish Habitat

5.10.5.1 Summary of Project Residual Effects on Freshwater and Estuarine Fish and Fish Habitat

The Project effects on freshwater and estuarine fish and fish habitat are changes in fish habitat and habitat quality, physical injury or mortality to fish, and change in fish health. Table 5.10-6 summarizes Project residual effects on freshwater and estuarine fish and fish habitat.

Table 5.10-6: Summary of Project Residual Effects on Freshwater and Estuarine Fish and Fish Habitat

Valued Component ¹	Potential Effects	Key Mitigation Measures ²	Significance Analysis of Residual Effects
Facility Activities and Works			
Freshwater and estuarine fish and fish habitat (C)	Changes in fish habitat	<ul style="list-style-type: none"> ▪ Measures to protect fish and fish habitat will be provided in various EMPs including a Fish Habitat Offsetting Plan, an Erosion and Sediment Control Plan, a Surface Water Management Plan, and a Wastewater Management Plan. (Mitigation 5.7-6). ▪ A Fish Habitat Offsetting Plan will be developed and implemented to offset unavoidable permanent alteration or destruction of fish habitat from Project activities and works. The Plan will be developed in consultation with DFO, Haisla Nation, and key stakeholders (Mitigation 5.7-8). 	Not significant. PAD will be mitigated through offsetting, in accordance with a <i>Fisheries Act</i> authorization for the Project. Therefore, the potential effects on changes in fish habitat quality have a low likelihood of leading to residual effects. Given the legislative requirements of the <i>Fisheries Act</i> , changes in fish habitat are assessed as not significant.

Valued Component ¹	Potential Effects	Key Mitigation Measures ²	Significance Analysis of Residual Effects
Freshwater and estuarine fish and fish habitat (C, O)	Change in risk of physical injury or mortality to fish	<ul style="list-style-type: none"> ▪ If isolating freshwater habitats during instream works occurs, fish will be salvaged and relocated to unaffected habitats (Mitigation 5.7-3). ▪ To minimize impact to fish and fish habitat, instream works will occur within the relevant reduced risk work windows, where practicable. Where Project activities need to occur outside the reduced risk work windows, measures to protect fish and fish habitat will be developed in consultation with appropriate regulatory bodies including DFO. These measures will be detailed in the Fish Habitat Offsetting Plan (Mitigation 5.7-5). ▪ Measures to protect fish and fish habitat will be provided in various EMPs including a Fish Habitat Offsetting Plan, an Erosion and Sediment Control Plan, a Surface Water Management Plan, and a Wastewater Management Plan (Mitigation 5.7-7). ▪ To protect fish from injury and mortality, freshwater habitats to be affected by construction activities will be isolated from adjacent fish-bearing aquatic habitats (Mitigation 5.7-9). ▪ Water use will be managed under an operational water management plan and licence issued by the respective provincial agency (Mitigation 5.7-10). ▪ Water intake design will minimize the risk of injury and mortality to fish, and will take into consideration the risk of entrainment of planktonic eulachon larvae during seaward migrations (Mitigation 5.7-11). 	<p>Not significant.</p> <p>With the application of mitigation measures, the potential change in risk of physical injury or mortality to freshwater or estuarine fish species in the LSA will not affect the sustainability of fish populations during the construction or operation phases. Any such residual effect has a low likelihood of occurrence and is assessed to be not significant.</p>

NOTES:

¹ Construction Phase = C; Operation Phase = O

² See Section 20 (Summary of Mitigation Measures) for a full list of mitigation measures.

5.10.5.2 Summary of Cumulative Effects on Freshwater and Estuarine Fish and Fish Habitat

Cumulative effects from the Project will be local and will not lead to population effects on eulachon or Pacific salmon. As a result, the Project will not affect the long-term sustainability of regional fish populations and cumulative effects are assessed to be not significant.

5.10.6 Marine Resources

5.10.6.1 Summary of Project Residual Effects on Marine Resources

The Project effects on marine resources are change in fish habitat at the LNG facility; change in fish health at the LNG facility as a result of toxicity; harm to fish and marine mammals at the LNG facility; change in behaviour of fish or marine mammals due to underwater noise or pressure waves at the LNG facility; and change in behaviour of fish or marine mammals due to underwater noise or pressure waves from shipping. Table 5.10-7 summarizes Project residual effects on marine resources.

5.10.6.2 Summary of Cumulative Effects on Marine Resources

Cumulative effects on fish habitat from past, present, and foreseeable future projects are assessed as low in magnitude, restricted to the facility RSA, continuous, reversible, and not significant. Due to the negligible magnitude of Project effects on fish habitat, and the low magnitude of past, present, and foreseeable project cumulative effects, the Project contribution to cumulative effects on fish habitat in the facility RSA will not adversely affect the long-term viability of populations of fish species that support or are part of CRA fisheries, or fish species at risk.

Cumulative effects on fish health are assessed as not significant and will not adversely affect the viability of fish populations (including species at risk), and it is unlikely that individual fish species at risk will be affected. Levels of contaminants at other sites in the facility RSA are likely to be similar or lower than those at the Project site, and similar mitigation measures are expected to be used for all projects. Deposition of cleaner sediment over dispersed contaminants is expected to occur at all sites.

Cumulative harm to fish or marine mammals from past, current and foreseeable future projects through construction activities is anticipated to be moderate in magnitude, because of the use of mitigation measures. These effects are assessed as short term and not significant. The Project is expected to contribute to these cumulative effects, but not substantially. The resulting cumulative effect will be moderate in magnitude, short term in duration, and not significant because the population viability of fish, marine mammals, or species at risk will not be affected, and *threatened* or *endangered* species are not expected to be harmed.

Table 5.10-7: Summary of Project Residual Effects on Marine Resources

Valued Component ¹	Potential Effects	Key Mitigation Measures ²	Significance Analysis of Residual Effects
Facility Activities and Works			
Marine resources (C)	Change in fish habitat	<ul style="list-style-type: none"> ▪ A Fish Habitat Offsetting Plan will be developed and implemented to offset unavoidable permanent alteration or destruction of fish habitat from Project activities and works. The Plan will be developed in consultation with DFO, Haisla Nation, and key stakeholders (Mitigation 5.7-8). ▪ If and where quay walls/slopes are required, use materials that promote post-construction colonization of marine algae and invertebrate communities (Mitigation 5.8-1). ▪ Develop and implement a Marine Activities Plan (MAP) in accordance with applicable federal and provincial legislation and regulations. The MAP will include measures to address potential effects from dredge activities, pile installation (including marine mammal exclusion zone, soft start procedures and consideration of sound dampening technologies) and shipping (Mitigation 5.8-2). ▪ Construction of the marine terminal does not currently plan for blasting in the marine environment. If blasting is determined to be required, it will comply with all regulatory requirements (Mitigation 5.8-3). ▪ A Disposal at Sea Permit will be obtained prior to any sediment disposal in the marine environment. A disposal site will be selected in consultation with Environment Canada, DFO, affected Aboriginal Groups, and key stakeholders (Mitigation 5.8-4). ▪ Vessels arriving at the marine terminal will comply with legislation and regulations on the management of ballast water. LNG Canada may conduct random audits of vessel logs. No ballast will be discharged until compliance has been determined. Only clean ballast from segregated ballast tanks will be allowed to be discharged into the sea at the marine terminal (Mitigation 5.8-5). 	<p>Not significant.</p> <p>With implementation of the Fish Habitat Offset Plan, there will be no net loss in total area or productive capacity of fish habitat. Consequently, the change in fish habitat is expected to be negligible and reversible, and there is a low likelihood that the anticipated change in fish habitat will affect viability of fish populations that support or are part of CRA fisheries, or fish species at risk. With mitigation and offsetting measures, change in fish habitat as a result of Project activities is assessed as not significant.</p>

Valued Component ¹	Potential Effects	Key Mitigation Measures ²	Significance Analysis of Residual Effects
Marine resources (C)	Change in fish health as a result of toxicity	<ul style="list-style-type: none"> ▪ Develop and implement a Marine Activities Plan (MAP) in accordance with applicable federal and provincial legislation and regulations. The MAP will include measures to address potential effects from dredge activities, pile installation (including marine mammal exclusion zone, soft start procedures and consideration of sound dampening technologies) and shipping (Mitigation 5.8-2). ▪ In-water marine construction, dredging, and sediment disposal activities will be conducted throughout the year. For the periods outside the timing windows of least risk, additional mitigation measures will be implemented to protect sensitive species and life stages as appropriate. Timing windows and mitigations will be developed in consultation with DFO at the permitting stage and will consider the location and timing of sensitive life stages specific to CRA fishery species (Mitigation 5.8-6). ▪ Optimization of sediment containment will be considered when selecting dredging and sediment disposal methods/equipment (Mitigation 5.8-7). ▪ Full assessment of effects of the selected sediment disposal methods and use of mitigation measures, with details to be provided in the Disposal at Sea Permit application (Mitigation 5.8-8). ▪ Movement of barge anchors will be minimized to limit sediment disturbance (Mitigation 5.8-9). ▪ A Disposal at Sea Permit will be obtained prior to any sediment disposal in the marine environment. A disposal site will be selected in consultation with Environment Canada, DFO, affected Aboriginal Groups, and key stakeholders (Mitigation 5.8-4). 	<p>Not significant.</p> <p>Any adverse change in fish health will be short term and low in magnitude, and will not affect the population viability of any fish species (including species at risk), and no <i>endangered</i> or <i>threatened</i> fish species are likely to be harmed as a result of toxicity. Effects will be limited to the facility LSA and will be reversible. The natural deposition of clean material over any dispersed contaminants following dredging, combined with removal of sediment containing high PAH levels from the dredge area, will result in a net improvement in fish health due to reduced exposure to contamination. Therefore, change in fish health as a result of toxicity related to the LNG facility is assessed as not significant.</p>

Valued Component ¹	Potential Effects	Key Mitigation Measures ²	Significance Analysis of Residual Effects
Marine resources (C, D)	Harm to fish and marine mammals	<ul style="list-style-type: none"> ▪ Develop and implement a Marine Activities Plan (MAP) in accordance with applicable federal and provincial legislation and regulations. The MAP will include measures to address potential effects from dredge activities, pile installation (including marine mammal exclusion zone, soft start procedures and consideration of sound dampening technologies) and shipping (Mitigation 5.8-2). ▪ For marine pile installation, LNG Canada will proactively manage pile installation with noise measurement and active monitoring of marine mammal exclusion zones (see MAP for more detail). Additional sound dampening methods and/or alternative pile installation methods will be investigated and applied if necessary, to prevent the exposure of marine mammals to underwater noise exceeding defined thresholds. These methods and the defined thresholds will be described in the MAP (Mitigation 5.8-10). ▪ In-water marine construction, dredging, and sediment disposal activities will be conducted throughout the year. For the periods outside the timing windows of least risk, additional mitigation measures will be implemented to protect sensitive species and life stages as appropriate. Timing windows and mitigations will be developed in consultation with DFO at the permitting stage and will consider the location and timing of sensitive life stages specific to CRA fishery species (Mitigation 5.8-6). ▪ Prior to isolation of the salt marsh habitat immediately north of the dredge area, fish using the area will be captured with a beach seine net strung across tidal channels. Fish will be relocated to more suitable areas in the marine resources facility RSA that will not be affected by Project activities (Mitigation 5.8-11). ▪ A Disposal at Sea Permit will be obtained prior to any sediment disposal in the marine environment. A disposal site will be selected in consultation with Environment Canada, DFO, affected Aboriginal Groups, and key stakeholders (Mitigation 5.8-4). ▪ Full assessment of effects of the selected sediment disposal methods and use of mitigation measures, with details to be provided in the Disposal at Sea Permit application (Mitigation 5.8-8). ▪ Optimization of sediment containment will be considered when selecting dredging and sediment disposal methods/equipment (Mitigation 5.8-7). ▪ Construction of the marine terminal does not currently plan for blasting in the marine environment. If blasting is determined to be required, it will comply with all regulatory requirements (Mitigation 5.8-3). 	<p>Not significant.</p> <p>The number of individual fish of CRA fishery species potentially harmed is anticipated to be only a small proportion of the total population sizes in the facility RSA (i.e., fish stocks managed in DFO FMA 6-1). Harm to a limited number of individual fish will not affect population viability of species that support or are part of CRA fisheries, and no harm to <i>endangered</i> or <i>threatened</i> fish species is anticipated. Consequently, harm to fish that support or are part of CRA fisheries, and to fish species at risk, is assessed as negligible and not significant.</p> <p>Implementation of mitigation measures will reduce the potential for marine mammals to be exposed to noise above the injury threshold and the extent of noise and, combined with the low estimated abundance of marine mammals in the facility LSA, the number of individuals anticipated to be exposed to noise above injury thresholds is low. There is a lower likelihood of affecting <i>threatened</i> or <i>endangered</i> marine mammal species, given their estimated low abundance near the facility LSA. With mitigation, there is a low likelihood of harm and affecting the viability of marine mammal populations, and of causing harm to <i>threatened</i> or <i>endangered</i> species. The harm to marine mammals is assessed as not significant.</p>

Valued Component ¹	Potential Effects	Key Mitigation Measures ²	Significance Analysis of Residual Effects
Marine resources (C, D)	Change in behaviour of fish or marine mammals due to underwater noise or pressure waves	<ul style="list-style-type: none"> ▪ Develop and implement a Marine Activities Plan (MAP) in accordance with applicable federal and provincial legislation and regulations. The MAP will include measures to address potential effects from dredge activities, pile installation (including marine mammal exclusion zone, soft start procedures and consideration of sound dampening technologies) and shipping (Mitigation 5.8-2). ▪ For marine pile installation, LNG Canada will proactively manage pile installation with noise measurement and active monitoring of marine mammal exclusion zones (see MAP for more detail). Additional sound dampening methods and/or alternative pile installation methods will be investigated and applied if necessary, to prevent the exposure of marine mammals to underwater noise exceeding defined thresholds. These methods and the defined thresholds will be described in the MAP (Mitigation 5.8-10). ▪ In-water marine construction, dredging, and sediment disposal activities will be conducted throughout the year. For the periods outside the timing windows of least risk, additional mitigation measures will be implemented to protect sensitive species and life stages as appropriate. Timing windows and mitigations will be developed in consultation with DFO at the permitting stage and will consider the location and timing of sensitive life stages specific to CRA fishery species (Mitigation 5.8-6). ▪ Construction of the marine terminal does not currently plan for blasting in the marine environment. If blasting is determined to be required, it will comply with all regulatory requirements (Mitigation 5.8-3). 	<p>Not significant.</p> <p>With mitigation, there is a medium likelihood that Project activities and works during the construction and operation phase will result in change in behaviour of fish that support or are part of CRA fishery species, and fish species at risk. The change in behaviour of fish is anticipated to be low magnitude, long term, and reversible. Temporary changes in behaviour of a limited number of individual fish in the facility RSA will not affect population viability of fish that support or are part of CRA fisheries, or fish species at risk. Consequently, change in behaviour of fish is assessed as not significant.</p> <p>Even with mitigation, pile installation and dredging will increase underwater noise levels above baseline conditions and may exceed the NOAA marine mammal behavioural disruption threshold, leading to a high likelihood of a moderate magnitude residual effect, but in a smaller area than for unmitigated effects. There is a low likelihood that changes in behaviour will affect the population viability of marine mammals (including species at risk). With mitigation, change in behaviour from underwater noise and pressure waves from the LNG facility is assessed as not significant</p>

Valued Component ¹	Potential Effects	Key Mitigation Measures ²	Significance Analysis of Residual Effects
Shipping Activities			
Marine resources (C, O, D)	Change in behaviour of fish or marine mammals due to underwater noise or pressure waves	<ul style="list-style-type: none"> LNG carriers will travel at speeds of 8 knots to 14 knots. Speeds will vary depending on navigational safety, weather conditions, location, and marine mammal presence, and will be determined based on the judgment of the ship's master who receives advice from the BC Coast Pilots on board. Subject to navigational safety needs, in areas of high whale density between the northern end of Campania Island and the southern end of Hawkesbury Island, LNG carriers will travel at speeds of 8 knots to 10 knots from July through October (recognizing periods of high use by marine mammals) (Mitigation 5.8-12). 	<p>Not significant.</p> <p>With implementation of mitigation measures, residual effects from shipping are not anticipated to affect the ongoing viability of marine fish or marine mammal populations (including species at risk), or to cause harm to endangered or threatened species. Mitigation measures will reduce the change in behaviour of fish and marine mammals due to underwater noise or pressure waves. Overall, residual effects from shipping are expected to be low to moderate in magnitude, long-term in duration, extend through the shipping RSA, and to be reversible. Residual effects on marine resources from shipping are assessed as not significant.</p>

NOTES:

¹ Construction Phase = C; Operation Phase = O; Decommissioning Phase = D

² See Section 20 (Summary of Mitigation Measures) for a full list of mitigation measures.

Cumulative effects on fish or marine mammal behaviour from past, current, and foreseeable future projects result from vessel activities along the marine access route and at the marine terminal that add underwater noise above behavioural disruption thresholds. The Project's contribution to cumulative effects from underwater noise or pressure waves in the facility and shipping LSAs is assessed as not significant because the effects are low in magnitude and reversible. Cumulative effects on behaviour will not affect the ongoing viability of fish populations (including species at risk). The Project's contribution to the cumulative change in behaviour of marine mammals is assessed as not significant because of mitigation measures that will reduce the areal extent of underwater noise and reduce the time marine mammals are exposed to that noise. The Project's contribution to cumulative effects on behaviour is expected to be moderate in magnitude and is assessed as not significant for marine mammals, although there is low confidence in this prediction because of uncertainties in population-level effects from changes in behaviour. The increase in vessel transits will increase the time when the behavioural disruption threshold is exceeded, but it is anticipated that for most species, when compared to provincial population estimates, relatively low numbers of marine mammals will be affected and their population viability will not be affected.

Cumulative effects on fish from all past, current, and foreseeable future project, including the Project's contribution, from change in fish habitat, change in fish health as a result of toxicity, harm to fish and change in behaviour of fish are not anticipated to adversely affect the long-term viability of populations of fish species. Cumulative effects on marine mammals from all past, current, and foreseeable future project, including the Project's contribution, from harm and changes in behaviour are not expected to adversely affect population viability, although there is low confidence due to uncertainties associated with population-level effects from changes in behaviour.

5.10.7 Surface Water Quality

5.10.7.1 Summary of Project Residual Effects on Surface Water Quality

The Project effects on surface water quality are change in acidification potential and change in trophic status causing eutrophication. Table 5.10-8 summarizes Project residual effects on surface water quality.

Table 5.10-8: Summary of Project Residual Effects on Surface Water Quality

Valued Component ¹	Potential Effects	Key Mitigation Measures ²	Significance Analysis of Residual Effects
Facility Activities and Works			
Surface water quality (O)	Change in acidification potential	<ul style="list-style-type: none"> ▪ Manage, through Project engineering design and operational procedures, the continuous NOx emissions associated with the gas turbine exhaust to meet regulatory requirements (Mitigation 5.2-5). ▪ Diesel fired equipment will be powered by low sulphur fuel (Mitigation 5.2-7). 	Not significant. With mitigation and environmental protection measures, residual effects on acidification potential are not significant.
Surface water quality (O)	Change in trophic status causing eutrophication	<ul style="list-style-type: none"> ▪ Manage, through Project engineering design and operational procedures, the continuous NOx emissions associated with the gas turbine exhaust to meet regulatory requirements (Mitigation 5.2-5). 	Not significant. With mitigation and environmental protection measures, residual effects on trophic status causing eutrophication are not significant.

NOTES:

¹ Operation Phase = O

² See Section 20 (Summary of Mitigation Measures) for a full list of mitigation measures.

5.10.7.2 Summary of Cumulative Effects on Surface Water Quality

Cumulative change in acidification potential and change in trophic status from past, present, and foreseeable future projects are low in magnitude, restricted to the LSA, continuous (throughout the operation), and reversible. As such, cumulative effects are assessed as not significant.