

PART B—ASSESSMENT OF POTENTIAL EFFECTS,
MITIGATION AND SIGNIFICANCE OF RESIDUAL EFFECTS

Environmental Assessment Certificate Application

LNG Canada Export Terminal

Section 4 – Assessment Methods

October 2014



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4 ASSESSMENT METHODS

This section describes the assessment methods used in this Application. Any VC-specific modifications to these methods are provided in the VC sections. The assessment methods meet the requirements of BCEAA and CEEA 2012 and are based on the EAO “*Guideline for the Selection of Valued Components and Assessment of Potential Effects*” (EAO 2013). These methods use a structured approach that first identify and assess the potential effects of the Project and second, determine the contribution of potential Project residual effects to cumulative effects. As indicated in Section 2.2, the scope of the Project and scope of the assessment follow the requirements of both BCEAA and CEEA 2012, as set out in the section 11 Order.

Key steps in the effects assessment (Figure 4.0-1) are to:

1. identify key issues and associated VCs that are relevant to the Project and the assessment that reflect BCEAA requirements and the environmental effects to be considered as identified in section 5 of CEEA 2012
2. define the scope of assessment for each VC:
 - a. regulatory/policy setting
 - b. key issues (potential effects)
 - c. establish assessment boundaries for each VC (spatial, temporal, technical and administrative)
 - d. measurable parameters and significance thresholds
 - e. information limitations
 - f. traditional knowledge (TK) and traditional use (TU) information considered, and
 - g. role of consultation in the assessment.
3. review baseline conditions in the local and regional study areas based on existing information, TK and TU information, and data collected for the Project
4. assess potential effects by:
 - a. predicting measurable interactions between the Project and VCs
 - b. identifying potential effects including the environmental effects identified in Sections 5 (1)(a) and (b) and 5(2) of CEEA 2012
 - c. developing mitigation measures for potential effects
 - d. characterizing predicted residual effects
 - e. determining likelihood of predicted residual effects
 - f. determining significance of predicted residual effects, and

- g. assessing the level of confidence and risk in the significance prediction.
5. assess cumulative effects, which involves:
 - a. identifying past, present and reasonably foreseeable projects or activities that could potentially interact in a cumulative fashion with predicted Project residual effects
 - b. establishing the context for cumulative effects
 - c. determining the potential for the Project to interact cumulatively with other projects and activities
 - d. determining the significance of cumulative effects, resulting from Project residual effects in combination with those of other projects and activities:
 - description of cumulative effects
 - mitigation of cumulative effects
 - characterization of predicted cumulative effects
 - likelihood of cumulative effects
 - significance of cumulative effects
 - characterization of the change in cumulative effects attributable to the Project, and
 - confidence and risk.
6. develop a follow-up program and compliance monitoring as required to validate predicted effects and assess the effectiveness of mitigation measures.

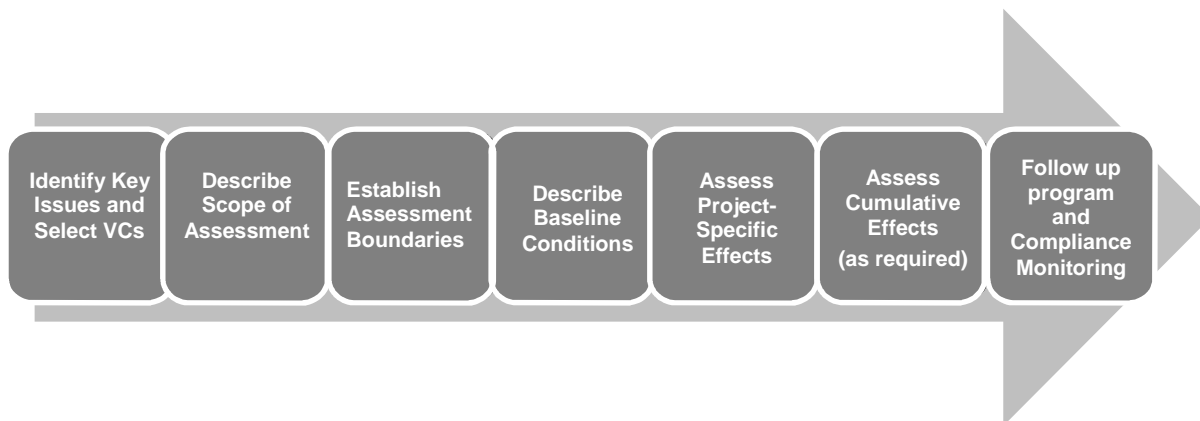


Figure 4.0-1: Key Steps in the Effects Assessment

4.1 Valued Components

VCs are components of the natural and human environment that are considered by LNG Canada, the public, Aboriginal Groups, scientists, technical specialists, and government agencies involved in the assessment process to have scientific, ecological, economic, social, cultural, archaeological, historical or other importance (EAO 2013).

Candidate VCs for consideration in the assessment were identified on the basis of issues scoping with input from the EAO and Working Groups. Table 4.1-1 sets out the candidate VCs for consideration in Part B of the assessment, along with the rationale for their inclusion or exclusion in the assessment. VCs were selected for inclusion in the assessment through the development of the VC Scoping Document and the AIR, in consultation with the EAO and the Working Groups, to ensure effective, efficient, and focused analysis of potential effects. The Working Groups include Aboriginal Groups, government agencies, and key stakeholders. Also taken into consideration was feedback from the general public, and the professional experience and judgment of the study team.

Table 4.1-1: VC Selection for the Project

Candidate VC	Included/ Excluded in the Assessment	Rationale for Inclusion or Exclusion
Environment		
Air Quality	Included	<ul style="list-style-type: none"> ▪ The LNG facility and marine shipping traffic will have air emissions; there is the potential to affect air quality within the Kitimat airshed. ▪ Air emissions from the LNG facility will be regulated by the Waste Discharge Regulation (under the <i>Environmental Management Act</i>). ▪ The <i>Canadian Environmental Protection Act, 1999</i> mandates the reporting of certain air emissions to the National Pollutant Release Inventory. ▪ Aboriginal Groups and local communities (including Kitimat and Terrace) are concerned about air emissions.
GHG Management	Included (with modified methods based on CEA Agency [2003] guidance)	<ul style="list-style-type: none"> ▪ The Project will emit GHGs from both the LNG facility and marine shipping. ▪ The BC Government's Reporting Regulation (2009), pursuant to the <i>Greenhouse Gas Reduction (Cap and Trade) Act</i>, requires reporting of GHG emissions from BC facilities emitting 10,000 tonnes or more of CO₂ equivalent emissions per year. ▪ The <i>Canadian Environmental Protection Act, 1999</i> mandates the reporting of GHG emissions to Environment Canada's Greenhouse Gas Emissions Reporting Program. ▪ Aboriginal Groups are concerned with potential effects of GHG emissions.

Candidate VC	Included/ Excluded in the Assessment	Rationale for Inclusion or Exclusion
Acoustic Environment	Included (excluding vibration)	<ul style="list-style-type: none"> ▪ The LNG facility will have acoustic emissions that may reach adjacent residential and business areas, as well as recreation, parks and other protected or traditional use areas. These emissions have the potential to affect sensitive receptors in the surrounding area. ▪ Marine shipping activities may have acoustic emissions that could reach communities along the marine access route. ▪ The OGC requires oil and gas facilities to meet the British Columbia Noise Control Best Practices Guideline (2009). ▪ Health Canada recommends consideration of noise effects for assessments of projects subject to federal regulatory jurisdiction. ▪ The level of vibration at the nearest receptor is expected to be below the threshold of perception. Pile driving, for example, is not expected to exceed 0.1 mm/s at a distance of 400 m. The nearest receptor is located more than 1.5 km away. As a result, vibration is excluded from the assessment. ▪ Aboriginal Groups and local communities are concerned about acoustic emissions from the Project.
Soils	Excluded (relevant information included under vegetation resources VC)	<ul style="list-style-type: none"> ▪ The Project is not located within an agricultural land reserve (ALR). ▪ The soils directly affected by the Project will be limited to the Project footprint. Proven standard industry practices for salvage of topsoil will be undertaken and LNG Canada will incorporate erosion and sediment control measures. ▪ The effect on the quality of soils from potential acid deposition (from air emissions) is addressed under the vegetation resources VC because the primary concern is subsequent effects on vegetation from soils acidification.
Vegetation Resources	Included	<ul style="list-style-type: none"> ▪ Site clearing and preparation will remove all vegetation from the Project footprint and may affect vegetation indirectly through the introduction of non-native invasive species or changes in abiotic conditions (e.g., air emissions, soil moisture, or light levels). ▪ Regional land use plans and the BC Conservation Framework have established objectives for maintaining vegetation biodiversity. ▪ The Environmental Protection and Management Regulation (under OGAA) establishes objectives for the protection of old growth management areas and control of invasive plants for oil and gas activities. ▪ Aboriginal Groups are concerned about potential loss of traditional use and culturally important plants due to facility site clearing and any effects on traditional use and culturally important plants due to air emissions.

Candidate VC	Included/ Excluded in the Assessment	Rationale for Inclusion or Exclusion
Wildlife Resources	Included	<ul style="list-style-type: none"> ▪ Site clearing will remove existing habitat from the Project footprint and potentially influence wildlife movement corridors. Operational activities occurring in the marine environment may affect marine birds (e.g., noise) and emissions from operation activities may result in acidification of water bodies that could affect amphibians. ▪ The <i>Migratory Birds Convention Act</i>, <i>Species at Risk Act</i>, <i>Wildlife Act</i>, <i>Environmental Protection and Management Regulation</i> (under OGAA) and <i>Water Regulation</i> (under the <i>Water Act</i>) jointly provide various levels of protection to wildlife resources and specific wildlife habitats. ▪ Section 5 of CEAA 2012 requires assessment of environmental effects on migratory birds, as defined under the <i>Migratory Birds Convention Act</i>. ▪ The Project has potential to affect SARA listed wildlife resources. Section 79(2) of SARA requires that all adverse effects to SARA listed species must be identified, avoided, lessened, and monitored. ▪ FLNRO is concerned with protecting grizzly bears, connectivity corridors, staging areas, breeding birds and species at risk. ▪ Aboriginal Groups are concerned about potential effects on wildlife species that are hunted or have cultural importance.
Freshwater and Estuarine Fish and Fish Habitat	Included	<ul style="list-style-type: none"> ▪ The Project will affect the Kitimat River estuary, Anderson Creek, and Beaver Creek. It has the potential to affect freshwater and estuarine fish and fish habitats. These areas support fish that have associated commercial, recreational, and Aboriginal (CRA) fisheries. ▪ The <i>Fisheries Act</i> regulates activities that may affect fish or fish habitat. These include activities that are pertinent to this project, such as introduction of barriers (s.20), modification of flows (s.20), permanent alteration or destruction of habitat (s.35), and deposition of deleterious substances (s.36). ▪ Section 5 of CEAA 2012 requires assessment of environmental effects on fish and fish habitat, as defined under the <i>Fisheries Act</i>, and aquatic species, as defined in the <i>Species at Risk Act</i>. ▪ The provincial <i>Environmental Protection and Management Regulation</i> and <i>Water Regulation</i> require the protection of water quality and habitat during works occurring in and about a stream. ▪ Aboriginal Groups and stakeholders are concerned about potential effects on fish, including salmon and eulachon.

Candidate VC	Included/ Excluded in the Assessment	Rationale for Inclusion or Exclusion
Marine Resources	Included	<ul style="list-style-type: none"> ▪ The Project's components and activities (e.g., dredging, marine pile installation, marine terminal construction, and marine shipping) will interact with the marine environment and have the potential to affect marine resources. ▪ Underwater noise from shipping and terminal construction may affect fish and marine mammals. ▪ The <i>Fisheries Act</i> regulates activities that may affect fish or fish habitat including harm to fish (s.32) permanent alteration or destruction of habitat (s.35), and deposition of deleterious substances (s.36). ▪ Section 5 of CEAA 2012 requires assessment of environmental effects on fish and fish habitat, as defined under the <i>Fisheries Act</i>, and aquatic species (including marine plants), as defined in the <i>Species at Risk Act</i>. This includes marine mammals, which are considered 'fish' under the <i>Fisheries Act</i> and Marine Mammal Regulations. ▪ The Project has potential to affect SARA listed marine resources. Section 79(2) of SARA requires that all adverse effects to SARA listed species must be identified, avoided, lessened, and monitored. ▪ Bilge and ballast discharge are regulated by the <i>Ballast Water Control and Management Regulations</i> (SOR 2011-237) under the <i>Canada Shipping Act 2001</i> and by the International Convention for the Prevention of Pollution from Ships (MARPOL). ▪ Aboriginal Groups and the local communities are concerned about potential effects on marine country foods including fish, seaweeds, shellfish, and marine mammals that are harvested or have cultural, ecological or economic importance.
Surface Water Quality (freshwater)	Included	<ul style="list-style-type: none"> ▪ Deposition from acidifying emissions may affect freshwater quality. ▪ Air, stormwater, and treated effluent discharges from the LNG facility will be regulated by the Waste Discharge Regulation (under the <i>Environmental Management Act</i>). ▪ Aboriginal Groups and stakeholders are concerned about the potential effects of acidifying air emissions from the Project.
Surface Water Quantity	Excluded (included as part of Freshwater and Estuarine Fish and Fish Habitat VC)	<ul style="list-style-type: none"> ▪ Project water will be supplied from the Kitimat River under authorization (s.1, <i>Water Act</i>) ▪ A report on site water intake quantity will be made available, concurrent to the Application that includes a quantitative analysis and assessment of water availability, based on Kitimat River hydrometric monitoring and consideration of other water users. ▪ The indirect effect of Project induced changes in water flow in the Kitimat River on freshwater fish is addressed in the freshwater and estuarine fish and fish habitat VC.
Groundwater Quality and Quantity	Excluded	<ul style="list-style-type: none"> ▪ The Project does not rely on groundwater resources and, therefore, will not alter subsurface water quantity (i.e., flow direction, water levels) in the shallow groundwater system. ▪ Rain water is the lone source of recharge to the shallow groundwater system at the LNG facility site and is the primary influence on shallow groundwater chemistry. Stormwater and wastewater source controls identified in the Project "Operational Water Management Plan" will manage and maintain site surface water quality, prior to releasing to the Kitimat River and the marine environment.

Candidate VC	Included/ Excluded in the Assessment	Rationale for Inclusion or Exclusion
Economic		
Economic Conditions	Included	<ul style="list-style-type: none"> ▪ BCEAA requires consideration of adverse economic effects. ▪ Municipal, provincial, and federal governments are interested in economic effects of major projects. ▪ Aboriginal Groups are concerned about the potential adverse economic effects of the Project.
Social		
Infrastructure and Services	Included	<ul style="list-style-type: none"> ▪ Potential for in-migration of temporary and permanent populations, leading to increased demand for regional infrastructure and services. ▪ Potential for displacement of low-income households. ▪ Aboriginal Groups and stakeholders are concerned with potential effects of the Project on infrastructure and services in their communities.
Land Use	Excluded	<ul style="list-style-type: none"> ▪ The Project is sited on private land and, therefore, will not directly affect public or tenured uses of Crown land. Effects on public recreation are considered in 1) infrastructure and services and 2) marine transportation and use. Effects on Aboriginal Groups as a result of any change to the current use of lands and resources for traditional purposes (as required by CEAA 2012) are considered in Sections 14 and 15.
Visual Quality	Included	<ul style="list-style-type: none"> ▪ The Project may alter visual quality from a number of important terrestrial and marine based viewpoints due to the presence of the LNG facility and the movement of LNG carriers along the marine access route. ▪ Changes in visual quality may affect tourism, recreation and quality of life. ▪ Aboriginal Groups and stakeholders are concerned about the effects of the LNG facility and related marine shipping on visual quality from marine- and shore-based viewpoints. ▪ Light beyond the Project boundary and emanating from the marine access route may be an aesthetics issue or a hazard to wildlife as a result of disorientation.
Odour	Excluded	<ul style="list-style-type: none"> ▪ Odour will not be a concern since the gas used will be 'sales quality natural gas' and, therefore, will contain only a small concentration of reduced sulphur compounds. All of the reduced sulphur compounds are stripped out as the gas enters the LNG facility and are incinerated. ▪ Sulphur fuel oil limits were recently imposed for all vessels within Canadian waters (MARPOL Annex VI). These limits require an 86% reduction in sulphur content in fuel relative to 2012 levels. Odours are typically associated with sulphur emissions; therefore, odours associated with marine shipping are not anticipated.
Marine Transportation & Use	Included	<ul style="list-style-type: none"> ▪ The marine terminal and associated safety zone may interfere with navigation and CRA fisheries and have the potential to affect marine transportation and use in the Kitimat area. ▪ Approval under the <i>Navigation Protection Act</i> may be needed for some marine infrastructure components. ▪ Increase in vessel traffic may affect fishing, tourism, public and commercial recreation, public park use, and other marine uses, including Aboriginal use, as well as marine infrastructure in the area. ▪ Aboriginal Groups are concerned about the potential effects of the Project on marine fisheries, recreation and other marine uses.

Candidate VC	Included/ Excluded in the Assessment	Rationale for Inclusion or Exclusion
Community Health and Wellbeing	Included	<ul style="list-style-type: none"> ▪ The Project may place additional demand on health services and infrastructure and may affect community health and wellbeing. ▪ Demographic changes caused by the Project may affect community wellness indicators, such as community stability and personal security. ▪ The Project may affect availability and quality of country foods. ▪ Aboriginal Groups and stakeholders are concerned about the potential effects of the Project on the health and resilience of their communities.
Heritage		
Archaeological and Heritage Resources	Included	<ul style="list-style-type: none"> ▪ Construction of the LNG facility and associated infrastructure will result in ground disturbance and tree removal; therefore, it has the potential to affect archaeological and heritage resources. ▪ BCEAA requires consideration of adverse effects on heritage resources. ▪ Section 5(2)(b) of CEAA 2012 requires consideration of Aboriginal physical and cultural heritage and of any structure, site or object of historical or archaeological significance. Requirements under section 5(1)(c) are discussed in Sections 8.2 and 15. ▪ The <i>Heritage Conservation Act</i> protects heritage and archaeological resources that pre-date AD 1846 as well as Aboriginal rock art and human remains, regardless of their age. The Act also protects heritage wrecks more than two years in age. Sites that post-date AD 1846 are also protected if they have been designated by the Minister as provincial heritage sites under the <i>Heritage Conservation Act</i>. ▪ Aboriginal archaeological and heritage sites (including those that post-date AD 1846) provide a record of traditional use of the land by Aboriginal Groups. ▪ Aboriginal Groups are concerned with potential effects on archaeological and cultural heritage resources.
Health		
Human Health	Included	<ul style="list-style-type: none"> ▪ The Project will have air emissions that might directly or indirectly affect human health. ▪ The Project will have the potential to affect vegetation, surface water quality and sediment quality, and these might provide a pathway for uptake of contaminants in humans. ▪ Aboriginal Groups and stakeholders are concerned with potential health effects associated with the Project.

Input on the VC Scoping Document (dated May 16, 2013) and on the first or second draft (or both) of the AIR (dated August 14, 2013 and November 8, 2013, respectively) was received from the public and the following government agencies and Aboriginal Groups:

- provincial agencies:
 - EAO
 - Ministry of Community, Sport and Cultural Development (MCSCD)
 - MOE
 - MOTI
 - FLNRO
 - Ministry of Health
 - Northern Health, and
 - OGC.
- federal agencies:
 - CEA Agency
 - Transport Canada
 - Environment Canada
 - DFO, and
 - Health Canada.
- municipal and regional agencies:
 - District of Kitimat, and
 - City of Terrace.
- Kitimat Fire and Rescue Services
- Aboriginal Groups
 - Haisla Nation
 - Gitga'at First Nation
 - Gitxaala Nation
 - Kitselas First Nation
 - Kitsumkalum First Nation
 - Lax Kw'alaams First Nation, and
 - Metlakatla First Nation.

The following criteria guided the final selection of VCs:

- 1 The VC must represent an aspect of one of the five pillars of BCEAA (environment, economic, social, heritage or health).

The VC must be a receptor and susceptible to adverse effects resulting from interaction with the Project (“Project-VC interactions”).

The nature of Project-VC interactions (direct or indirect) must be clearly understood.

Adverse effects on the VC must be meaningful and measurable.

These adverse effects should be of concern to regulators, Aboriginal Groups, resource managers, scientists, and the general public.

The selection of VCs must enable the assessment of the potential environmental effects identified in sections 5(1)(a) and (b) and 5(2) of CEAA 2012.

Several other factors contributed to VC selection:

- knowledge of the Project, including its components and activities
- potential effects of the Project on the biophysical and human environment
- requirements of BCEAA
- requirements of CEAA 2012
- discussions with technical experts and various provincial and federal agencies
- consultations with Aboriginal Groups
- consultations with stakeholders
- review of and findings from recent studies or assessments in the region
- professional judgment based on experience of the assessment team, and
- benefits of grouping similar candidate VCs that are affected by the same or similar effects under a common VC.

Potential project effects and measurable parameters for each selected VC were identified using the professional judgment of the assessment team and in response to the issues and concerns raised by Aboriginal Groups, the public, and stakeholders. Measurable parameters were identified to facilitate quantitative or qualitative measurement of potential Project effects and cumulative effects. Measurable parameters provide a means to determine the level or amount of change to a VC. The Project effects considered in the assessment and the measurable parameters identified to measure Project effects on each selected VC are listed in Table 4.1-2. Some measurable parameters are not consistent with those listed in the AIR. The rationale for these changes is provided in the VC sections.

Table 4.1-2: Potential Project Adverse Effects and Measurable Parameters

Valued Component	Topics Addressed in the Assessment	Potential Adverse Effects	Measurable Parameters
Environment			
Air quality	<ul style="list-style-type: none"> Criteria Air Contaminants (LNG facility and marine shipping) Ozone Acidifying air emissions (i.e., NO₂ and SO₂) (facility) 	Change in ambient air quality in the Kitimat airshed or along the marine access route	<ul style="list-style-type: none"> Estimated levels of criteria air contaminants (CACs): SO₂, NO₂, CO, PM_{2.5}, H₂S and VOC
Greenhouse gas management	<ul style="list-style-type: none"> Greenhouse Gases 	Emission of GHG from LNG facility and marine shipping	<ul style="list-style-type: none"> Anticipated GHG emissions (CO₂, CH₄, N₂O, expressed as CO₂e) from Project activities
Acoustic environment	<ul style="list-style-type: none"> Sound levels (LNG facility and marine shipping) 	Change (increase) in overall noise levels	<ul style="list-style-type: none"> Overall equivalent continuous A-weighted (dBA) daytime and nighttime sound level (L_d and L_n) A-weighted (dBA) daytime and nighttime equivalent sound level (L_{dn}) Percent Highly Annoyed (%HA)
		Increase in low frequency noise during LNG facility construction and operation	<ul style="list-style-type: none"> The difference between A-weighted and C-weighted (dBA and dBC) daytime sound level (L_d) The difference between A-weighted and C-weighted (dBA and dBC) nighttime sound level (L_n) Linear (dB) daytime and nighttime sound level (L_d and L_n)

Valued Component	Topics Addressed in the Assessment	Potential Adverse Effects	Measurable Parameters
Vegetation resources	<ul style="list-style-type: none"> ▪ Plant species at risk ▪ Ecological communities at risk ▪ Wetlands and wetland function ▪ Old forest ▪ Non-native invasive species ▪ Traditional use plant species ▪ Vegetation health (direct effects of air emissions on vegetation or indirect effects via the soil) 	Change in abundance of plant species of interest (e.g., species at risk, traditional use plant species, non-native invasive species)	<ul style="list-style-type: none"> ▪ Abundance (count, frequency, density or cover) of: <ul style="list-style-type: none"> • federally- or provincially-listed plant species • traditional use plant species • invasive plant species
		Change in abundance or condition of ecological communities of interest	<ul style="list-style-type: none"> ▪ Area (hectares) of: <ul style="list-style-type: none"> • provincially-listed ecological communities • old forest • floodplain associations • wetland ecosystems (by class) ▪ Wetland functions (biogeochemical, hydrological and habitat functions), qualitatively assessed and related to wetland area
		Change in native vegetation health and diversity because of air emissions	<ul style="list-style-type: none"> ▪ Areal extent of sensitive vegetation communities where: <ul style="list-style-type: none"> • critical levels for sulphur dioxide or nitrogen dioxide are predicted to be exceeded • critical loads for nitrogen and sulphur deposition are predicted to be exceeded • critical loads for acid deposition are predicted to be exceeded
Wildlife resources (terrestrial wildlife, marine birds)	<ul style="list-style-type: none"> ▪ Species at risk ▪ Traditional use species ▪ Migratory birds 	Loss or change in habitat for species of interest (e.g., key species, species at risk, traditional use species)	<ul style="list-style-type: none"> ▪ Areal extent of high-, moderate-, and low-value habitat for terrestrial wildlife key species, namely: <ul style="list-style-type: none"> • grizzly bear • Pacific marten • western screech-owl • western sandpiper • harlequin duck • western toad • marbled murrelet
		Risk of injury or mortality	<ul style="list-style-type: none"> ▪ Potential increased mortality to wildlife resources from Project activities (qualitative analysis)
		Sensory disturbance or behavioural alterations	<ul style="list-style-type: none"> ▪ Potential change in movement patterns related to placement of Project infrastructure (qualitative analysis)

Valued Component	Topics Addressed in the Assessment	Potential Adverse Effects	Measurable Parameters
Freshwater and estuarine fish and fish habitat	<ul style="list-style-type: none"> ▪ Fish species part of a commercial, recreational or Aboriginal fishery ▪ Fish species at risk ▪ Fish habitat ▪ Surface water quality and quantity (Kitimat River) ▪ Sediment quality (in terms of the potential for the Project activities to cause flow obstructions or sediment release) 	Changes in fish habitat (i.e., permanent alteration to or destruction of freshwater or estuarine fish habitat including changes in habitat quality and quantity)	<ul style="list-style-type: none"> ▪ Area of fish habitat potentially affected (m²); ▪ Quality (i.e., productivity) of fish habitat potentially affected (habitat units; HU)
		Change in risk of physical injury or mortality to fish (i.e., harm by way of physical injury or mortality to freshwater or estuarine fish species)	<ul style="list-style-type: none"> ▪ Likelihood of harm to fish that are part of commercial, recreational or Aboriginal fisheries, or those considered species at risk (includes likelihood of harm to fish as a result of reduced water flow in Kitimat River)
		Change in fish health	<ul style="list-style-type: none"> ▪ Water quality parameters for fish and fish habitat (e.g., RISC 2001)
Marine resources (fish and fish habitat, marine mammals)	<ul style="list-style-type: none"> ▪ Fish species that support or are part of a commercial, recreational or Aboriginal fishery ▪ Aquatic species as defined under SARA ▪ Fish habitat (e.g., algae and seagrass) ▪ Bilge and ballast waters ▪ Water quality ▪ Sediment quality ▪ Sediment transport ▪ Underwater noise ▪ Wake from LNG carriers vessels 	Change in fish habitat	<ul style="list-style-type: none"> ▪ Total area of fish habitat permanently altered or destroyed (m²) ▪ Productive capacity of fish habitat permanently altered or destroyed (qualitative)
		Harm to fish or marine mammals	<ul style="list-style-type: none"> ▪ Likelihood of harm to fish species that support or are part of CRA fisheries ▪ Likelihood of harm to marine mammals ▪ Likelihood of harm to species at risk
		Change in fish health as a result of toxicity	<ul style="list-style-type: none"> ▪ Chemical composition of sediment and water (unit depends on the contaminant)
		Change in behaviour of fish or marine mammals due to underwater noise or pressure waves	<ul style="list-style-type: none"> ▪ Likelihood of exposure to underwater noise relative to recommended acoustic thresholds
Surface water quality	<ul style="list-style-type: none"> ▪ Water quality of lakes, rivers and streams associated with acidification and eutrophication 	Change in the acidification potential of streams and lakes (related to sulphur dioxide (SO ₂) and nitrogen oxide (NO _x) emissions)	<ul style="list-style-type: none"> ▪ Water chemistry: standard water quality parameters (e.g., total suspended solids, temperature, total phosphorous, dissolved oxygen), major anions (e.g., chloride, sulfate), DOC, pH, alkalinity, major cations (e.g., calcium, magnesium) ▪ Acid neutralising capacity (ANC) ▪ Critical load exceedances (SO₄ and NO_x) ▪ Physical stream characteristics (e.g., catchment area)
		Change in trophic status resulting in eutrophication of lakes and streams (related to N emissions)	<ul style="list-style-type: none"> ▪ Major anions (e.g., sulphate, chloride), nutrients (e.g., total nitrogen, total phosphorus)

Valued Component	Topics Addressed in the Assessment	Potential Adverse Effects	Measurable Parameters
Economic			
Economic conditions	<ul style="list-style-type: none"> ▪ Key economic indicators ▪ Cost of living ▪ Labour market ▪ Goods and services 	Change in labour supply and demand	<ul style="list-style-type: none"> ▪ Labour availability (persons) ▪ Labour force skill levels ▪ Labour wages ▪ Supply of local and regional training programs related to skills required for the Project
		Change in economic activity of other sectors	<ul style="list-style-type: none"> ▪ Cost of living (i.e., housing cost) ▪ Measurements of economic activity (i.e., revenue production) ▪ Change in availability of goods and services
Social			
Infrastructure and services	<ul style="list-style-type: none"> ▪ Demographic composition ▪ Housing and accommodations ▪ Emergency response services ▪ Community recreational resources ▪ Traffic (roads, air and rail) ▪ Transportation infrastructure ▪ Domestic water supply ▪ Sewage and water treatment facilities ▪ Solid waste collection and disposal ▪ Recycling facilities 	Effects on community services and infrastructure	<ul style="list-style-type: none"> ▪ Population/ demographic composition ▪ Demand and supply of community, social and government infrastructure and services (i.e., education facilities, community centres, first responder services, domestic water supply, wastewater, solid waste) ▪ Access and availability of green spaces and land based parks and places of recreation ▪ Parameters based on affected infrastructure and services (i.e., students/educator, police officers/1,000 people) ▪ Local government cost measurements
		Effects on traffic and pressure on transportation infrastructure	<ul style="list-style-type: none"> ▪ Daily road traffic volume (vehicles/day) ▪ Traffic incidents (collisions/year) ▪ Air and rail traffic volumes
		Change in housing availability	<ul style="list-style-type: none"> ▪ Housing supply and demand, including government assisted housing ▪ Indicators of housing affordability

Valued Component	Topics Addressed in the Assessment	Potential Adverse Effects	Measurable Parameters
Visual quality	<ul style="list-style-type: none"> ▪ Visual condition (LNG facility and marine shipping) ▪ Nighttime lighting of the LNG facility and LNG carriers 	Reduction in visual quality related to the LNG facility	<ul style="list-style-type: none"> ▪ Visibility ▪ Existing visual condition (EVC)
		Reduction in visual quality related to LNG carriers in marine access route	<ul style="list-style-type: none"> ▪ Visibility ▪ Frequency, duration, and prominence of LNG carriers within field of view
Marine transportation and use	<ul style="list-style-type: none"> ▪ Marine navigation (includes availability of BC Coast Pilots) ▪ Anchorages ▪ Marine traffic ▪ Wake from LNG carriers ▪ Aboriginal, commercial and recreational fisheries. ▪ Coastal recreation and tourism ▪ Marinas and moorages ▪ BC Coast Pilots 	Interference with marine navigation	<ul style="list-style-type: none"> ▪ Proportion of navigable channel affected by construction and operation of marine terminal, including safety zones
		Change in demand on marina and moorage facilities	<ul style="list-style-type: none"> ▪ Attribute data on marina and moorage facilities (i.e., moorage slips)
		Interference with marine fisheries and shoreline harvesting	<ul style="list-style-type: none"> ▪ Number and types of marine vessels as a result of the Project (vessels per month) ▪ Location of fisheries including access routes ▪ Attribute data (i.e., characteristics of a fishery, such as type of fish caught, location of landings) on marine uses along shipping channel (i.e., fishing, aquaculture, other seafood and shoreline harvesting)
		Interference with marine recreation and tourism	<ul style="list-style-type: none"> ▪ Recreational and tourism activities, destinations, and access routes overlapping with Project infrastructure and marine access route ▪ Indicators of visitor frequency (i.e. visitor days)
Community health and wellbeing	<ul style="list-style-type: none"> ▪ Health infrastructure and services ▪ Community and family cohesion ▪ Community health ▪ Diet and nutrition (related to country foods) ▪ Physical and mental health issues, including stress 	Change in community health and wellbeing	<ul style="list-style-type: none"> ▪ Demand and supply of health infrastructure and services (includes counselling services) ▪ Changes in health outcome indicators (i.e., mental health issues, substance abuse, sexually transmitted infections (STIs)) ▪ Indicators of community cohesion and resilience (i.e., rapid population change, crime rates) ▪ Indicators of factors affecting families (i.e., violence against women, divorce rates, children and youth at risk)
		Change in diet and nutrition	<ul style="list-style-type: none"> ▪ Proportion of diets from country foods ▪ Composition of country foods in diet

Valued Component	Topics Addressed in the Assessment	Potential Adverse Effects	Measurable Parameters
Heritage			
Archaeological and heritage resources	<ul style="list-style-type: none"> ▪ Culturally modified trees (CMTs) ▪ Historic sites ▪ Archaeological sites ▪ Wake from LNG carriers vessels 	Damage to or removal of culturally modified trees (CMTs)	<ul style="list-style-type: none"> ▪ Number, type, age and heritage value of CMTs being altered or removed
		Alteration or removal of terrestrial archaeological or heritage sites	<ul style="list-style-type: none"> ▪ Number and heritage value of terrestrial archaeological or heritage resources, or portions thereof, being altered or removed
		Alteration or removal of intertidal archaeological or heritage sites	<ul style="list-style-type: none"> ▪ Number and heritage value of intertidal archaeological and heritage sites, or portions thereof, being altered or removed
Health			
Human health	<ul style="list-style-type: none"> ▪ Air quality ▪ Country foods 	Change in human health risk from degraded air quality	<ul style="list-style-type: none"> ▪ Concentration ratios (CR) for non-carcinogenic chemicals of concern ▪ Incremental lifetime cancer risk (ILCR) for carcinogenic chemicals of concern
		Change in human health risk from degraded drinking water quality	<ul style="list-style-type: none"> ▪ CRs for non-carcinogenic chemicals of concern ▪ ILCR for carcinogenic chemicals of concern
		Change in human health risk from ingestion of contaminated country foods	<ul style="list-style-type: none"> ▪ Hazard quotients (HQ) for non-carcinogenic chemicals of concern ▪ Incremental lifetime cancer risk (ILCR) for carcinogenic chemicals of concern

4.2 Assessment Boundaries

4.2.1 Spatial Boundaries

Spatial boundaries for the assessment of each selected VC encompass the geographic extent of environmental, economic, social, heritage and health effects of concern that could arise from the Project. Some spatial boundaries are not consistent with those listed in the AIR. The rationale for these changes is provided in the VC sections. As per discussions with the EAO, the effects of the LNG facility and shipping activities are assessed separately in each VC section, where applicable, to reflect the requirements of the section 11 Order; spatial boundaries reflect this separation as appropriate.

4.2.1.1 Project Footprint (LNG Facility)

The Project footprint is the physical area cleared for the Project, and includes the LNG processing and storage site, LNG loading line corridor, marine terminal and dredging area, workforce accommodation centre(s), associated infrastructure, and potential tree clearing area. Subsequent to the finalization of the AIR, an additional location for a potential workforce accommodation centre has been identified, as shown in Section 1, Figure 1.0-3, and is included as part of the Project footprint. The Project footprint is approximately 430 ha.

4.2.1.2 Marine Access Route (Shipping Activities)

The marine access route is from the BC Coast Pilots boarding location near the Triple Island Pilotage Station through Principe Sound and Douglas Channel to Kitimat Arm, as shown in Section 1, Figure 1.0-2.

4.2.1.3 Local Study Areas (LSA)

The local study area (LSA) encompasses the area in which both (a) Project-related effects can be predicted or measured with a level of confidence that allows for assessment; and (b) there is a reasonable expectation that those predicted or measured effects could be of concern. The LSA for each VC is described in the relevant VC sections. Where relevant, a marine shipping LSA, centered along the marine access route, is defined for assessing the effects of marine shipping.

Factors considered for defining VC-specific LSAs are:

- scope of the Project and scope of the assessment as defined in the section 11 Order
- local and regional environmental, social, heritage, economic or health conditions
- available TU and TK information
- technical or scientific information

- social considerations
- input from Working Groups, and
- input from Aboriginal Groups.

4.2.1.4 Regional Study Areas (RSA)

A regional study area (RSA) is the area that (a) establishes the context for the determination of significance of Project-specific effects; and (b) encompasses where Project residual effects overlap with effects of past, present, and reasonably foreseeable future activities; and is consequently the area for which cumulative effects are assessed.

The RSA for each VC and the rationale for their selection are described in the relevant VC section. Factors considered in defining RSAs for each VC are the same as for the LSAs.

4.2.2 Temporal Boundaries

The temporal boundaries of the assessment are defined by the timing and duration of Project activities that could result in effects on the biophysical and human environment. Temporal boundaries identify when an effect may occur in relation to specific Project phases and activities.

Based on the current Project schedule, the temporal boundaries for the assessment are:

- construction, Phase 1 (trains 1 and 2) to be completed approximately five to six years following issuance of permits, the subsequent phase(s) (trains 3, 4) to be determined based on market demand
- operation, minimum of 25 years after commissioning, and
- decommissioning, approximately 2 years at the end of the Project life.

Because the life of the LNG facility is expected to exceed 25 years, timing for decommissioning and abandonment is preliminary.

4.2.3 Administrative and Technical Boundaries

Administrative and technical boundaries are identified in each VC section. Administrative boundaries might include specific aspects of provincial and federal regulatory requirements, in addition to those described under regulatory setting, as well as regional planning initiatives that are relevant to the assessment of a specific VC. Administrative boundaries are sometimes selected to establish spatial boundaries based on regulatory requirements.

Technical boundaries include limitations in information, data analyses, and data interpretation relevant to a particular VC.

4.3 Description of Baseline Conditions

Baseline conditions are described for each VC (and associated subcomponents when applicable) in the VC sections and associated technical data reports (TDRs) (where applicable). The description of baseline conditions has sufficient detail to allow potential interactions to be identified, understood, and assessed. Baseline conditions focus on information required to address measurable parameters defined for the VC. Key elements of the approach to describing baseline conditions are:

- appending and/or referencing existing reports and documents, standards and guidelines as appropriate
- collecting (through field studies, surveys and other research methods), analyzing and presenting data following appropriate provincial or federal standards (e.g., Resource Information Standards Committee)
- providing rationale for the selection of sampling sites and analytical parameters
- discussing the quality and reliability of these data sources and how they are used to support the assessment
- incorporating available TK
- describing field and laboratory methods, along with any quality assurance and quality control measures applied, and
- describing modelling and limitations of modelling.

4.4 Assessment of Project-Specific Effects

The section 11 Order issued by the EAO established a Facility Working Group and a Shipping Working Group. The Working Groups provide input on aspects related to the assessment of the facility and shipping activities respectively as defined in the section 11 Order. As per discussions with the EAO, the effects of the LNG facility and shipping activities are assessed separately in each VC section, where applicable, to reflect the requirements of the section 11 Order.

4.4.1 Identification of Project-VC Interactions

Table 4.4-1 identifies potential interactions of concern between Project activities and each of the selected VCs. Project activities were identified based on the information provided in Section 2, Project Overview. Potential Project-VC interactions are identified with a checkmark. These interactions are assessed in the relevant VC sections using the methods described below. The interaction table also lists past, present and other reasonably foreseeable future activities and indicates for each VC which of these activities may have already acted or could potentially act cumulatively on it.

Table 4.4-1: Interaction of the Project with the Biophysical and Human Environment and Other Activities

Project Activities and Physical Works	Air Quality	Greenhouse Gas Management ¹	Acoustic Environment	Vegetation Resources	Wildlife Resources	Surface Water Quality ²	Freshwater and Estuarine Fish and Fish Habitat	Marine Resources	Economic Conditions	Visual Quality	Marine Transportation and Use	Infrastructure and Services	Archaeological and Heritage Resources	Community Health and Wellbeing	Human Health
Facility Activities and Works															
Construction															
Site preparation (clearing, grubbing, grading , levelling, and set-up of temporary facilities)	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓
Onshore construction (installation of LNG facility, utilities, ancillary support facilities, access roads, and includes hydrotesting)	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
Dredging (includes disposal)	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓	✓	✓
Marine terminal construction (Modifications to existing wharf, installation of sheet piling, material offloading and laydown areas, transfer piping and electrical infrastructure)	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓	✓	✓
Waste management (waste collection and treatment)					✓			✓	✓		✓	✓		✓	✓
Vehicle and rail traffic (haul road upgrades, road use, vehicle traffic)	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓		✓	✓
Commissioning and start-up	✓	✓	✓		✓				✓		✓	✓		✓	✓
Operation															
LNG production (including natural gas treatment, condensate extraction, storage, and transfer), storage and loading	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓
Waste management (solid and liquid waste collection and disposal, wastewater effluent collection and treatment, site stormwater management)					✓			✓	✓		✓	✓		✓	✓
Vehicle and rail traffic (road use, vehicle traffic)		✓	✓	✓	✓		✓		✓	✓	✓	✓		✓	✓
Decommissioning															
Dismantling of land-based and marine infrastructure	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓

Project Activities and Physical Works	Air Quality	Greenhouse Gas Management ¹	Acoustic Environment	Vegetation Resources	Wildlife Resources	Surface Water Quality ²	Freshwater and Estuarine Fish and Fish Habitat	Marine Resources	Economic Conditions	Visual Quality	Marine Transportation and Use	Infrastructure and Services	Archaeological and Heritage Resources	Community Health and Wellbeing	Human Health
Remediation and reclamation of the site	✓	✓	✓		✓		✓		✓	✓	✓	✓	✓	✓	✓
Waste management					✓			✓	✓		✓	✓		✓	✓
Post-closure monitoring and follow-up									✓		✓	✓		✓	✓
Shipping															
Construction															
Shipping equipment and materials	✓	✓	✓		✓			✓	✓	✓	✓			✓	✓
Operation															
LNG shipping	✓	✓	✓		✓			✓	✓	✓	✓			✓	✓
Decommissioning															
Shipping equipment and materials	✓	✓	✓		✓			✓	✓	✓	✓			✓	✓
Other Projects															
Kitimat Area Project/Facility															
Coastal GasLink Pipeline Project			✓	✓	✓		✓		✓	✓		✓		✓	✓
Douglas Channel LNG Terminal (also known as BC LNG)	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Enbridge Northern Gateway Project	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Former Eurocan Pulp and Paper Co. site					✓		✓	✓		✓	✓				
Former Methanex/Cenovus Terminal				✓	✓		✓	✓		✓	✓				✓
Former Moon Bay Marina (footprint only)				✓	✓			✓		✓					
Kitimat Clean	✓			✓	✓	✓						✓		✓	✓
Kitimat LNG Terminal Project	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓

Project Activities and Physical Works	Air Quality	Greenhouse Gas Management ¹	Acoustic Environment	Vegetation Resources	Wildlife Resources	Surface Water Quality ²	Freshwater and Estuarine Fish and Fish Habitat	Marine Resources	Economic Conditions	Visual Quality	Marine Transportation and Use	Infrastructure and Services	Archaeological and Heritage Resources	Community Health and Wellbeing	Human Health
MK Bay Marina	✓		✓	✓	✓			✓		✓	✓				
Pacific Northern Gas Pipeline (includes proposed looping)			✓	✓	✓		✓		✓	✓		✓		✓	✓
Pacific Trail Pipelines Project			✓	✓	✓		✓		✓	✓		✓		✓	✓
Rio Tinto Alcan Facility and Modernization Project	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Sandhill Materials – Aggregate Processing [†]	✓		✓	✓	✓				✓	✓	✓	✓			✓
Prince Rupert Areas Project/Facility															
BG Group – Prince Rupert LNG Project *									✓	✓		✓		✓	✓
Canpotex – Potash Export Terminal*									✓	✓		✓		✓	✓
Maher Terminals – Fairview Terminal Phase 2 Expansion Project*									✓	✓		✓		✓	✓
Pinnacle Renewable Resources – Pellet Export Terminal*									✓	✓		✓			✓
Prince Rupert Grain Terminal*										✓					
Prince Rupert Port Authority –Ridley Island Road, Rail Utility Corridor*										✓					✓
Progress Energy – Pacific Northwest LNG Project *									✓	✓		✓		✓	✓
Ridley Terminal Inc.*										✓				✓	
Spectra Energy – Natural Gas Pipeline*									✓			✓		✓	✓
TransCanada Corporation – Prince Rupert Gas Transmission Project*									✓			✓		✓	✓
Watco – Watson Island Re-Development*									✓	✓		✓		✓	✓
Terrace Area Project/Facility															
Galore Creek Copper-Gold-Silver Project*									✓			✓		✓	
KSM (Kerr-Sulphurets-Mitchell) Project*									✓			✓			

Project Activities and Physical Works	Air Quality	Greenhouse Gas Management ¹	Acoustic Environment	Vegetation Resources	Wildlife Resources	Surface Water Quality ²	Freshwater and Estuarine Fish and Fish Habitat	Marine Resources	Economic Conditions	Visual Quality	Marine Transportation and Use	Infrastructure and Services	Archaeological and Heritage Resources	Community Health and Wellbeing	Human Health
Brucejack Gold Mine Project*									✓			✓			
Kitsault Mine Project*									✓			✓		✓	
Altagas Hydro Projects (Forest Kerr, McLymont Creek, Volcano Creek)*									✓			✓		✓	
Kinskuch Hydro Project*									✓			✓		✓	
Northwest Transmission Line*												✓		✓	
Activity															
BC Ferries	✓		✓		✓			✓		✓	✓			✓	
Cruise Ships	✓		✓		✓			✓		✓	✓			✓	
Forestry Activities			✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	
Fisheries and Aquaculture			✓		✓		✓	✓		✓	✓			✓	

NOTES:

†The proposed Sandhill Materials Terminal Expansion Project has been cancelled and thus removed from the Project Inclusion List.

* Projects and activities considered for socio-economic VCs only. ✓ = interactions between the Project activities and VCs and other projects and activities whose effects have the potential to interact cumulatively with the Project's residual effects.

- 1 A cumulative effects assessment following the methods outlined in Section 4.5 cannot be completed for Project-level GHG.
- 2 Assessed with respect to acidification and eutrophication from air emissions only

The project description for the Kitimat Clean Project has not been submitted. As a result, inclusion of this project in the cumulative effects assessment is based on available information as per discussions with the EAO. Based on these discussions information included in the assessment was limited to air emissions (including acid deposition) and clearing of the project footprint. Rio Tinto Alcan submitted a Project Description for its Terminal A Extension on June 9, 2014, after the Project and Activities Inclusion List was finalized. It is considered in the cumulative effects for marine resources and marine transportation and use, as appropriate.

In each VC assessment section, the potential Project effects that could arise from the interactions are identified and assessed. The extent of the assessment warranted for each interaction is determined by a consideration of the severity of the resulting potential effect, the level of understanding and acceptance of mitigation measures, and the level of concern of regulators, the public and Aboriginal Groups. Further review of the interactions may reveal that some are unlikely to result in a significant adverse residual effect while others require a more extensive assessment.

The extent of assessment warranted for each interaction is indicated in each VC-Project interactions table using the following categories:

- 0 No interaction.
- 1 Potential adverse effect requiring mitigation, but further consideration determines that any residual adverse effects will be eliminated or reduced to negligible levels by existing codified practices, proven effective mitigation measures, or best management practices (BMPs).
- 2 Interaction may occur and the resulting effect may exceed negligible or acceptable levels without implementation of Project-specific mitigation. Further assessment is warranted.

Where it is determined that the Project is not likely to cause an effect (Rank 0), the interaction is not assessed further. Rank 1 is assigned if an interaction with potentially adverse effects may occur but the resulting effects are well understood and, with existing mitigation, can be managed to levels that are no longer of concern. A justification for Rank 1 is provided in the VC assessment section along with a description of proven mitigation, BMPs, and codified practices that apply. The assessment of the interaction ends with a characterization of the residual effect, which is considered in the cumulative effects assessment. A conservative approach is taken in assigning a Rank of 1, whereby interactions with a meaningful degree of uncertainty are assigned Rank 2. Rank 2 interactions may result in effects that exceed acceptable levels without development and implementation of Project-specific mitigation. These are discussed in detail in the VC assessment sections.

The assessment of potential effects includes the assessment of environmental effects as defined in sections 5(1) (a) and (b) and section 5(2) of CEEA 2012. The Application provides sufficient information for a conclusion to be reached on the significance of any residual adverse effect.

4.4.2 Description of Project Effect Mechanisms

Mechanisms by which Project activities and actions could result in environmental, economic, social, heritage or health effects are described for each VC. Where possible, the spatial and temporal extent of these effects (i.e., where and when an effect might occur) are described.

4.4.3 Mitigation of Potential Effects

Mitigation is defined as “any practical means or measures taken to avoid, minimize, restore onsite, compensate, or offset the potential adverse effects of a project” (EAO 2013). CEEA 2012 further notes that mitigation measures must be “technically and economically feasible” (section 19(1)). Mitigation measures include changes in the temporal or spatial aspects of the Project or the means by which the Project will be constructed, operated, or decommissioned, as well as specialized measures such as habitat compensation, replacement, transplant, and timing considerations.

Mitigation measures reduce or eliminate adverse environmental, economic, social, heritage, or health effects, and thus reduce or eliminate potential residual effects. These measures are described in each VC section, with an emphasis on the process and methods used to identify and select such measures and how these measures will reduce potential effects. Where possible, information is provided on the time required for mitigation measures to become effective, and the effectiveness of the mitigation measure(s) in managing the change in measureable parameter(s). Mitigation measures may include monitoring to verify results.

A description of mitigation measures incorporated into the site selection and design of the Project is provided in Section 2; these measures are repeated in the VC assessments only when they are particularly relevant. Section 16 describes the views expressed by Aboriginal Groups about the mitigation measures for the Project.

4.4.4 Characterization of Residual Effects

Residual effects are those remaining after application of mitigation measures. The following criteria are used in the Application to characterize the residual adverse effects on the environmental, economic, social, heritage, and health VCs. The definitions for the characterization criteria are based on the *Guideline for the Selection of Valued Components and Assessment of Potential Effects* (EAO 2013). The ranking categories for each of these criteria (e.g., low, medium, and high magnitude) are specific to each VC and are defined in each VC assessment section. Where possible, rankings are described

quantitatively for each VC. When residual effects cannot be characterized quantitatively, characterization is completed using qualitative terms defined in the VC assessment.

- **Magnitude**—the expected size or severity of effect (e.g., low, medium or high). Low magnitude effects may have negligible to little effect, while high magnitude effects may have a substantial effect.
- **Geographical Extent**—the spatial scale over which the residual effects of the Project are expected to occur. The geographic extent of effects can be local or regional. Local effects may have a lower effect than regional effects.
- **Duration**—the length of time the residual effect persists. The duration of an effect can be short term or long term; a VC section may quantitatively define the duration as months or years.
- **Frequency**—how often the residual effect occurs. The frequency of an effect can be frequent or infrequent (e.g. single event, multiple irregular events, multiple regular events, continuous). Short term and/or infrequent effects may have a lower effect than long term and/or infrequent effects.
- **Reversibility**—whether or not the residual effect on the VC can be reversed once the physical work or activity causing the disturbance ceases. Residual effects can be reversible or permanent. Reversible effects may have lower effect than irreversible or permanent effects.
- **Context**—refers primarily to the sensitivity and resilience of the VC. Context draws heavily on an understanding of existing conditions, which reflect cumulative effects of other projects and activities that have been carried out, and information about the effect of natural and human-caused trends on the condition of the VC (i.e. low, medium, or high resilience). Residual effects may have a higher effect if they occur in areas or regions that have already been adversely affected by human activities (i.e., disturbed) or that are ecologically fragile and have little resilience to imposed stresses (i.e., fragile).

Section 16 describes the views expressed by Aboriginal Groups about the residual effects and the degree to which they may adversely affect the exercise of Aboriginal Interests.

4.4.5 Likelihood of Residual Effects

Likelihood refers to whether a residual effect is likely to occur. An analysis of the likelihood of a residual effect is discussed after the characterizations of residual effects in each VC assessment. The probability of a residual adverse effect occurring and rationale for this determination are presented.

4.4.6 Determination of Significance for Residual Effects

A conclusion on the significance of residual effects is included for each VC. Where possible, threshold criteria or management standards are identified beyond which a residual effect is assessed as significant. Standards are recognized government or industry regulations or objectives for physical parameters used to describe, for example, air quality, water quality, and effluent release. These thresholds reflect the limits of an acceptable state for a VC, based on resource management objectives, community standards, scientific literature, or ecological processes (e.g., maintenance of important wildlife habitat areas). Government or industry standards are used as a guide in combination with an assessment of the Project-specific circumstances in determining the likelihood that a receptor would be affected and consequently in determining whether or not the Project's effect is significant. Where standards or thresholds do not exist, significance criteria are defined and justifications for the criteria are provided. Most often this is done using the measurable parameters established for the VC along with input from the consultation process. The thresholds developed should present the limits of an acceptable state for an environmental component based on resource management objectives, community standards, scientific literature, or ecological processes (e.g., desired states for fish or wildlife habitats or populations).

4.4.7 Confidence and Risk

The determination of significance includes a discussion of the prediction confidence based on:

- scientific certainty relative to qualifying or estimating the effect, including the quality and/or quantity of data and the understanding of the effect mechanisms
- scientific certainty relative to the effectiveness of the mitigation measures, and
- professional judgment from prior experience, including proven mitigation measures.

Higher confidence in all three variables produces greater confidence in the effect predictions, assessment of significance, and the selection of mitigation measures. Where confidence is low, details of additional risk assessment are provided.

4.4.8 Residual Effects Summary

A summary of residual effects and their significance is provided for each VC assessment following the format of Table 4.4-2.

Table 4.4-2: Summary of Residual Effects and Significance

Project Phase	Mitigation Measures	Residual Effects Rating Criteria						Likelihood of Residual Effects	Significance	Confidence and Risk	Follow-up and Monitoring
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context				
LNG Facility											
Effect #1											
Construction											
Operation											
Decommissioning											
Residual effect for all phases											
Effect #2											
Construction											
Operation											
Decommissioning											
Residual effect for all phases											
Shipping											
Effect #1											
Construction											
Operation											
Decommissioning											
Residual effect for all phases											

4.5 Cumulative Effects

Each VC assessment that determines there are residual effects includes an assessment of potential cumulative effects. The potential cumulative environmental, economic, health, social, and heritage effects assessed are those resulting from Project residual effects interacting with similar effects of past, present, and future projects and activities. Future projects and activities considered in the cumulative effects assessment are those that are reasonably foreseeable, including those that: (a) have been publicly announced with a defined project execution period and with sufficient project details that they can be included in the assessment, (b) are currently undergoing an environmental assessment or (c) are in a permitting process. One exception to the above criteria is the inclusion of Kitimat Clean as a future

project. Kitimat Clean has not been publicly announced but the EAO requested that it be included on the Project Inclusion List (Table 4.5-1).

4.5.1 Project and Activities Inclusion List

The list of other projects and activities considered in the cumulative effects assessment was finalized on March 15, 2014 as agreed with the EAO. Table 4.5-1 presents the list of these projects and activities and Figure 4.5-1 shows their location. RTA submitted a Project Description for the Terminal A Extension Project on June 6, 2014, after the Project and Activities Inclusion List was finalized. This project is considered in the cumulative effects assessment for marine resources and marine transportation and use, as appropriate. The Terminal A Extension Project is located along the west side of Douglas Channel adjacent to RTA which overlaps with the location of the proposed Sandhill Materials Export Terminal Project. As a result, the Export Terminal Project has been cancelled and thus removed from the Project and Activities Inclusion List.

Table 4.5-1: Project and Activities Inclusion List

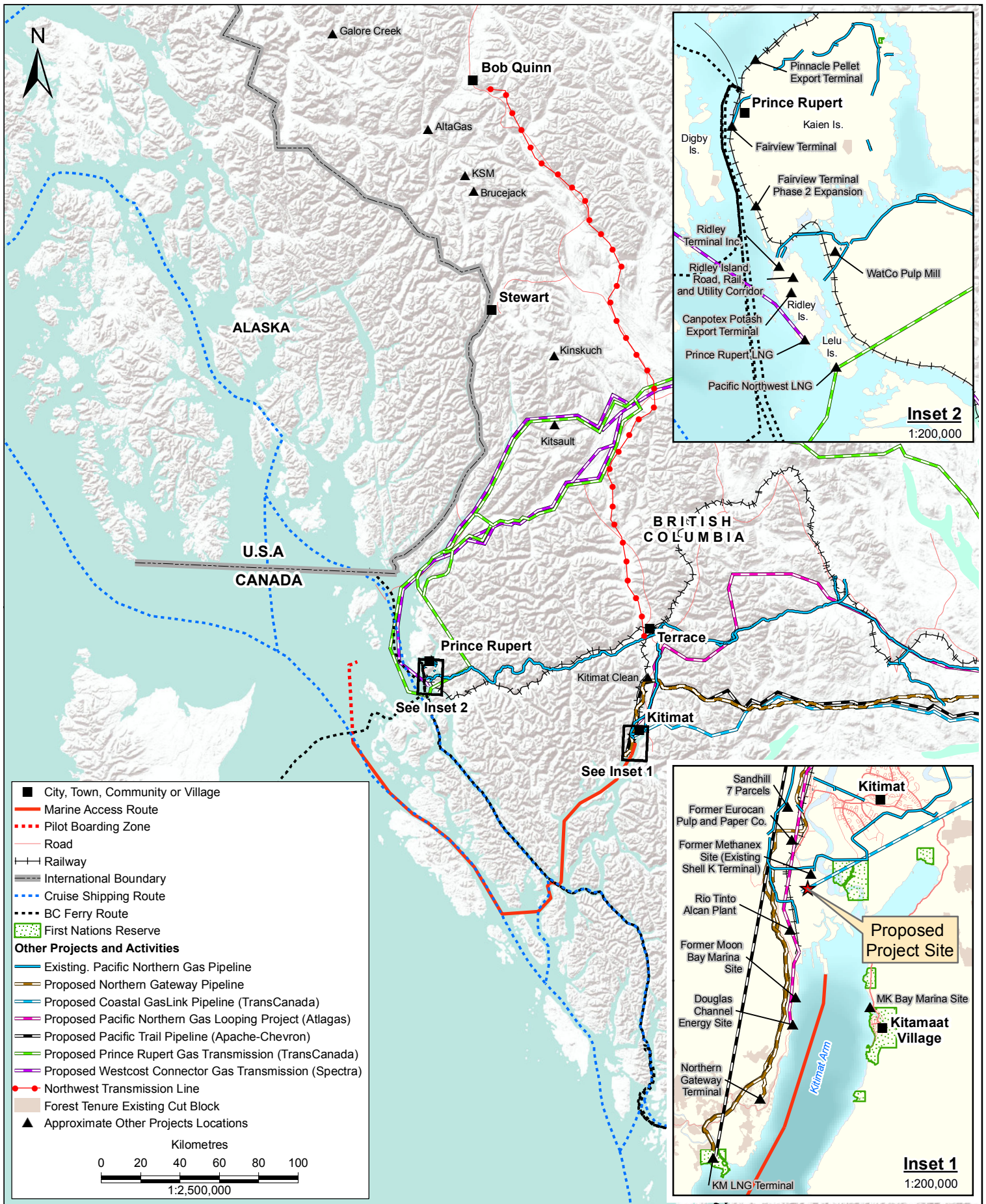
Project/Facility/Activity	Status (Past/Ongoing/ Future)	Description
Kitimat Area Project/Facility		
Coastal GasLink Pipeline Project	Future	Proposed 650 km natural gas pipeline from near Dawson Creek to Kitimat, BC. Pipeline capacity is 1.7 Bcf/day with a single compressor station, with provisions for up to 5 Bcf/day with five compressor stations.
Douglas Channel LNG Project (also known as BC LNG)	Future	Proposed small-scale LNG plant located on the west side of Douglas Channel, south of Moon Bay. Using existing capacity from Pacific Northern Gas' pipeline, the plant will produce approximately 900,000 tonnes of LNG per annum. The gas export licence was granted February 2012
Enbridge Northern Gateway Project	Future	Proposed oil export terminal in Kitimat. The project includes two parallel pipelines; one to transport bitumen from Edmonton to Kitimat (for export) and the other to transport imported condensate from Kitimat to Edmonton. The Project is currently waiting for a decision from Cabinet.
Former Eurocan Pulp and Paper Co. Site	Past	A pulp and paper mill producing linerboard and kraft paper for forty years until it was closed down in January 2010.
Former Methanex/Cenovus Terminal	Past	The Methanex/Cenovus site was sold to Shell in 2011 and will be decommissioned. Only the footprint of this project, which is within the footprint of the LNG Canada Project, is considered in the cumulative effects assessment because there are no emissions.
Former Moon Bay Marina (footprint only)	Past	The lease was terminated for this recreational marina in June of 2010. Rio Tinto Alcan currently owns the property. Because it is not operational, only the footprint is considered in the cumulative effects assessment.
Kitimat Clean	Future	A proposed oil refinery located approximately 25 km north of Kitimat, BC for importing diluted bitumen by rail or pipeline for the purpose of processing approximately 87,445 m ³ of refined bitumen/day.
Kitimat LNG Terminal Project	Future	LNG plant and marine loading facilities to be located at Bish Cove, south of Kitimat, with a 10 million tonnes per annum capacity. The project includes a 14 km natural gas pipeline to connect with Pacific Trail Pipeline near Minette substation. Also, the project includes redeveloping the former Eurocan mill site as a project lay down and construction camp. Certified by the EAO in June 2006.

Project/Facility/Activity	Status (Past/ Ongoing/ Future)	Description
MK Bay Marina	Ongoing	Marina with 140 berths located at the head of Douglas Channel.
Pacific Northern Gas Pipeline (includes proposed looping)	Ongoing	Pacific Northern Gas' Western system's distribution system comprises approximately 1,180 km of distribution pipelines. The Western system transmission pipeline connects with the Spectra Energy pipeline system near Summit Lake, BC and extends 587 km to the west coast of BC at Kitimat.
Pacific Trail Pipelines Project	Future	470 km, 914 mm natural gas pipeline between Summit Lake and Kitimat BC. Includes a new compressor station as well as upgrades to existing stations. It will provide a direct connection between the Spectra Energy Transmission pipeline and Kitimat LNG terminal. The Project was certified by the EAO in June 2008.
Rio Tinto Alcan Facility and Kitimat Modernization Project	Ongoing	Expanded facility, from 280,000 tonnes per annum to 420,000 tonnes per annum by 2014. Facility includes an existing 287 kV BC Hydro transmission line and a 230 kV transmission line to Kemano.
Sandhill Materials	Ongoing	Sandhill Materials and Arthon Industries Limited have title to an estimated 93 million metric tonnes of aggregate.
Prince Rupert Area Project/Facility		
BG Group – Prince Rupert LNG Project *	Future	In the early feasibility stage, this potential LNG terminal is proposed on Ridley Island. A final investment decision is expected by 2015.
Canpotex – Potash Export Terminal*	Future	Proposed potash export terminal that will receive 180,000 tonne vessels, and includes a 180,000 tonne potash storage building and automated railcar and conveyor system. Docks and marine infrastructure will be used. An environmental assessment has been approved for the project.
Maher Terminals – Fairview Terminal Phase 2 Expansion Project*	Future	Proposal to quadruple the capacity of the Fairview Terminal. It will infill 11.1 ha of marine environment, add an additional wharf, container yard and intermodal yard space. An environmental assessment has been approved for the project.
Pinnacle Renewable Resources – Pellet Export Terminal*	Future	Wood pellet biofuel project with capacity to export two million tonnes of wood pellets annually. Currently under construction.
Prince Rupert Grain Terminal*	Ongoing	The Prince Rupert Grain Terminal, opened in 1985, cleans and exports in excess of 6 million tonnes of Canada Wheat Board grains such as wheat and barley annually. Terminal can accommodate vessels up to 145,000 DWT.
Prince Rupert Port Authority –Ridley Island Road, Rail Utility Corridor*	Future	To support future terminal developments, this project will extend current limits of road and rail service to loop the perimeter of Ridley Island. Phase 1 includes installation of one road and five rail cars to allow a combined capacity of 2,250 rail cars. Phase 2 is dependent on the construction of proposed LNG projects. Currently under construction.
Progress Energy – Pacific Northwest LNG Project *	Future	The terminal on Lelu Island will process up to 12-million tonnes of liquid natural gas fed through Trans Canada's pipelines from Northeastern BC. Early construction phase is anticipated for 2015 to 2018. The environmental assessment is underway.
Ridley Terminal Inc.*	Ongoing	Ridley Coal Terminal, built in 1984, is a deep sea bulk terminal that handles the export of coal and petroleum coke volumes from western Canada. Bulk material is received by train and is shipped in vessels up to 250,000 DWT.
Spectra Energy – Natural Gas Pipeline*	Future	An 850 km natural gas pipeline transporting up to 4.2 billion cubic feet per day of natural gas. It will connect with proposed terminal on Ridley Island.
TransCanada Corporation – Prince Rupert Gas Transmission Project*	Future	A 750 km natural gas pipeline starting in northeastern BC and ending at the proposed Pacific Northwest LNG export terminal on Lelu Island in Port Edward.

Project/Facility/Activity	Status (Past/ Ongoing/ Future)	Description
Watco – Watson Island Re-Development*	Future	Proposed redevelopment of a 100 ha pulp mill on Watson island into a seaport terminal and industrial park. Dependent on remediation and land titles case with previous owner, Sun Wave Forest Products
Terrace Area Project/Facility		
Galore Creek Copper-Gold-Silver Project*	Ongoing	An open pit copper, gold, and silver mine located between the Stikine and Iskut rivers in northwest BC. It will have an expected production capacity of up to 60,000 tonnes per day and is located approximately 150 km northwest of Stewart, BC.
KSM (Kerr-Sulphurets-Mitchell) Project*	Future	Proposed open pit and underground gold, copper, silver and molybdenum mine located approximately 65 km northwest of Stewart, BC. The ore extraction capacity is expected to be approximately 130,000 tonnes per day.
Brucejack Gold Mine Project*	Future	A proposed underground gold and silver mine located approximately 65 km north of Stewart, BC.
Kitsault Mine Project*	Future	An open-pit molybdenum mine located near Kitsault, BC with an ore extraction capacity of approximately 40,000 tonnes per day. Kitsault is located about 140 km north of Prince Rupert. Construction is expected to start in 2014.
Altagas Hydro Projects (Forest Kerr, McLymont Creek, Volcano Creek)*	Future	Forrest Kerr is a 100 MW run-of-river hydroelectric plant located in the Iskut River near its confluence with Forrest Kerr Creek in northwest BC, approximately 100 km northwest of Stewart, BC. McLymont Creek Hydroelectric Project is a run-of-river project located in northwest BC and is expected to have a capacity of 55 MW to 70 MW. It is located near the Forrest Kerr project, approximately 100 km northwest of Stewart, BC. Volcano Creek is a small run-of-river project in northwest BC with a proposed capacity of 16 MW. Located in a similar area to other Altagas Hydro projects.
Kinskuch Hydro Project*	Future	A hydroelectric project located in northwest BC, in the upper reaches of the Kinskuch river with a proposed capacity of approximately 80 MW.
Northwest Transmission Line*	Ongoing	A 344 km transmission line that runs north from the Skeena Substation just outside of Terrace to near Bob Quinn Lake. Under construction and expected to be operational in May 2014.
Activity		
BC Ferries	Ongoing	BC Ferries offers year-round service from Prince Rupert through the Inside Passage to Port Hardy. Ferries travel every other day in the summer (May to September) and two to three times per month in the winter. Only activities within Douglas Channel, Caamaño Sound, and Principe Channel are considered in the cumulative effects assessment.
Cruise Ships	Ongoing	Cruise ships using inside passage route, typically transiting to Alaska from Vancouver or Seattle.
Forestry Activities	Ongoing	BC Timber Sales and other licences. Includes existing and future cut blocks.
Fishing and Aquaculture Activities	Ongoing	Commercial, recreational, and aboriginal fishing, traditional harvesting, and aquaculture.

NOTES:

* These projects are included in the cumulative assessment of social and economic VCs only.



ENVIRONMENTAL EFFECTS ASSESSMENT
ASSESSMENT METHODS

PROJECTS AND ACTIVITIES INCLUSION LIST

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION	BC Albers	DRAWN BY	SS
DATUM	NAD 83	CHECKED BY	SW
DATE	07-APR-14	FIGURE NO.	4.5-1

4/7/2014 - 4:43:48 PM \\cd1183-f04\workgroup\1231\active\EM\1231\10458\gis\figures\EA\assessment_methods\fig_10458_ea_methods_4.5-1_project_inclusion_list.mxd

4.5.2 Cumulative Effects Assessment

Cumulative effects are assessed for each VC that is determined to have a residual effect. The CEA Agency's (2013) Operational Policy Statement (OPS), *Assessing Cumulative Environmental Effects Under the Canadian Environmental Assessment Act, 2012*, was considered during development of the cumulative effects assessment scope and methods. In accordance with the OPS, the cumulative effects assessment includes consideration of other physical activities that have been, are being, and will be carried out in the RSA.

The cumulative effects assessment involves three stages: (1) establishing context by providing an overview of the predicted effects of other projects and activities on the VC; (2) determining the potential for Project-specific residual effects to interact with the predicted effects of other projects and activities; and (3) if the Project does interact cumulatively with other projects and activities, assessing the significance of the resulting cumulative effects and characterizing the Project's contribution to the change in cumulative effects.

4.5.2.1 Stage 1,-Cumulative Effects Context

The first stage summarizes baseline information for each VC within the RSA, as well as baseline cumulative effects resulting from other past and present physical works and activities. Reasonably foreseeable future-project effects that may interact cumulatively with the Project's residual effects are also considered for establishing an overview of cumulative effects prior to determining the potential contribution of Project residual effects to the cumulative effects.

4.5.2.2 Stage 2,-Determination of Potential Cumulative Interactions

The second stage proceeds with an analysis of whether the following two conditions are met:

- The Project results in a demonstrable or measurable residual effect on the VC.
- The Project-specific residual effect on a VC does, or has a potential to, act in a cumulative fashion with the effects on that VC of other past, existing or future projects and activities in the area (i.e., there is an overlap of the Project residual effects with similar effects of other projects and activities).

If either of these conditions is not met, further assessment is not warranted—the Project does not have the potential of contributing to the cumulative effect being considered. When this is the case, the rationale for this decision is provided in the VC assessment.

4.5.2.3 Stage 3,-Determining Significance of Cumulative Effects

The third stage of the assessment proceeds if the potential for the Project to contribute to cumulative effects has been established in the second stage. The assessment makes a determination of significance of the overall cumulative effect resulting from the addition of the Project's residual effects. The assessment also determines the Project's contribution to the cumulative effects allowing for an understanding of the potential change in cumulative effects due to the Project.

The first step in the third stage is establishing the level of analysis required in making the significance determination. This is done by assessing whether there is a reasonable expectation that the contribution (i.e., addition) of the Project's residual effects would cause a change in cumulative effects, which could in turn affect the quality or sustainability of the VC. If there is not a reasonable expectation of this, then a determination of overall cumulative effects is made based on information provided in the first stage (cumulative effects context) and in the baseline studies. This determination is accompanied by a discussion of the confidence in the significance determination and of the conclusions regarding the potential change in cumulative effects that could be due to Project's contribution.

If there is a reasonable expectation that the Project's contribution to cumulative effects could affect the quality or sustainability of the VC, then the assessment continues to a second level of analysis described below. A conservative approach is taken in determining reasonable expectation. If the level of confidence in the quality and quantity of information raises plausible doubts, the Application provides the second level of analysis.

4.5.2.3.1 Effects Mechanisms for Cumulative Effects

To support the second level of analysis, the Application describes the mechanisms whereby the adverse residual effects from the Project interact with those from other projects and activities in the RSA for each VC. The spatial and temporal extent of these changes are described and quantified in terms of the degree of change in the measurable parameter(s).

4.5.2.3.2 Mitigation of Cumulative Effects

The Application describes measures committed to by LNG Canada to reduce potentially adverse Project cumulative effects, including a discussion of how these measures might modify the characteristics of a cumulative effect. Mitigation measures that would require government action or a broader industry approach are also identified and briefly discussed.

4.5.2.3.3 Characterization of Cumulative Effects

Adverse cumulative effects, after application of the additional mitigation measures, are described. The cumulative effects are characterized by magnitude, geographic extent, frequency, duration, reversibility and context to the extent possible. This is done for both:

- the overall cumulative effect (i.e., the effect of all past, present and reasonably foreseeable projects and activities in combination with the effect of the Project), and
- the contribution of the Project residual effects to overall cumulative effects.

4.5.2.3.4 Likelihood of Cumulative Effects

The probability of an adverse cumulative effect occurring is described in this section.

4.5.2.3.5 Determination of Significance for Cumulative Effects

Significance of cumulative effects is determined using the same standards or thresholds established for the Project residual effects on VCs. Conclusions on the change in cumulative effects due to the Project are provided where applicable.

4.5.2.3.6 Confidence and Risk

The determination of significance and characterization of change in cumulative effects due to the Project includes a discussion of the prediction confidence, based on the following factors:

- scientific certainty relative to quantifying or estimating the cumulative effect, including the quality and/or quantity of data and the understanding of the effect mechanisms
- scientific certainty relative to the effectiveness of the mitigation measures, and
- professional judgment from prior experience including experience with the mitigation measures.

Higher confidence in the three factors produces greater confidence in the cumulative effect predictions, assessment of significance, selection of mitigation measures and the Project's effect on cumulative effects.

4.5.2.4 Summary of Cumulative Effects

A summary of cumulative effects (Table 4.5-2) is provided for each VC assessment following the format of Table 4.4-2.

Table 4.5-2: Summary of Cumulative Effects on [VC Name]

Effect	Other Projects, Activities and Actions	Cumulative Effects Characterization					
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context
Cumulative Effect #1							
Cumulative effect with the Project							
Contribution from the Project to the overall cumulative effect							
Cumulative Effect #2							
Cumulative effect with the Project							
Contribution from the Project to the cumulative effect							

4.6 Follow-Up Program and Compliance Monitoring

Follow-up and compliance monitoring programs verify the accuracy of the environmental assessment predictions are briefly described for each VC. A summary of all follow-up programs and compliance monitoring is provided in Section 21.