5.5 Vegetation Resources

5.5.1 Introduction

Vegetation resources is a valued component because of its ecological, aesthetic, recreational, economic values, and importance to the public and potentially affected Aboriginal Groups with Aboriginal Interests in the Terrestrial RSA. The vegetation resources considered in this assessment are:

- listed plant species (as defined by the BC Conservation Data Centre (CDC), *Species at Risk Act* (SARA) and Committee on the Status of Endangered Wildlife in Canada (COSEWIC)
- traditional use plants (identified through consultation with potentially affected Aboriginal Groups)
- non-native invasive plant species (as listed in the *Weed Control Act* and associated Regulation, or by the Northwest Invasive Plant Council [NWIPC])
- provincially listed ecological communities, as defined by the CDC
- wetlands and wetland function
- floodplain associations
- old forests, and
- vegetation communities sensitive to air emissions.

To assess potential effects on vegetation resources, results from the Vegetation TDR (Stantec 2014a), TK and TU studies (Section 13), Wildlife TDR (Stantec 2014b), internally supplied modelling information from the air quality assessment team (see Air Quality TDR Stantec 2014c for methods), and the Emissions Assessment on Soils and Vegetation TDR (Stantec 2014d) are incorporated. Information on vegetation resources is considered in the assessment of effects on wildlife resources (Section 5.6) and in the assessment of potential effects on Aboriginal Interests (Section 14). Information on wildlife resources (Section 5.6) and freshwater and estuarine fish and fish habitat (Section 5.7) is considered in the assessment of effects on wetland habitat functions. Vegetation resources below the average high tide are assessed within marine resources (see Section 5.8).

5.5.2 Scope of Assessment

5.5.2.1 Regulatory and Policy Setting

Table 5.5-1 lists the regulations, policies, and guidance documents regarding the protection and management of vegetation resources considered in this assessment.

Table 5.5-1: Assessment and Permitting Regulations for Vegetation Resources

Regulation/ Guideline*	Brief Description or Requirement	Data Required to Meet Regulation/ Guideline
Oil and Gas Activities Act (OGAA) and Associated Regulations and/or guidance such as the Environmental Protection and Management Regulation	The Project will follow the OGAA guidance (BC OGC 2013) and requirements relating to wetlands which include avoiding operating in wetlands and riparian reserve zones where possible, preventing deleterious substances from entering wetlands during crossings, maintaining riparian vegetation and flows within riparian management areas, preventing invasive species from entering riparian management zones, and limiting natural drainage pattern changes within wetlands. The Environmental Protection and Management Regulation provides guidance for oil and gas activities near wetlands.	Wetland location, size and type. Characterize riparian vegetation (composition, structural stage). Pre-construction field surveys to determine presence and areal extent of invasive plant species.
BC Forest and Range Practices Act	The *Forest and Range Practices Act* (FRPA) and its regulations set the requirements for planning, road building, logging, reforestation, and grazing for forest and range licences in BC. The requirements for forest and range activities, such as targets for old forest, are used here as guidelines for non-forest and range activities that affect vegetation resources.	Field surveys to assess forest stand composition and structural stage along with any invasive species present at baseline.
Species at Risk Act (SARA)	Prohibits killing, harming, or taking of *threatened or endangered* species. Prohibitions only apply to aquatic species and migratory bird species and all species on federal lands. Requires identifying potential adverse effects on any SARA-listed species during Project review by the Canadian Environmental Assessment Agency and ensuring measures are taken to avoid or lessen effects. Measures must be consistent with any applicable recovery strategies and action plans.	Inventory and surveys to determine plant species listed under SARA that potentially or actually occur in the study areas.
BC *Weed Control Act* and Weed Control Regulations	The BC *Weed Control Act* requires control of designated noxious plants. The *Act* identifies those species that are considered noxious weeds, both provincially and regionally. In addition, the Northwest Invasive Plant Council (NWIPC) has identified species of management concern in the NWIPC Management Area.	Inventory of non-native invasive and designated noxious plant species.

Regulation/ Guideline*	Brief Description or Requirement	Data Required to Meet Regulation/ Guideline
Federal Policy on Wetland Conservation	The objective of the Federal Policy on Wetland Conservation is to “promote the conservation of Canada's wetlands to sustain their ecological and socio-economic functions, now and in the future” (Government of Canada 1991). The Federal Policy on Wetland Conservation promotes the recognition of wetland functions in resource management and economic decision-making. The Federal Policy on Wetland Conservation also provides a “no net loss” goal for wetlands: ▪ on federal lands and waters, ▪ in areas affected by the implementation of federal programs where the continuing loss or degradation of wetlands has reached critical levels ▪ where federal activities affect wetlands designated as ecologically or socio-economically important to a region The last bullet point applies to the Project. Ecologically important wetlands are present in the terrestrial LSA and include red- and blue-listed wetlands and estuarine wetlands as defined by guidance from Environment Canada (Environment Canada 2014a).	Inventory (mapping), field surveying, classification, and assessment of wetland functions.
BC Conservation Framework, in association with the Conservation Data Centre	The BC Conservation Framework (BC MOE 2009) sets objectives for the preservation of biodiversity by helping to coordinate and align conservation efforts across government and non-government sectors. The BC Conservation Framework is built with data from the CDC (BC MOE 2009 and BC MOE 2013a) and incorporates existing provincial and federal species listing. The CDC lists species and ecological communities of conservation concern through their red and blue lists. ▪ The red list includes indigenous species or subspecies that are candidates for *extirpated, endangered,* or *threatened* status in BC, which are defined as follows: • *Extirpated* taxa no longer exist in the wild in BC, but do occur elsewhere; • *Endangered* taxa are facing imminent extirpation or extinction; and • *Threatened* taxa are likely to become endangered if limiting factors are not reversed (BC MOE 2013a). ▪ The blue list includes any indigenous species or subspecies considered to be *of special concern* in BC. Taxa are of *special concern* because of characteristics that make them particularly sensitive to human activities or natural events (BC MOE 2013a).	Inventory and surveys to determine plant species listed under CDC that potentially or actually occur in the study areas.

Regulation/ Guideline*	Brief Description or Requirement	Data Required to Meet Regulation/ Guideline
District of Kitimat Official Community Plan 2008 (OCP)	The District of Kitimat Official Community Plan 2008 (Stantec 2013) identifies management objectives for areas within the Kitimat boundary. The guiding management of the OCP focuses on provincially and federally identified environmentally sensitive areas, forest lands within the OCP boundary, and naturally vegetated areas. It also enforces a development permit application, except in the case where a provincial environmental assessment is required.	Identify natural undisturbed areas; identify impacts on vegetation and forest resources; and identify environmentally sensitive areas.
Kalum Land and Resource Management Plan (LRMP)	The Kalum Land and Resource Management Plan (BC MSRM 2002) sets out to maintain the long term sustainability of biological resources in its governed area. This includes biological diversity, health, functionality and ecological services. This is in conjunction with timber harvest, and commercial and other industrial activities. The LRMP is an ecosystem-based management approach.	Conduct field studies to determine the seral stages of the forested communities within the Kalum LRMP jurisdiction; determine the amount of disturbance to vegetation because of the Project; identify forested old growth areas; identify leading tree species; and, develop management plans for vegetation that include limiting herbicide use, encouraging ecological restoration, and conducting ecosystem inventories.
Water Act	The *Water Act* regulates works (e.g. installation of culverts, diversion around work sites) in or about a stream, which includes wetland (WSP 2009).	Provide to the BC Ministry of Forest, Lands, and Natural Resource Operations (MFLNRO) the plans, specifications, and other information regarding works in and about a stream (including wetland).

NOTES:

*Some of these regulations apply to provincial Crown Land, not private lands, but are used here as guidance for scoping the assessment, determining data requirements, and determining mitigation measures

5.5.2.2 Consultation's Influence on the Identification of Issues and the Assessment Process

The scope of the assessment is based on the AIR, which was approved by the EAO in February 2014. The draft AIR was the subject of a public comment period in November/December 2013; and LNG Canada consulted with the EAO Working Groups, which include government agencies and Aboriginal Groups, throughout the development of the AIR. Through LNG Canada's consultation program, Aboriginal Groups identified in the section 11 Order have identified issues and concerns with respect to vegetation resources. These are assessed as applicable, in the assessment on vegetation resources, as well as in Part C of this Application as they relate to potential adverse effects on Aboriginal Interests (Section 14) or Other Matters of Concern (Section 16). The following changes were made to the assessment of vegetation resources and mitigation measures as a result of consultation:

- Potential effects of acid deposition from the Project on vegetation communities were added to the scope of the assessment.
- Wetland functions were included in the effects assessment.
- The Federal Policy on Wetland Conservation of no net loss of wetland functions will be followed for wetlands that are designated as ecologically important to the region and will be affected by the Project.

5.5.2.3 Traditional Knowledge and Traditional Use Incorporation

The LNG facility and terrestrial LSA fall within the traditional territory of Haisla Nation. The traditional territories of the following First Nations also occur within the emissions LSA: Kitselas First Nation, Kitsumkalum First Nation, Lax Kw'alaams First Nation, and Metlakatla First Nation. The LSA boundaries are defined in Section 5.5.2.6.1.

TK and TU information was gathered from Project-specific studies submitted to LNG Canada and publicly available sources (see Section 13 and Section 14 for more detail). The available TK and TU information at the time of writing has been used to describe the baseline conditions for vegetation resources. Haisla Nation provided a Project-specific study to LNG Canada titled "The LNG Canada Proposed Terminal Site and Tanker Route within Haisla Traditional Territory" (the "Haisla Report") (Powell 2013). Traditional use plants for medicinal, food, and materials identified from the Haisla Report and publicly available sources have been incorporated into the assessment of change in abundance of plant species of interest, specifically for the traditional use plants measureable parameter. Additionally, the results from the effects assessment for the change in vegetation health and diversity from air emissions was compared to traditional territories and reported with the modelling results.

5.5.2.4 Selection of Effects

Potential effects of the Project on vegetation resources are related primarily to clearing and site preparation, which will unavoidably and directly result in the loss of vegetation resources. Air emissions during operations could also result in direct effects through fumigation (nitrogen dioxide or sulphur dioxide) and indirect effects on vegetation through soil eutrophication (via nitrogen deposition) or acidification of soils (via acid deposition). The following potential effects on vegetation resources are assessed:

- 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 air emissions

5.5.2.4.1 Change in Abundance of Plant Species of Interest

The abundance of plant species of interest could change directly through clearing and site preparation, indirectly through introduction of invasive non-native plant species, or indirectly through altered abiotic conditions (e.g., soil moisture, temperature, light levels). Effects from air emissions on vegetation health and diversity are not included in this effect; they are assessed separately with different spatial boundaries and methods.

Plant species discussed in this assessment are:

- provincially and federally listed plant species,
- traditional use plant species identified by Aboriginal Groups in the Haisla Report and publicly available sources (see Section 13 and Section 14 for more detail), and
- non-native invasive plant species identified as noxious in the BC *Weed Control Act Weed Control Regulation* and/or on the NWIPC (2013) list.

5.5.2.4.2 Change in Abundance or Condition of Ecological Communities of Interest

Ecological communities of interest include red- and blue-listed ecological communities, old forest, wetlands, and floodplains. The abundance of ecological communities of interest could be affected directly through clearing and site preparation; or, their condition could change within proximity of the clearing activities through the introduction of invasive non-native plant species or altered abiotic conditions (e.g., soil moisture, temperature, light levels). Effects from air emissions on vegetation health and diversity are not included in this effect; they are assessed separately with different spatial boundaries and methods.

5.5.2.4.3 Change in Native Vegetation Health and Diversity

Air emissions may cause changes to native vegetation health and diversity. Changes to native vegetation health and diversity could occur directly as a result of increases in airborne sulphur dioxide and nitrogen dioxide concentrations, or indirectly through nitrogen, sulphur, or acid deposition on soil.

5.5.2.5 Selection of Measurable Parameters

The measurable parameters selected for vegetation resources are listed in Table 5.5-2.

Table 5.5-2: Potential Project Effects on Vegetation Resources and Measurable Parameters

Potential Effects	Measurable Parameter
Change in abundance of plant species of interest	▪ Abundance (count, frequency, density or cover) of: • federally or provincially listed plant species • traditional use plant species • invasive plant species
Change in abundance or condition of ecological communities of interest	▪ Area (hectares) of: • provincially listed ecological communities • old forest • floodplain associations • wetland ecosystems ▪ Wetland functions (biogeochemical, hydrological and habitat functions), qualitatively assessed and related to wetland area
Change in native vegetation health and diversity	▪ Area of sensitive vegetation communities where: • critical levels for sulphur dioxide or nitrogen dioxide are predicted to be exceeded • critical loads for nitrogen deposition are predicted to be exceeded • critical loads for acid and sulphur deposition are predicted to be exceeded

5.5.2.6 Boundaries

5.5.2.6.1 Spatial Boundaries

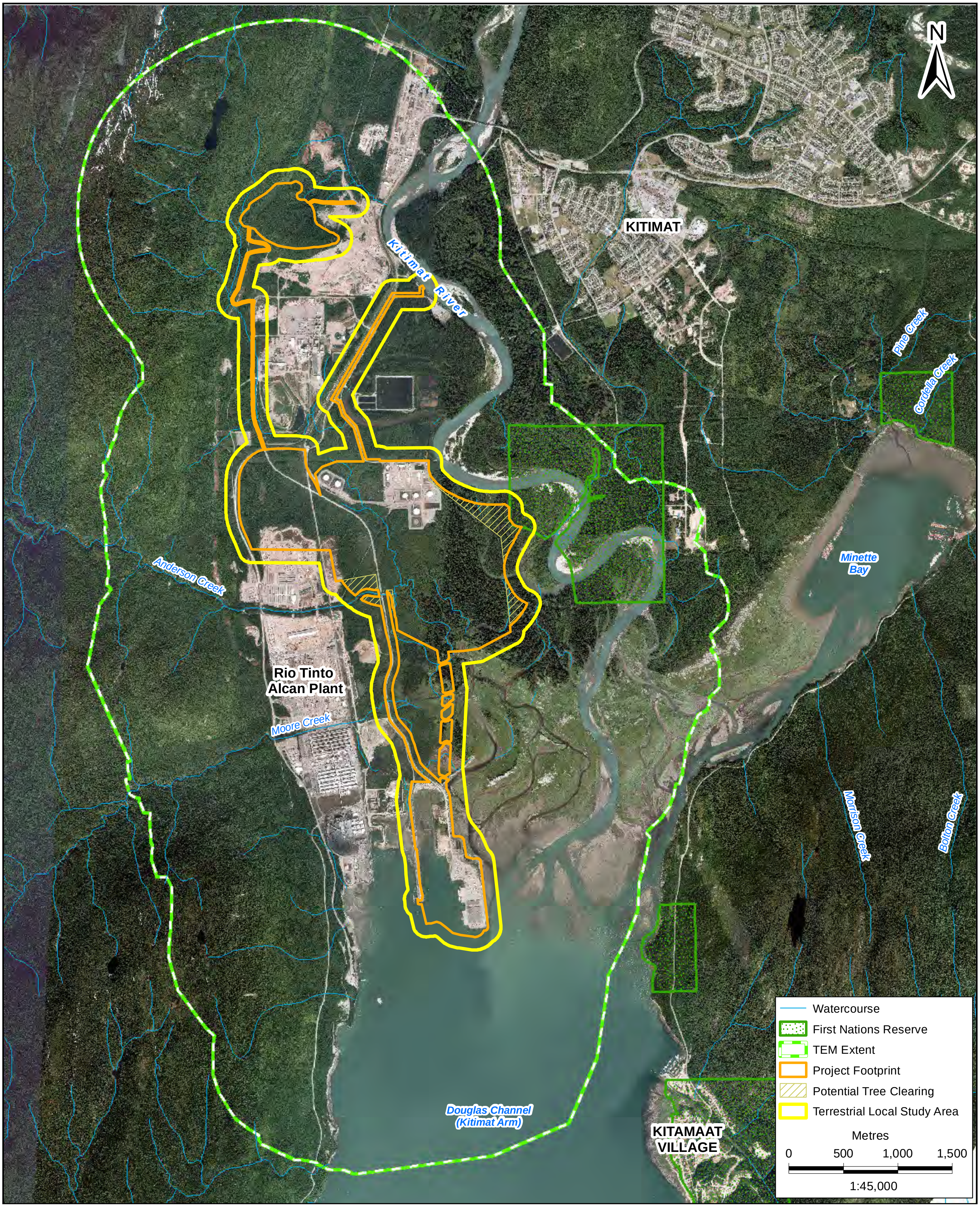
Five study areas are used in the assessment of vegetation resources: the Project footprint, terrestrial LSA, terrestrial RSA, emissions LSA and emissions RSA.

The terrestrial LSA and RSA (collectively called the Terrestrial Study Areas) are used to assess potential effects on vegetation due to clearing and site preparation, while the emissions LSA and RSA (collectively called the Emissions Study Areas) pertain to the potential effects on vegetation due to air emissions.

- The **Project footprint** is the physical area cleared for the Project (LNG facility) as well as the area that will be cleared of trees only (tree clearing) for safety requirements. The total area is approximately 430 ha, of which 21 ha may be subject to tree clearing but will not result in loss of understory vegetation.

- The **terrestrial LSA** is used to assess potential effects on vegetation related to physical works (e.g., clearing and site preparation) (Figure 5.5-1). It contains the Project footprint plus a 120 m buffer. The terrestrial LSA covers 786 ha and is selected because vegetation in this area is susceptible to potential direct and indirect (edge) effects. Extension Note 21 (Voller 1998; issued by MOF) reports that edge effects on soil temperature and moisture resulting from removal of forest cover can extend 60 m to 120 m from a clear-cut edge. Vegetation resources found below the average high tide are assessed within Marine Resources (see Section 5.8).
- The **terrestrial RSA** covers 127,893 ha and is used to place potential effects from physical works (e.g., clearing and site preparation) on vegetation into a regional context and to assess cumulative change in abundance (i.e., removal) of vegetation resources (Figure 5.5-2). The terrestrial RSA is the terrestrial portion of the Coastal Western Hemlock Very Wet Maritime (CWHvm) biogeoclimatic subzone that occurs within the Wedeene and Hirsch landscape units (BC MSRM 2002). The CWHvm is characterized by similar climate and vegetation to the Project footprint and is capable of supporting the vegetation resources included in this assessment. The Wedeene and Hirsch landscape units are established boundaries used for managing forest resources and biodiversity on provincial Crown land and are contiguous with the Project footprint.
- The **emissions LSA** is 63,419 ha and is based on the CALPUFF air quality modelling results encompassing the combined outermost boundary where empirical critical levels or loads are modelled to be exceeded, i.e., for nitrogen dioxide and sulphur dioxide fumigation and nitrogen, sulphur, and acid deposition (Figure 5.5-3). It is used to assess potential effects on vegetation health and diversity (see Stantec 2014d for modelling results). This spatial boundary deviates from the definition proposed in the AIR in order to align better with potential effects on the vegetation resources due to this mechanism.
- The **emissions RSA** is used for assessing potential effects on vegetation from air emissions, and it is 125 km by 40 km around the LNG facility (Figure 5.5-3). The emissions RSA is the modelling domain used for assessing acid deposition patterns and covers approximately 500,000 ha. The air modelling results were generated by CALPUFF and provided internally to the vegetation team by the air quality team.

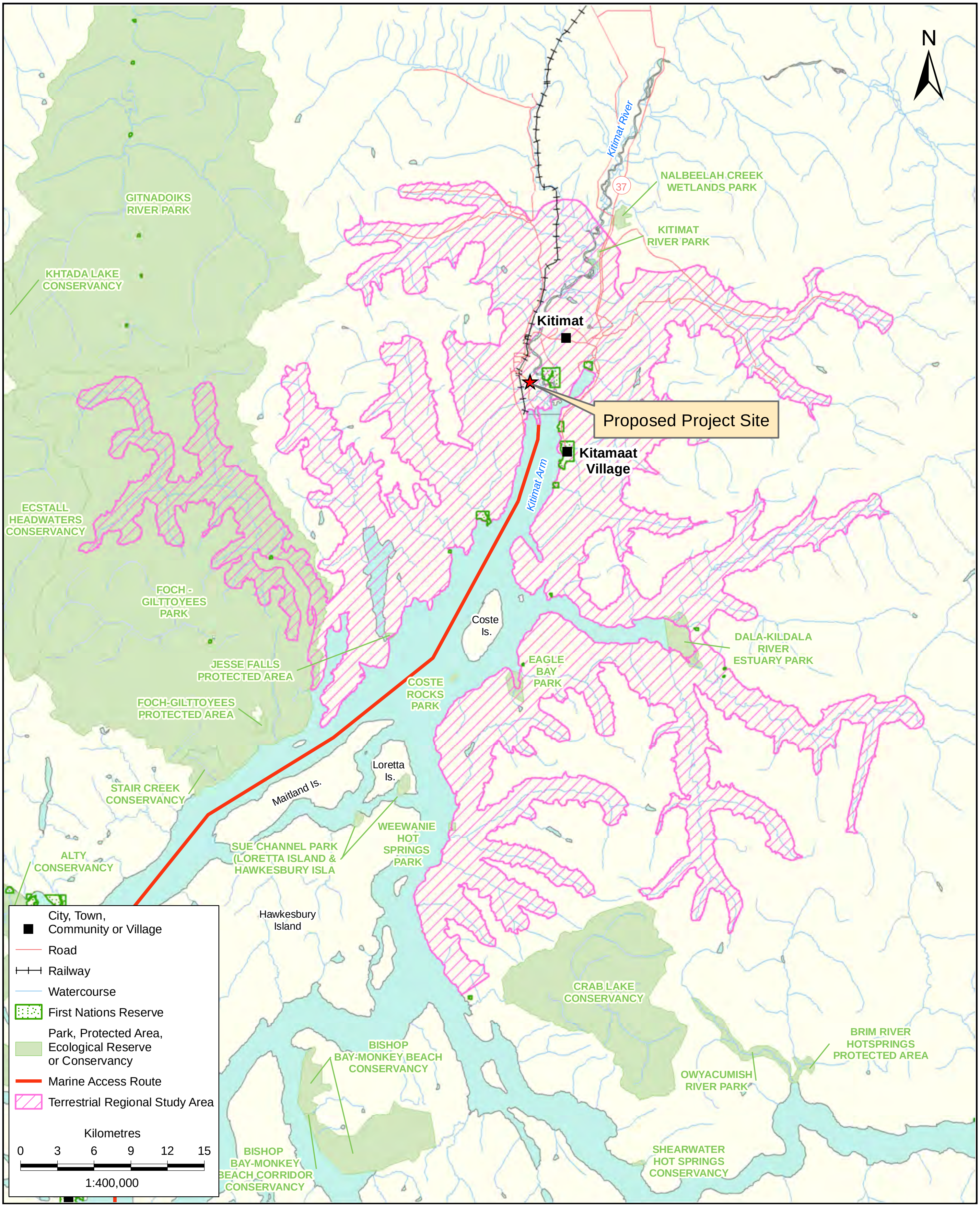
Cumulative effects of emissions on vegetation resources, including both direct and indirect effects, are assessed in the emissions RSA, while cumulative effects of vegetation removal are assessed within the terrestrial RSA.



V:\1231\active\EM\123110458\gis\figures\EA\section_5.5_vegetation\fig_10458_ea_veg_05_05_01_LSA.mxd

8/22/2014 - 10:46:35 AM

Stantec / LNG CANADA Opportunity for British Columbia. Energy for the world	*VEGETATION ENVIRONMENTAL EFFECTS ASSESSMENT* **TERRESTRIAL LOCAL STUDY AREA - VEGETATION RESOURCES** LNG CANADA EXPORT TERMINAL KITIMAT, BRITISH COLUMBIA	PROJECTION: UTM9	DRAWN BY: SS
		DATUM: NAD 83	CHECKED BY: SW
		DATE: 22-AUG-14	FIGURE NO. **5.5-1**



\\cd1183-f04\workgroup\1231\active\EM123110458\gis\figures\EA\section_5.5_vegetation\fig_10458_ea_veg_05_05_02_RSA.mxd

6/26/2014 - 10:12:15 AM

Stantec

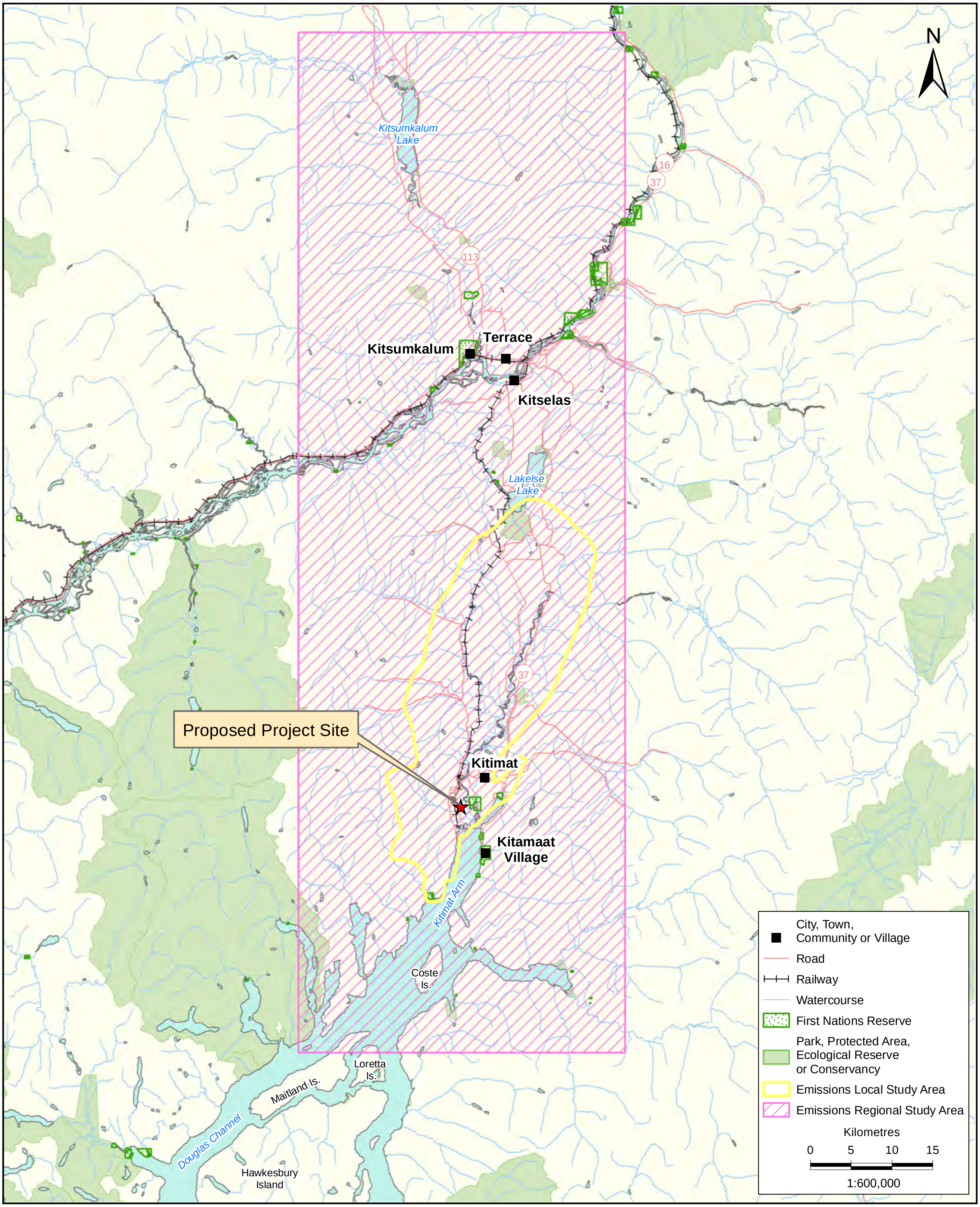
LNG CANADA
Opportunity for British Columbia. Energy for the world

VEGETATION ENVIRONMENTAL EFFECTS ASSESSMENT

TERRESTRIAL REGIONAL STUDY AREA - VEGETATION RESOURCES

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION	DRAWN BY
UTM9	SS
DATUM	CHECKED BY
NAD 83	SW
DATE	FIGURE NO.
26-JUN-14	5.5-2



Stantec

LNG CANADA
Opportunity for British Columbia. Energy for the world

VEGETATION ENVIRONMENTAL EFFECTS ASSESSMENT

EMISSIONS LOCAL AND REGIONAL STUDY AREAS

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION: UTM9	DRAWN BY: SS
DATUM: NAD 83	CHECKED BY: SW
DATE: 25-JUN-14	FIGURE NO. **5.5-3**

\\cd1183-f04\workgroup\1231\active\EM\123110458\gis\figures\EA\section_5.5_vegetation\fig_10458_ea_veg_05_05_03_emission_study_area.mxd

6/25/2014 - 3:37:47 PM

5.5.2.6.2 Temporal Boundaries

Based on the current Project schedule, the temporal boundaries 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 two years at the end of the Project life.

5.5.2.6.3 Administrative and Technical Boundaries

The Project site is in the District of Kitimat, and land use is governed by its current zoning, with future land use goals, objectives, and policies reflected in the District of Kitimat 2008 OCP (Stantec 2013). The four zoning types in the OCP are residential, commercial, industrial, and greenbelt. The Project is located in industrial zoning and much of the Project infrastructure lies within and adjacent to existing industrial infrastructure. The site is located on private, fee-simple lands, adjacent to the Rio Tinto Alcan site.

The Project is also inside the boundaries of the Kalum Land and Resource Management Plan (LRMP); however, the LRMP only guides land use outside the District of Kitimat (BC MSRM 2002). Nonetheless, the guidance, objectives, and strategies from the LRMP are considered guidance for characterizing potential effects on vegetation resources.

Technical boundaries for the vegetation assessment include limitations in scientific information, data analyses, and interpretation. The description of vegetation resources in the terrestrial LSA is based on literature sources, provincial databases (e.g., CDC 2013a searches for listed species and ecological communities), site-specific data collected through fieldwork in and near the terrestrial LSA, and extrapolation of Terrestrial Ecosystem Mapping (TEM) data (primarily used for ecosystem inventory and spatial distribution of ecosystem types). The description of vegetation resources in the terrestrial RSA and emissions LSA and RSA is based on the analysis of provincial datasets, including the Kalum Predictive Ecosystem Mapping (PEM) (Banner et al. 2003), Vegetation Resources Inventory (VRI) (BCGOV FOR 2013) for stand age predictions, and CDC data for listed ecological communities and species in the region.

The following are limitations of the datasets and analyses:

- TEM polygons are spatial map delineations created manually to which ecosystem types are assigned. TEM polygons can be mapped with more than one ecosystem type (up to a maximum of three map units per polygon). These complex polygons are mapped following standard guidelines and have known limitations. TEM polygons inherently include spatial error in specific ecosystem distributions due to the limitations of delineating pure (single ecosystem) polygons. Complex polygons (i.e., containing more than one ecosystem type) can be mapped, but the exact spatial location within the polygon is not apparent in the resulting map product. This is a known limitation of TEM.

- PEM is a coarse-scale computer-modelled ecosystem map based on provincial standards (BC Resources Inventory Committee (RIC) 1999). The overall reported accuracy of the Kalum PEM dataset is 47% to 49% (Yole 2007). This accuracy is averaged for all site series listed in the dataset region, which is much larger than the terrestrial and emissions RSAs. However, the accuracy for CWHvm1, the only biogeoclimatic subzone of the terrestrial LSA, is assessed at 67% to 68%. Site series in the terrestrial LSA are mapped using TEM and were field verified during baseline studies (Stantec 2014a).
- The VRI age data coverage is used to determine mature and old forest in the terrestrial and emissions RSAs; however, the area of this spatial layer only covers 63% of the terrestrial RSA. Old forest occurs within the area where VRI is missing; therefore, the area of old forest prediction in the terrestrial and emissions RSAs is a minimum estimate. Similarly, the PEM forested listed ecological communities are used in combination with the VRI age data to determine the mature and old stands of listed communities in the terrestrial RSA. Where the VRI age data are lacking, the mature forest stands cannot be separated from younger stands of listed forested communities. Therefore, reporting of listed forested communities likely includes younger seral stages (i.e., for any communities within the 37% of the terrestrial RSA lacking VRI coverage) and could be an overestimate. The available area for these parameters is deemed reasonable to allow Project residual effects and cumulative effects to be placed in the regional context and be assessed. Old forest and the age of provincially listed communities assessed in the terrestrial LSA are determined from TEM and do not contain the same limitations described for the data sets used for the terrestrial RSA and the emissions LSA and RSA.
- The datasets used to provide ecosystem information for the emissions RSA were originally created in different projections (e.g., BC Albers, UTM), necessitating the need to convert into a universal projection for application to this Project. These slight variations in original input projections have led to a minor discrepancy between the area of the emissions RSA and the calculated area ecosystem data intersected with air quality modelling data.
- Provincially listed ecological communities are described by a particular species assemblage and sometimes by a particular structural or seral stage as well (e.g., late-successional mature forest ecosystem that is dominated by certain climax coniferous species and understory species form an association). TEM classifies areas of land according to site series, which represents the climax community potentially supported by soils, climate, and landscape position at a given site. Recently disturbed, early successional stage examples of some site series do not necessarily exhibit the characteristic plant species assemblage of the provincially listed ecological communities. These instances may be considered either historical occurrences, or occurrences with low ecological integrity. In their current condition, they would not rank as high value conservation targets; however, given time and access to propagules, these areas may develop into the provincially listed ecological community

indicated by the site series name and, therefore, could be managed for recruitment or restoration purposes.

- Evaluation of traditional use, listed, and non-native invasive plants is limited to those recorded during 2012 and 2013 baseline field surveys (Stantec 2014a). A lack of detection of any of these vegetation parameters does not imply they are not present. Similarly, the list of traditional use plants was received after field surveys were completed; therefore, traditional use plants are compared to the field-generated plant lists post-field work.
- Emissions assessment on native vegetation health and diversity is limited to the scale and accuracy of the mapping products. For example, deciduous forests may be present within the areas affected by emissions but were not mapped by PEM within the modelled exceedance areas.

5.5.2.7 Residual Effects Description Criteria

Residual effects on vegetation resources remaining after the implementation of mitigation measures are characterized using the criteria in Table 5.5-3.

Table 5.5-3: Characterization of Residual Effects for Vegetation Resources

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Characterization of Residual Effects		
Magnitude	The expected size or severity of effect. Low magnitude effects may have negligible to little effect, while high magnitude effects may have a substantial effect.	**Negligible**—no measurable change of plant species, ecological communities of interest, or vegetation health or diversity **Low**— a measurable change affecting a portion of the regional population or community, yet the remaining regional population density or community's extent and health remain sufficient to sustain that population or community without active management **Moderate**— a measurable change affecting a portion of the regional population or community and there remains a degree of uncertainty or risk associated with ability of the regional population or community's extent to sustain that population or community; requires active management to ensure regional sustainability of population or community **High**—measurable change in plant species or ecological communities of interest relative to baseline conditions that would affect the entire local occurrence, population or community (see exceptions below), or measurable change in native vegetation health and diversity relative to baseline that would affect the entire local occurrence of ecological communities that are sensitive to air emissions. A high magnitude effect for wetlands is one that results in an unmitigated net-loss of wetland functions associated with wetlands that are designated as ecologically important to the region (Environment Canada 2014a). A high magnitude effect for old forest is a reduction in abundance of old forest from baseline extent that exceeds 87% of the estimated old forest mapped within the terrestrial RSA. This is in line with the provincial non-spatial old growth order, which establishes a minimum retention target of 13% old forest area for the Wedeene landscape unit (BC MSRM 2004).

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Geographic 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.	**Project footprint**—residual effects are restricted to the Project footprint **LSA**—residual effects extend into the terrestrial LSA **RSA**—residual effects extend into the terrestrial RSA
Duration	The length of time the residual effect persists. The duration of an effect can be short term or longer term.	**Short-term**—Effect restricted to one growing season **Medium-term**—Effect extends through operation of the Project **Long-term**—Effect extends beyond closure of the Project **Permanent**—measurable parameter unlikely to recover to baseline
Frequency	How often the effect occurs. The frequency of an effect can be frequent or infrequent. Short term and/or infrequent effects may have a lower effect than long term and/or infrequent effects.	**Single event** — occurs once **Multiple irregular event** (no set schedule)— occurs sporadically at irregular intervals throughout construction, operation or decommissioning phases **Multiple regular event** —occurs on a regular basis and at regular intervals throughout construction, operation, or decommissioning phases **Continuous**—occurs continuously throughout the life of the Project
Reversibility	Whether or not the residual effect on the VC can be reversed once the physical work or activity causing the disturbance ceases. Effects can be reversible or permanent. Reversible effects may have lower effect than irreversible or permanent effects.	**Reversible**—will recover after closure and reclamation. Irreversible—permanent.
Context	Refers primarily to the sensitivity and resilience of the VC. Consideration of context draws heavily on the description of existing conditions of the VC, which reflect cumulative effects of other projects and activities that have been carried out, and information about the impact of natural and human-caused trends on the condition of the VC. Project effects may have a higher effect if they occur in areas or regions that have already been adversely affected by human activities or have little resilience to imposed stresses (i.e., fragile)	**Low resilience**—low capacity for vegetation resources to recover from a perturbation, with consideration of the baseline level of disturbance **Moderate resilience**—moderate capacity for vegetation resources to recover from a perturbation, with consideration of the baseline level of disturbance **High resilience**— high capacity for vegetation resources to recover from a perturbation, with consideration of the baseline level of disturbance.
Likelihood of Residual Effects		
Likelihood	Whether or not a residual effect is likely to occur	**Low**—low likelihood that there will be a residual effect. **Medium** —moderate likelihood that there will be a residual effect. **High**—high likelihood that there will be a residual effect.

5.5.2.8 Significance Thresholds for Residual Effects

No regulatory defined thresholds exist for rating significance of effects on vegetation resources. Quantitative data available from vegetation studies along with qualitative professional judgment, based on literature and local knowledge of the ecology of the vegetation resources, are combined to develop significance thresholds for each residual effect. These thresholds are defined in Table 5.5-4.

Table 5.5-4: Significance Thresholds for Vegetation Resources

Potential Effect	Threshold
Change in abundance of plant species of interest	Significant if residual effects are such that the viability of these plant species is impaired within the terrestrial RSA.
Change in abundance or condition of ecological communities of interest	Significant if residual effect interferes with the persistence of these communities within the terrestrial RSA. For wetlands, residual effects from the Project are significant if they result in an unmitigated net-loss of wetland functions for ecologically important wetlands as defined by guidance from Environment Canada (Environment Canada 2014a).
Change in native vegetation health and diversity	Significant if residual effects interfere with the regional persistence of ecological communities that are sensitive to air emissions in excess of critical loads or critical levels.

5.5.3 Baseline Conditions

5.5.3.1 Baseline Data Sources

Baseline conditions for vegetation resources within the terrestrial LSA are described in detail in the Vegetation TDR (Stantec 2014a) and are summarized here with a focus on results that are relevant to this assessment.

Data sources used for the baseline description are:

- TEM in the vegetation LSA and the TEM extent (i.e., the larger wildlife LSA); the TEM extent is used to determine minimum extent of ecological communities of interest where the PEM was lacking detail
- listed vascular plant, bryophyte, and lichen species identified using CDC (2013a) Species Explorer tool provided by the MOE
- known occurrences of listed ecological communities or plant species within the terrestrial LSA by searching the CDC Internet Mapping Service
- ecosystem and vegetation field surveys (105 plots) conducted in August and September 2012, September 2013 and May 2014, including field checks of the TEM, ecosystem classifications, and plant species inventory

- rare plant surveys conducted in June and August 2012, and
- consultation with and input from Aboriginal Groups, including TU/TK information (see Section 13 for more detail), regulators, and the public.

Baseline conditions in the emissions RSA are described in the Emissions Assessment on Soils and Vegetation (Stantec 2014d). The Kalum PEM (Banner et al. 2003), VRI (BCGOV FOR 2013), and available disturbance spatial data are used to describe the vegetation types and land cover within the emissions RSA.

5.5.3.2 Baseline Overview

5.5.3.2.1 Terrestrial Local Study Area, Terrestrial Ecosystem Mapping

The TEM identified 26 ecological communities (including shallow open water) and 16 anthropogenic, sparsely vegetated, and non-vegetated map units in the terrestrial LSA (Table 5.5-5). The terrestrial LSA falls within the Coastal Western Hemlock Very Wet Maritime (CWHvm1) biogeoclimatic variant and is 14% upland forest, 33% floodplain, and 17% wetlands. The remaining 36% of the terrestrial LSA is anthropogenic, sparsely vegetated, and non-vegetated units. The most common ecosystem in the terrestrial LSA is the Sitka spruce - salmonberry high fluvial bench floodplain, which covers 180 ha (23% of the terrestrial LSA).

Table 5.5-5: Mapped Ecosystems in the Terrestrial Study Areas

Site Series/ Wetland Code	Map Code	Ecosystem Name	Terrestrial Study Area (ha)				
			Project Footprint			LSA	RSA[c]
			LNG Facility	Tree Clearing Area	Total		
Upland Forest Units							
CWHvm1/01	AB	western hemlock – amabilis fir / blueberry	15.8	0	15.8	49.3	17,108.9
CWHvm2/01			0	0	0	0	4,333.6
Subtotal AB (01)			15.8	0	15.8	49.3	21,442.5
CWHvm1/02	LC	western hemlock – shore pine / cladina	2.7	0	2.7	6.7	≥6.8
CWHvm1/03[a]	HS	western hemlock – western redcedar / salal	2.0	0	2.0	6.3	≥279.8
CWHvm2/03[a]			0	0	0	0	≥78.2
Subtotal HS (03)			2.0	0	2.0	6.3	≥358.0
CWHvm1/04[a]	RS	western redcedar – western hemlock / sword fern	6.4	0	6.4	9.6	≥61.3
CWHvm1/05	AF	amabilis fir – western redcedar / foamflower	0.5	0	0.5	6.3	≥136.2
CWHvm2/05			0	0	0	0	≥14.9
Subtotal AF (05)			0.5	0	0.5	6.3	≥151.1

Site Series/ Wetland Code	Map Code	Ecosystem Name	Terrestrial Study Area (ha)				
			Project Footprint			LSA	RSA[c]
			LNG Facility	Tree Clearing Area	Total		
CWHvm1/08[a]	AD	amabilis fir – Sitka spruce / devils club	3.4	0	3.4	12.5	10,522.2
CWHvm2/08			0	0	0	0	1,901.8
Subtotal AD (08)			3.4	0	3.4	12.5	12,424.0
CWHvm1/19[a]	SP	Sitka spruce – Pacific crab apple	10.2	0	10.2	20.2	≥51.1
Upland Forest Total			40.8	0	40.8	111.1	97,332.4
Floodplain							
High Fluvial Bench							
CWHvm1/09[b]	SS	Sitka spruce / salmonberry	114.5	10.9	125.3	179.8	1,852.9
CWHws1/07	SS		0	0	0	0	1.7
CWHws2/07	SS		0	0	0	0	156.0
Subtotal SS (09, 07)			114.5	10.9	125.3	179.8	2,010.6
Mid Fluvial Bench							
CWHvm1/Fm00	PC	Pacific crab apple / false lily of the valley floodplain	0.9	0	0.9	2.2	≥5.6
CWHvm1/10	CD	cottonwood / red-osier dogwood	24.3	6.2	30.5	67.3	≥322.4
CWHws1/08	CD		0	0	0	0	1.7
CWHws2/08	CD		0	0	0	0	156.0
Subtotal CD (10, 08)			24.3	6.2	30.5	67.3	≥637.8
Low Fluvial Bench							
CWHvm1/Fl50	SF	Sitka willow / false lily of the valley floodplain	0.2	0.3	0.5	1.0	≥6.4
CWHvm1/11	CW	cottonwood / willow	4.1	1.6	5.7	10.3	≥57.7
CWHws1/09	CW		0	0	0	0	2.9
CWHws2/09	CW		0	0	0	0	133.9
Subtotal CW (11, 09)			4.1	1.6	5.7	10.3	≥194.5
Floodplain Total			143.9	18.9	162.8	260.6	5,055.4
Wetlands							
Estuarine							
CWHvm1/Em05[b]	LY	Lyngbye’s sedge estuary	7.6	0	7.6	13.1	≥78.3
CWHvm1/Em06[a]	LD	Lyngbye’s sedge / Douglas water hemlock estuary	1.4	0	1.4	2.8	≥74.8
CWHvm1/Ed01[b]	TH	tufted hairgrass / meadow barley estuary	1.6	0	1.6	5.0	≥5.1
CWHvm1/Ed02[b]	TD	tufted hairgrass / Douglas aster estuary	2.5	0	2.5	10.8	≥87.4

Site Series/ Wetland Code	Map Code	Ecosystem Name	Terrestrial Study Area (ha)				
			Project Footprint			LSA	RSA[c]
			LNG Facility	Tree Clearing Area	Total		
CWHvm1/Fl00	DW	dune wildrye / Pacific hemlock / parsley estuary	0.3	0	0.3	0.9	≥21.2
Estuarine Total			13.2	0	13.2	32.5	394.2
Fen							
CWHvm1/Wf01	BK	water sedge / beaked sedge fen	0.1	0	0.1	0.1	≥0.1
CWHvm1/Wf52[b]	SG	sweet gale / Sitka sedge fen	1.1	0	1.1	4.7	≥10.2
Fen Total			1.2	0	1.2	4.8	≥10.3
Marsh							
CWHvm1/Wm05[a]	CT	cattail marsh	2.6	0	2.6	6.8	≥6.8
CWHvm1/Wm50[a]	PP	Sitka sedge / hemlock / parsley marsh	6.9	0	6.9	11.4	≥15.3
Marsh Total			9.5	0	9.5	18.2	≥22.1
Swamp							
CWHvm1/14	RC	western redcedar – Sitka spruce / skunk cabbage	32.9	1.6	34.5	46.1	1,209.4
CWHvm2/11			0	0	0	0	308.8
CWHws1/11			0	0	0	0	0.4
CWHws2/11			0	0	0	0	499.2
Subtotal RC (14 and 11)			32.9	1.6	34.5	46.1	2,017.8
CWHvm1/Ws50	PS	hardhack / Sitka sedge swamp	13.6	0.1	13.7	20.0	>22.5
CWHvm1/Ws51[b]	SW	Sitka willow – Pacific willow / skunk cabbage swamp	9.7	0.2	9.9	12.5	≥13.2
Swamp Total			56.2	1.9	58.1	78.6	2,017.8
CWHvm1/00	OW	shallow open water	1.5	0	1.5	1.6	≥2.4
Wetland Total			81.6	1.9	83.5	135.6	17,082.4
Avalanche – Slide total			0	0	0	0	2,118.4
Vegetated Total			262.8	21.2	291.5	507.3	121,613.5
Anthropogenic, Sparsely, and Non-Vegetated							
CWHvm1/00	BE	beach	3.6	0	3.6	4.3	≥22.9
CWHvm1/00	BU	build-up (developed areas)	87.1	0.4	87.6	155.5	≥604.7
CWHvm1/00	DK	dike	4.7	0	4.7	5.3	≥8.0
CWHvm1/00	EP	effluent ponds	0.3	0	0.3	3.0	≥26.0
CWHvm1/00	ES	exposed soil	0.2	0	0.2	1.0	
CWHvm1/00	GB	gravel bar	0	0	0	0.2	≥34.4
CWHvm1/00	OC	ocean	27.0	0	27.0	56.3	277.6
CWHvm1/00	OR	organic wood waste	0	0	0	1.0	≥1.3

Site Series/ Wetland Code	Map Code	Ecosystem Name	Terrestrial Study Area (ha)				
			Project Footprint			LSA	RSA[c]
			LNG Facility	Tree Clearing Area	Total		
CWHvm1/00	PD	pond	0.7	0	0.7	0.7	≥10.5
CWHvm1/00	RE	reservoir	0.1	0	0.1	3.7	≥10.9
CWHvm1/00	RI	river	2.6	0	2.6	14.5	1,705.5
CWHvm1/00	RN	railway	<0.1	0	<0.1	4.1	≥6.6
CWHvm1/00	RR	rural	0.6	0	0.6	0.7	≥9.0
CWHvm1/00	RZ	road surface	1.7	0	1.7	6.1	≥11.5
CWHvm1/00	TA	talus	0	0	0	0	≥0.5
CWHvm1/00	TL	transmission line / shrub cutline	7.3	0	7.3	18.1	≥50.6
CWHvm1/00	UR	urban	1.3	0.1	1.5	4.3	1,559.1
Anthropogenic, Sparsely, and Non-Vegetated Total			137.3	0.6	137.9	278.6	6,279.6
Total			408.0	21.4	429.4	785.9	127,893.1

NOTE:

Values may not sum to totals shown because of rounding, and spatial boundaries refer to the terrestrial LSA and RSA

[a] Blue-listed ecological community (note that some units (e.g., HS) do not occur in the terrestrial LSA in a mature state and therefore are not considered listed)

[b] Red-listed ecological community

[c] Terrestrial RSA subtotals for upland, floodplain, estuarine, wetland, and anthropogenic categories are the area of all communities within that broader category. Where the specific community is mapped within the terrestrial RSA, areas are reported by ecological community. Where the PEM did not identify the ecological community, the results from the TEM extent are included with '≥' and are the minimum mapped area. Only terrestrial RSA communities that occur within the terrestrial LSA are summarized here, with the reference to the terrestrial RSA where data exist. See Stantec (2014a) for a list of communities in the terrestrial RSA.

[d] Pre-existing disturbance layers developed from the combination of public sources and delineation from 2012 orthophoto imagery are overlaid onto the TEM for disturbed lands that are too small to delineate as pure polygons using the standard TEM methods. These disturbance areas are removed from the TEM summaries where these occurred and accounted for in the effluent pond, transmission line, and industrial build-up map codes.

[e] The MHmm1 is the Windward Moist Maritime Mountain Hemlock biogeoclimatic subzone.

The terrestrial LSA lies within the CWHvm1; however, according to the PEM dataset, the terrestrial RSA contains CHWvm1, CWHvm2, CWHws1, CWHws2, and MHmm1. The equivalent site series for communities in each variant are provided.

5.5.3.2.2 Vegetation Mapping within the Terrestrial RSA

The Kalum PEM (Banner et al. 2003) is used for estimating vegetation and ecosystem presence and their distribution across the terrestrial RSA. The summary of ecosystems mapped in the terrestrial RSA that are also in the terrestrial LSA and Project footprint are listed in Table 5.5-5; the remaining mapped ecosystems in the terrestrial RSA are reported in Stantec (2014a).

The terrestrial RSA spatial boundary is defined by the CWHvm because it was delineated in 2012 whereas the biogeoclimatic subzone boundaries in the PEM dataset were delineated in 2003. Therefore, the two versions of the subzone boundaries differ within portions of the RSA, resulting in some ecosystems within the PEM classified as other than CWHvm, such as mountain hemlock (MH) and CWH

Wet Submaritime (ws) (Stantec (2014a). This variation between revisions of provincial biogeoclimatic linework is not uncommon because the zone boundaries are periodically revised by the MFLNRO.

Approximately 76% of the landscape in the terrestrial RSA is forested upland, 13% is wetland, 4% is floodplain, and 2% is avalanche slopes. Non-vegetated and anthropogenic units are 5% of the landscape and include features such as rock outcrops or urban developments. Approximately 34% of the terrestrial RSA (43,255 ha) is old forest. The terrestrial RSA is dominated by four ecosystems, occupying 51% of the area:

- CWHvm1/06 and CWHvm2/06 western hemlock-amabilis fir / deer fern at 17%
- CWHvm1/01 and CWHvm2/02 western hemlock-amabilis fir / blueberry at 17%
- CWHvm1/08 and CWHvm2/08 amabilis fir-Sitka spruce / devil's club at 10%, and
- CWHvm1/03 and CWHvm2/03 western hemlock – western redcedar / salal at 7%.

5.5.3.2.3 Plant Species at Risk in the Terrestrial Study Areas

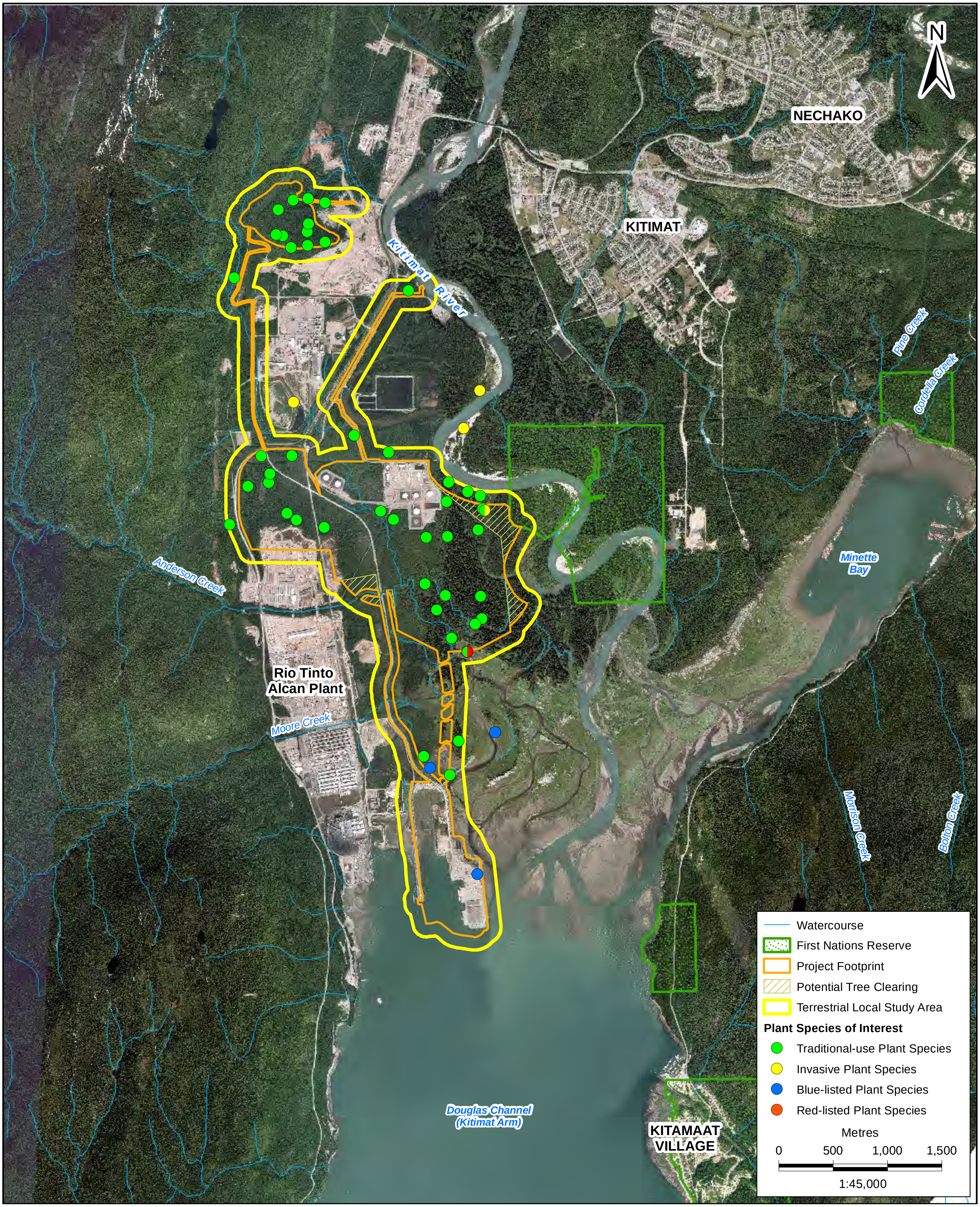
Twenty-four species at risk have potential to occur in the terrestrial RSA. All are provincially listed and three are listed by SARA and COSEWIC. Whitebark pine (*Pinus albicaulis*) is ranked *endangered* on SARA Schedule 1 and COSEWIC. Cryptic paw lichen (*Nephroma occultum*) and old growth specklebelly (*Pseudocyphellaria rainierensis*) are both ranked as *special concern* on SARA Schedule 1 and COSEWIC.

During the 2012 field surveys, three provincially listed plant species were detected in-, or near, the terrestrial LSA (Table 5.5-6, Figure 5.5-4). Eminent bluegrass (*Poa eminens*), a blue-listed species, was located twice: outside the footprint but in the terrestrial LSA and in the terrestrial RSA. Rock sandwort (*Minuartia stricta*), also a blue-listed species, was located in the Project footprint. One red-listed species, long-leaved aster (*Symphyotrichum ascendens*), was located in the Project footprint. No species assessed by COSEWIC or listed in SARA were detected during field surveys.

Table 5.5-6: Listed Plant Species in the Terrestrial Study Areas

Common Name	Scientific Name	Provincial Status	SARA Status	Number of Locations		In the Project Footprint (Yes/No)
				Within RSA, outside of LSA	LSA	
eminent bluegrass	*Poa eminens*	blue	not listed	1	1	No[a]
rock sandwort	*Minuartia stricta*	blue	not listed	0	1	Yes
long-leaved aster	*Symphyotrichum ascendens*	red	not listed	0	1	Yes

NOTES:
Spatial boundaries refer to the terrestrial LSA and RSA
[a] The eminent bluegrass location lies outside the Project footprint between clearing areas in the terrestrial LSA.



Stantec	LNG CANADA Opportunity for British Columbia. Energy for the world	*VEGETATION ENVIRONMENTAL EFFECTS ASSESSMENT*	PROJECTION UTM9	DRAWN BY SS
		PLANT SPECIES OF INTEREST	DATUM NAD 83	CHECKED BY SW
		LNG CANADA EXPORT TERMINAL KITIMAT, BRITISH COLUMBIA	DATE 22-AUG-14	FIGURE NO. **5.5-4**

V:\1231\active\EM1231104580\gis\figures\EA\section_5.5_vegetation\fig_10458_ea_veg_05_05_04_plant_species_of_interest_LSA.mxd 8/22/2014 - 10:56:02 AM

Listed species that are known to occur in the terrestrial RSA, but outside the terrestrial LSA, as determined from an online search, are the two lichen species ranked *special concern* on SARA Schedule 1 and COSEWIC (CDC 2013a):

- provincially blue-listed cryptic paw lichen, and
- provincially blue-listed old growth specklebelly.

5.5.3.2.4 Non-Native Invasive Plant Species in the Terrestrial Study Areas

Three non-native invasive plant species were detected near the Project (see Table 5.5-7 and Figure 5.5-4). Of these three species, one, Canada thistle (*Cirsium arvense*), is currently regulated as *noxious* under the BC *Weed Control Act*. The other two species, oxeye daisy (*Chrysanthemum leucanthemum*) and common tansy (*Tanacetum vulgare*) are listed by the NWIPC as being *very invasive* and *extremely invasive* in their region (NWIPC 2013). These species are generally associated with previously disturbed areas.

Table 5.5-7: Non-Native Invasive Plant Species in the Terrestrial Study Areas

Common Name	Scientific Name	NWIPC Invasiveness Class; Weed Control Act listing	RSA (Number of Locations)	LSA (Number of Locations)	In the Project Footprint (Yes/No)
Canada thistle	*Cirsium arvense*	very invasive[a] noxious[b]	1	0	No
oxeye daisy	*Chrysanthemum leucanthemum*	very invasive[a]	2	0	No
common tansy	*Tanacetum vulgare*	extremely invasive[a]	1	1	No

NOTES:
Spatial boundaries refer to the terrestrial LSA and RSA
[a] Listed by the Northwest Invasive Plant Council
[b] Regulated by the BC *Weed Control Act*

5.5.3.2.5 Traditional Use Plants in the Terrestrial Study Areas

Forty-nine genera and/or species used by potentially affected Aboriginal Groups were detected within the terrestrial LSA, including 7 tree, 20 shrub, 18 forbs, two fern, and 2 moss (Table 5.5-8; Figure 5.5-4). Several species were identified within the terrestrial LSA and RSA that were not in the Project footprint (Stantec 2014a). Four traditional use species were observed within the Project footprint, but not the terrestrial LSA: buttercup (*Ranunculus* sp.), licorice fern (*Polypodium glycyrrhiza*), Pacific willow (*Salix lasiandra* var *lasiandra*) and peat moss (*Sphagnum* spp.)

Table 5.5-8: Traditional Use Plant Abundance in the Terrestrial Study Areas

Form	Genus	Species	Common Name	Number of Plots			Plot Frequency (%)		
				Project Footprint	LSA	RSA	Footprint	LSA	RSA
Tree	Alnus	*Alnus rubra*	red alder	22	33	53	51	51	50
	Malus	*Malus fusca*	Pacific crab apple	12	17	26	28	26	24
	Picea	*Picea sitchensis*	Sitka spruce	19	27	48	44	42	45
	Populus	*Populus trichocarpa*	black cottonwood	7	15	27	16	23	25
	Thuja	*Thuja plicata*	western redcedar	13	18	34	30	28	32
	Tsuga	*Tsuga sp.*	hemlock	1	1	1	2	2	1
		Tsuga heterophylla	western hemlock	25	38	62	58	58	58
Shrub	Cornus	*Cornus stolonifera*	red-osier dogwood	8	16	26	19	25	24
	Lonicera	*Lonicera involucrata*	black twinberry	6	7	16	14	11	15
	Oplopanax	*Oplopanax horridus*	devil's club	20	33	48	47	51	45
	Ribes	*Ribes lacustre*	black gooseberry	0	1	1	0	2	1
		Ribes sp.	currant or gooseberry	0	1	1	0	2	1
		Ribes bracteosum	stink currant	8	12	17	19	18	16
		Ribes laxiflorum	trailing black currant	11	18	22	26	28	21
	Rosa	*Rosa nutkana*	Nootka rose	1	2	8	2	3	7
	Rubus	*Rubus idaeus*	red raspberry	0	0	3	0	0	3
		Rubus spectabilis	salmonberry	25	39	58	58	60	54
		Rubus parviflorus	thimbleberry	11	17	31	26	26	29
	Salix	*Salix lucida*	Pacific willow	1	1	3	2	2	3
		Salix sitchensis	Sitka willow	2	3	6	5	5	6
	Sambucus	*Sambucus racemosa*	red elderberry	25	38	52	58	58	49

Form	Genus	Species	Common Name	Number of Plots			Plot Frequency (%)		
				Project Footprint	LSA	RSA	Footprint	LSA	RSA
	Vaccinium	*Vaccinium alaskaense*	Alaskan blueberry	3	3	5	7	5	5
		Vaccinium membranaceum	black huckleberry	0	0	6	0	0	6
		Vaccinium ovatum	evergreen huckleberry	0	0	1	0	0	1
		Vaccinium ovalifolium	oval-leaved blueberry	1	2	8	2	3	7
		Vaccinium parvifolium	red huckleberry	7	10	13	16	15	12
	Viburnum	*Viburnum edule*	highbush-cranberry	0	1	2	0	2	2
Forb	Achillea	*Achillea millefolium*	yarrow	1	2	5	2	3	5
	Angelica	*Angelica genuflexa*	kneeling angelica	0	2	5	0	3	5
	Aruncus	*Aruncus dioicus*	goatsbeard	2	5	13	5	8	12
	Epilobium	*Epilobium angustifolium*	fireweed	0	0	2	0	0	2
	Fritillaria	*Fritillaria camschatcensis*	northern rice-root	0	0	2	0	0	2
	Heracleum	*Heracleum maximum*	cow-parsnip	3	7	13	7	11	12
	Lupinus	*Lupinus arcticus*	arctic lupine	0	1	1	0	2	1
		Lupinus nootkatensis	Nootka lupine	1	3	5	2	5	5
	Lysichiton	*Lysichiton americanus*	skunk cabbage	8	11	17	19	17	16
	Maianthemum	*Maianthemum dilatatum*	false lily-of-the-valley	10	20	29	23	31	27
	Oenanthe	*Oenanthe sarmentosa*	Pacific water-parsley	5	5	7	12	8	7
	Potentilla	*Potentilla egedii*	coast silverweed	3	7	12	7	11	11
	Ranunculus	*Ranunculus sp.*	buttercup	1	1	1	2	2	1
	Trifolium	*Trifolium pratense*	red clover	0	0	1	0	0	1
		Trifolium repens	white clover	0	0	1	0	0	1
	Typha	*Typha latifolia*	common cattail	1	2	3	2	3	3
	Urtica	*Urtica dioica*	stinging nettle	1	2	2	2	3	2

Form	Genus	Species	Common Name	Number of Plots			Plot Frequency (%)		
				Project Footprint	LSA	RSA	Footprint	LSA	RSA
	Veratrum	*Veratrum viride*	Indian hellebore	3	3	3	7	5	3
Fern	Dryopteris	*Dryopteris expansa*	spiny wood fern	18	29	39	42	45	36
	Polypodium	*Polypodium glycyrrhiza*	licorice fern	1	1	1	2	2	1
Moss	Sphagnum	*Sphagnum capillifolium*	common red peat-moss	0	0	1	0	0	1
		Sphagnum sp.	peat-moss	1	1	1	2	2	1

NOTES:

Spatial boundaries refer to the terrestrial LSA and RSA

[a] Plot frequency is calculated as the number of plots in which a species was found divided by the total number of plots in each area, multiplied by 100 to get percent. For the footprint, n=43 plots, terrestrial LSA n=65 plots and terrestrial RSA n= 107 plots.

[b] Where the common name provided by Aboriginal Groups could refer to multiple species, all species are included. These instances include willows (*Salix* spp), blueberries and huckleberries (*Vaccinium* spp), currant (*Ribes* spp) and lupines (*Lupinus* spp).

5.5.3.2.6 Ecological Communities at Risk in the Terrestrial Study Areas

Six blue-listed and six red-listed ecological communities comprise 54 ha (7%) and 130 ha (17%) of the terrestrial LSA, respectively (Table 5.5-9, Figure 5.5-5, and Figure 5.5-6). The dominant listed ecological communities in the terrestrial LSA are:

- Sitka spruce / salmonberry forest (CWHvm1/09; red-listed), covering 84 ha (11%),
- Sitka spruce / Pacific crab apple forest (CWHvm1/19; blue-listed), covering 20 ha (3%),
- Lyngbye's sedge estuary (CWHvm1/Em05; red-listed), covering 13 ha (2%), and
- Sitka willow / Pacific crab apple / skunk cabbage swamp (CWHvm1/Ws51; red-listed), covering 13 ha (2%).

In the Project footprint, 29 ha and 83 ha of blue- and red-listed communities occur, respectively (Table 5.5-9). Stantec (2014a) provides baseline information on these communities regarding their conservation status and rationale for listing. In general, the upland communities are productive sites with higher pressures from harvesting practices. Listed wetland communities satisfy at least one of the following conditions:

- are vulnerable to hydrological changes due to development disturbances, which result in changes to species composition and/or wetland function, or
- are limited in distribution across the landscape, or
- have insufficient information about known ranges.

The conservation listing of the estuarine communities derives from estuaries not being naturally abundant and occupying a small percentage of the BC coastline. Within the terrestrial RSA, the PEM estuary area is approximately 394 ha. In many parts of BC, estuaries have already been diked and drained. The Dala-Kildala Rivers Estuaries Provincial Park, located near Kitimat, in the terrestrial RSA, was created to protect estuaries (Flynn et al. 2006).

Table 5.5-9: Listed Ecological Communities in the Terrestrial Study Areas

Site Series / Wetland Code	Map Code	Ecosystem Name	Terrestrial Study Area (ha)				
			Project Footprint			LSA	RSA[b]
			Facility	Tree Clearing Area	Total		
Blue-listed							
CWHvm1/08[a]	AD	amabilis fir – Sitka spruce / devil's club	1.9	0	1.9	4.1	3,328.0
CWHvm1/14[a]	RC	western redcedar – Sitka spruce / skunk cabbage	5.7	0.1	5.8	8.3	1,040.2
CWHvm1/19[a]	SP	Sitka spruce / Pacific crab apple	10.2	0	10.2	20.2	≥50.3
CWHvm1/Em06	LD	Lyngbye's sedge / Douglas water hemlock estuary	1.4	0	1.4	2.8	≥74.8
CWHvm1/Wm05	CT	cattail marsh	2.6	0	2.6	6.8	≥6.8
CWHvm1/Wm50	PP	Sitka sedge / hemlock / parsley marsh	6.9	0	6.9	11.4	≥15.3
Subtotal			28.7	0.2	28.8	53.6	4,368.2
Red-listed							
CWHvm1/09[a]	SS	Sitka spruce / salmonberry	52.7	7.6	60.3	84.3	895.4
CWHvm1/Ed01	TH	tufted hairgrass / meadow barley estuary	1.6	0	1.6	5.0	≥5.1
CWHvm1/Ed02	TD	tufted hairgrass / Douglas aster estuary	2.5	0	2.5	10.8	≥87.4
CWHvm1/Em05	LY	Lyngbye's sedge estuary	7.6	0	7.6	13.1	≥78.3
CWHvm1/Wf52	SG	sweet gale / Sitka sedge fen	1.1	0	1.1	4.7	≥10.2
CWHvm1/Ws51	SW	Sitka willow / Pacific willow / skunk cabbage swamp	9.7	0.2	9.8	12.5	≥13.2
Subtotal			75.1	7.8	82.9	130.4	895.4
Total			103.8	8.1	11.9	184.0	5,263.6

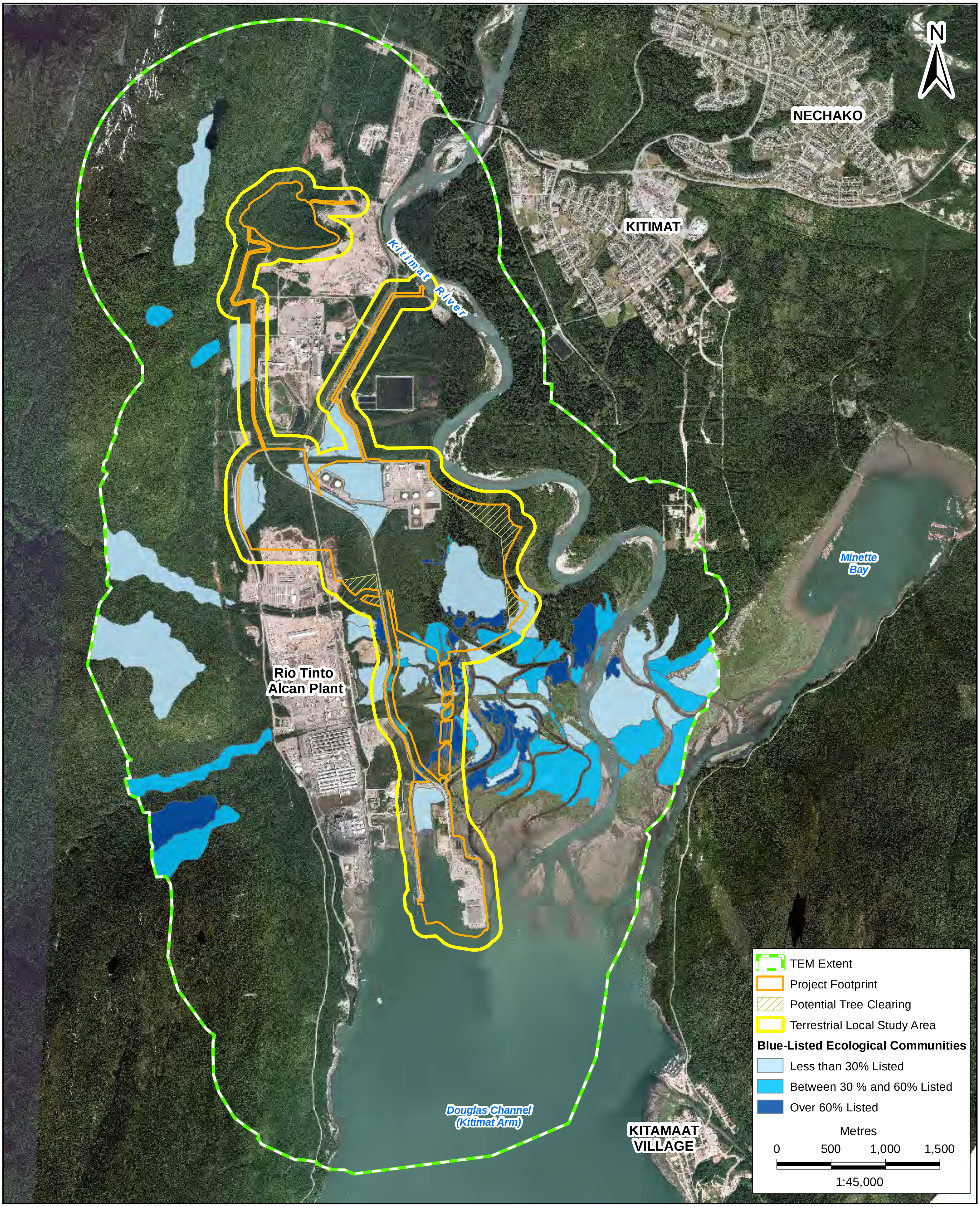
NOTES:

Values may not sum to totals shown because of rounding, and spatial boundaries refer to the terrestrial LSA and RSA

[a] Indicates forested plant community with a structural stage equal to or greater than 6.

[b] ≥ indicates that this community is found within the TEM extent beyond the terrestrial LSA, but is not mapped by PEM. The area may be greater to or equal to the area listed in the PEM, but by an unknown amount.

terrestrial RSA totals in this table only include mature (older than 80 years) stands estimated using available VRI data. Coverage of VRI in the terrestrial RSA is incomplete (approximately 63%); therefore, actual areas are likely higher.



Stantec

LNG CANADA
Opportunity for British Columbia. Energy for the world

VEGETATION ENVIRONMENTAL EFFECTS ASSESSMENT

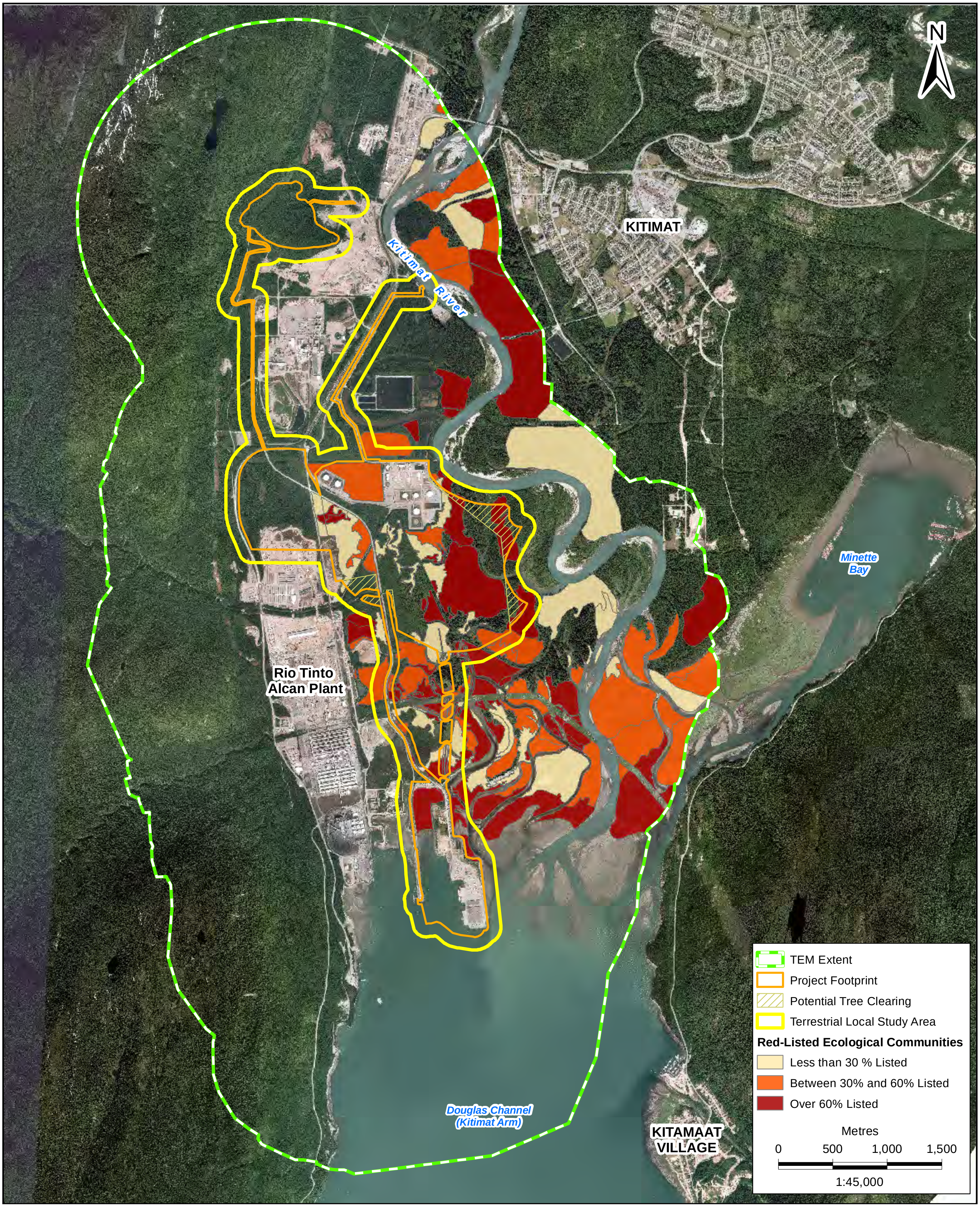
BLUE-LISTED ECOLOGICAL COMMUNITIES

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION	DRAWN BY
UTM9	SS
DATUM	CHECKED BY
NAD 83	SW
DATE	FIGURE NO.
22-AUG-14	**5.5-5**

V:\1231\active\EM\123110458\gis\figures\EA\section_5.5_vegetation\fig_10458_ea_veg_05_05_05_blue_listed_rare_plant_communities_LSA.mxd

8/22/2014 - 10:49:27 AM



V:\1231\active\EM1231\10458\gis\figures\EA\section_5.5_vegetation\fig_10458_ea_veg_05_05_06_red_listed_rare_plant_communities_LSA.mxd

8/22/2014 - 10:49:41 AM

Stantec

LNG CANADA Opportunity for British Columbia. Energy for the world

VEGETATION ENVIRONMENTAL EFFECTS ASSESSMENT

RED-LISTED ECOLOGICAL COMMUNITIES

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION: UTM9	DRAWN BY: SS
DATUM: NAD 83	CHECKED BY: SW
DATE: 22-AUG-14	FIGURE NO. **5.5-6**

5.5.3.2.7 Wetlands in the Terrestrial Study Areas

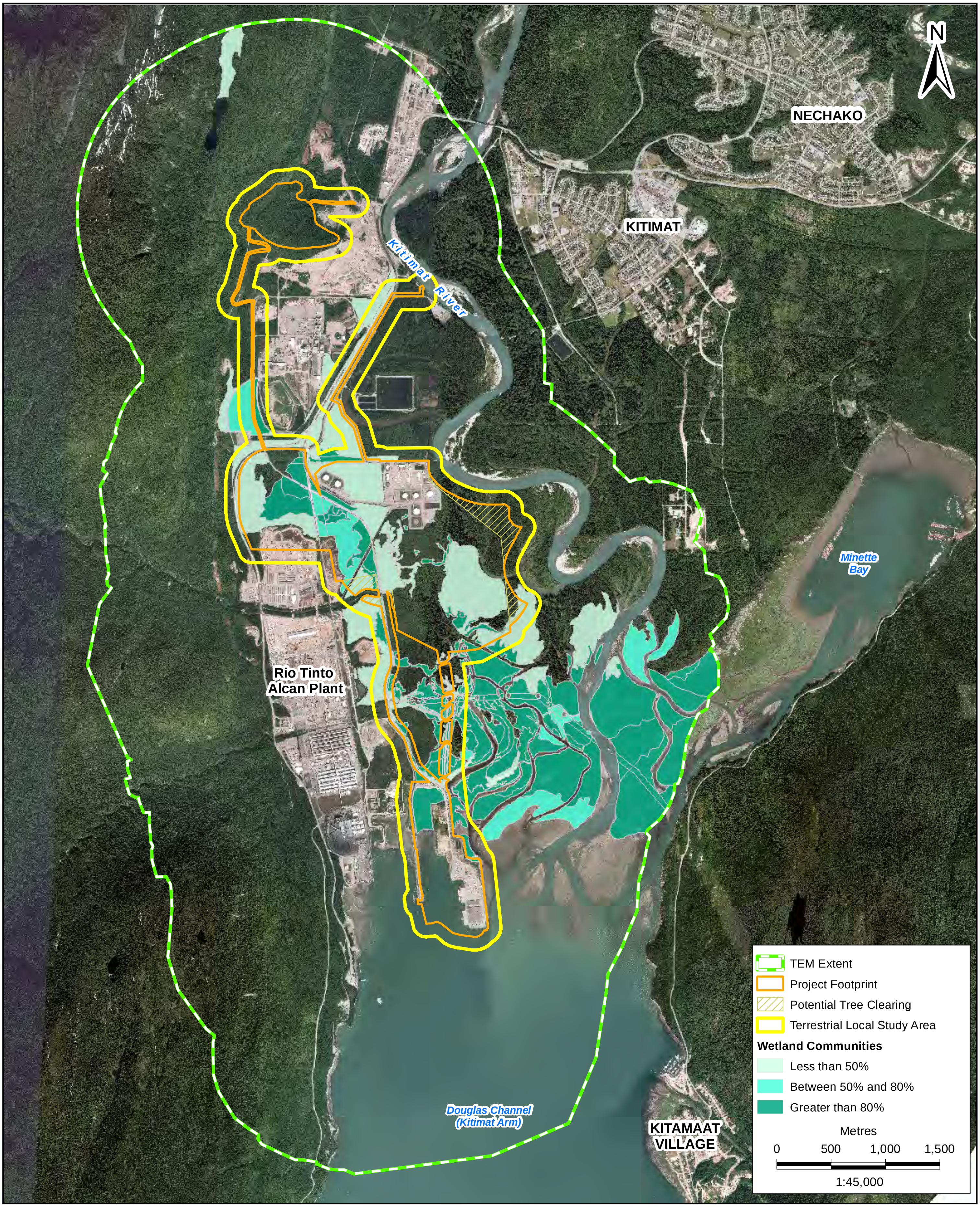
Wetlands are defined in the BC wetland guidebook (MacKenzie and Moran 2004) as “areas where soils are water-saturated for a sufficient length of time such that excess water and resulting low soil oxygen levels are principal determinants of vegetation and soil development.” Wetlands will have a relative abundance of hydrophytes in the vegetation community and soils featuring hydric characteristics. Thus, wetlands include a range of ecosystems from forested sites with wet soils, to areas with shallow open water. They include fens, bogs, swamps, marshes, estuarine, and shallow, open water classes.

Wetland Area

Wetlands occupy approximately 136 ha (17%) of the terrestrial LSA (Figure 5.5-7) and include 13 wetland site associations (Table 5.5-10). Six wetland classes (types) occur within the terrestrial LSA, including several (13) associations: two estuarine marsh, three estuarine meadow, two fen, two (freshwater) marsh, one open shallow water, and three swamp associations. All wetlands identified within the Project footprint also occur within the terrestrial study areas. Wetlands comprise 17,082 ha of the terrestrial RSA, the majority of which are swamp communities (2,018 ha) followed by estuarine (394 ha). At the PEM scale, the finer detail of wetland associations could not be distinguished within the terrestrial RSA but the TEM beyond the LSA was used to provide a minimum estimate where the PEM did not identify the detail.

Wetland Functions

The wetlands in the terrestrial LSA provide three functions: hydrological (capacity of a wetland to store, moderate, and release water in a watershed), biogeochemical (capacity of the wetland to improve water quality or store carbon), and habitat (manner in which a wetland contributes to biological productivity and diversity and includes habitat for wildlife and unique or rare plants and plant assemblages). Details of each function are provided in the Vegetation TDR (Stantec 2014a) and are considered in this assessment. Section 5.5.5.2.4 describes the wetland functions that are directly affected.



Stantec	LNG CANADA Opportunity for British Columbia. Energy for the world	*VEGETATION ENVIRONMENTAL EFFECTS ASSESSMENT* **WETLAND COMMUNITIES** LNG CANADA EXPORT TERMINAL KITIMAT, BRITISH COLUMBIA	PROJECTION: UTM9 DATUM: NAD 83 DATE: 22-AUG-14	DRAWN BY: SS CHECKED BY: SW FIGURE NO.: **5.5-7**

8/22/2014 - 10:49:54 AM V:\1231\active\EM\123110458\gis\figures\EA\section_5.5_vegetation\fig_10458_ea_veg_05_05_07_wetland_communities_LSA.mxd

Table 5.5-10: Wetland Classes and Associations in the Terrestrial Study Areas

Wetland Class	Map Code	Ecosystem Name	Terrestrial Study Area (ha)				
			Project Footprint			LSA[a]	RSA[b]
			LNG Facility	Tree Clearing	Total		
Estuarine							
CWHvm1/Fl00	DW	dune wildrye –Pacific hemlock – parsley	0.3	0.0	0.3	0.9	≥21.2
CWHvm1/Em06[c]	LD	Lyngbye's sedge – Douglas water hemlock	1.4	0.0	1.4	2.8	≥74.8
CWHvm1/Em05[d]	LY	Lyngbye's sedge	7.6	0.0	7.6	13.1	≥78.3
CWHvm1/Ed02[d]	TD	tufted hairgrass – Douglas aster	2.5	0.0	2.5	10.8	≥87.4
CWHvm1/Ed01[d]	TH	tufted hairgrass – meadow barley	1.6	0.0	1.6	5.0	≥5.1
Estuarine Total			13.2	0.0	13.2	32.5	394.2
Fen							
CWHvm1/Wf52[d]	SG	sweet gale – Sitka sedge	1.1	0.0	1.1	4.7	≥10.2
CWHvm1/Wf01	BK	water sedge - beaked sedge	0.1	0.0	0.1	0.1	≥0.1
Fen Total			1.2	0.0	1.2	4.8	≥10.3
Marsh							
CWHvm1/Wm05[c]	CT	cattail	2.6	0.0	2.6	6.8	≥6.8
CWHvm1/Wm50[c]	PP	Sitka sedge – hemlock – parsley	6.9	0.0	6.9	11.4	≥15.3
Marsh Total			9.5	0.0	9.5	18.2	≥22.1
Swamp							
CWHvm1/14[c]	RC	western redcedar – Sitka spruce – skunk cabbage	32.9	1.6	34.5	46.1	2,017.8
CWHvm1/Ws50	PS	hardhack – Sitka sedge	13.6	0.1	13.7	20.0	≥22.5
CWHvm1/Ws51[d]	SW	Sitka willow – Pacific willow /skunk cabbage	9.7	0.2	9.9	12.5	≥13.2
Swamp Total			56.2	1.9	58.1	78.6	2,017.8
CWHvm1/00	OW	shallow open water	1.5	0.0	1.5	1.6	≥2.4
Total			81.6	1.9	83.5	135.6	17,082.4

NOTES:

Values may not sum to totals shown because of rounding, and spatial boundaries refer to the terrestrial LSA and RSA

[a] Areas reported within the Project footprint do not include existing build up (i.e., these are removed from areal summaries). Areas where cut lines or transmission lines cross wetlands are included in the area of wetlands because wetland functions will persist with these disturbances.

[b] Subtotals and totals of terrestrial RSA areas include all associations within the broad category. However, areas preceded with '≥' are not mapped by PEM in the terrestrial RSA, but are mapped in the TEM extent and provide a minimum area for the community in the terrestrial RSA

[c] Portions of total areas listed, where structural stage is greater than 6, are blue listed ecological communities

[d] Portions of total areas listed, where structural stage is greater than 6, are red-listed ecological communities.

5.5.3.2.8 Floodplain Communities in the Terrestrial Study Areas

Floodplain communities, or flood associations, are “non-wetland ecosystems that occur on regularly flooded riparian sites with well-drained soils” (MacKenzie and Moran 2004). These communities occupy 261 ha (33%) of the terrestrial LSA, of which 163 ha occur in the Project footprint (Table 5.5-11, Figure 5.5-8). All five floodplain communities in the terrestrial LSA occur in the Project footprint. Floodplains in the terrestrial RSA occupy 5,055 ha (4%). One of the floodplain communities (Sitka spruce / salmonberry) is provincially red-listed and is considered in this assessment under the category of listed ecological communities.

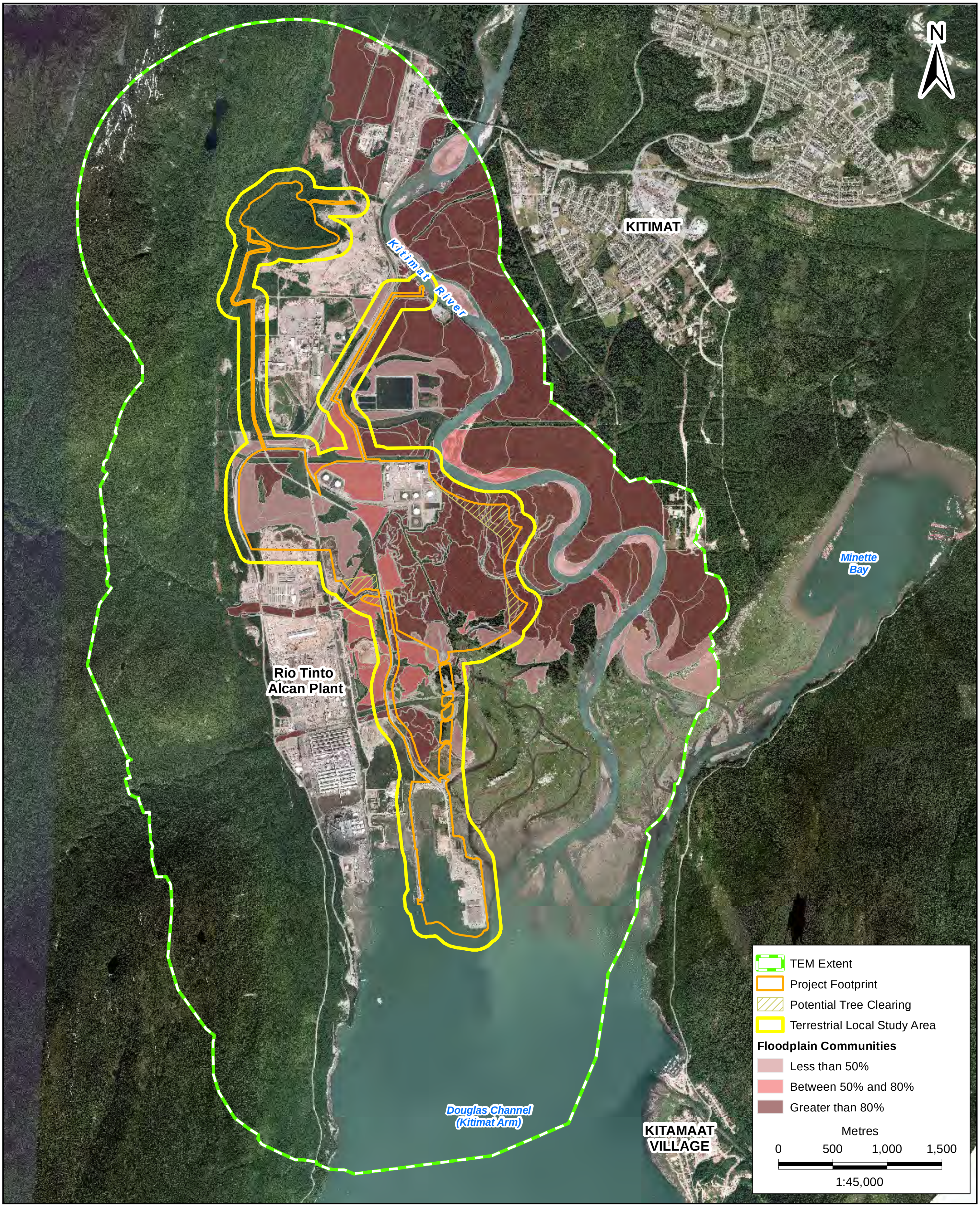
Table 5.5-11: Floodplain Associations in the Terrestrial Study Areas

Site Series / Ecosystem Unit	Map Code	Ecosystem Name	Terrestrial Study Area (ha)				
			Project Footprint			LSA	RSA
			LNG Facility	Tree Clearing Area	Total		
High Fluvial Bench							
CWHvm1/09[a]	SS	Sitka spruce / salmonberry	114.5	10.9	125.3	179.8	2,010.6
Mid Fluvial Bench							
CWHvm1/Fm00	PC	Pacific crab apple / false lily of the valley floodplain	0.9	0.0	0.9	2.2	≥ 5.6
CWHvm1/10	CD	cottonwood / red-osier dogwood	24.3	6.2	30.5	67.3	≥ 322.4
Low Fluvial Bench							
CWHvm1/Fl50	SF	Sitka willow / false lily of the valley floodplain	0.2	0.3	0.4	1.0	≥ 6.4
CWHvm1/11	CW	cottonwood / willow	4.1	1.6	5.7	10.3	136.9
Floodplain Total			143.9	18.9	162.8	260.6	5,055.4

NOTES: Values may not sum to totals shown because of rounding, and spatial boundaries refer to the terrestrial LSA and RSA.

Subtotals and totals of terrestrial RSA areas include all associations within the broad category. However, areas proceeded with the ‘≥’ are not mapped by PEM in the terrestrial RSA, but are mapped in the TEM extent and provide a minimum area for the community in the terrestrial RSA

[a] Red-listed ecological community



Stantec	LNG CANADA Opportunity for British Columbia. Energy for the world	*VEGETATION ENVIRONMENTAL EFFECTS ASSESSMENT* **FLOODPLAIN COMMUNITIES** LNG CANADA EXPORT TERMINAL KITIMAT, BRITISH COLUMBIA	PROJECTION: UTM9 DATUM: NAD 83 DATE: 22-AUG-14	DRAWN BY: SS CHECKED BY: SW FIGURE NO. **5.5-8**

V:\1231\active\EM123110458\gis\figures\EA\section_5.5_vegetation\fig_10458_ea_veg_05_05_08_floodplain_communities_LSA.mxd

8/22/2014 - 10:50:05 AM

5.5.3.2.9 Old Forest in the Terrestrial Study Areas

Old forest comprises 61 ha (8%) of the terrestrial LSA and 34% (43,255 ha) of the terrestrial RSA (Table 5.5-12, Figure 5.5-9). In the terrestrial LSA, old forest is primarily restricted to three ecosystem units (Stantec 2014a). The majority of old forest in the terrestrial LSA occurs in the CWHvm1/09 Sitka spruce / salmonberry community (37 ha), which is also addressed as one of the red-listed ecological communities and one of the floodplain communities (see Table 5.5-9 and Table 5.5-11, respectively). Approximately 45 ha of old forest (0.1% of the old forest in the terrestrial RSA) occur in the Project footprint. Old forest in the terrestrial RSA occupy 43,255 ha.

Table 5.5-12: Old Forest in the Terrestrial Study Areas

Site Series	Map Code	Ecosystem Name	Terrestrial Study Area (ha)				
			Project Footprint			LSA	RSA
			LNG Facility	Tree Clearing Area	Total		
CWHvm1/14[a]	RC	western redcedar – Sitka spruce – skunk cabbage	4.8	0.1	4.9	5.7	746.2
CWHvm1/19[a]	SP	Sitka spruce / Pacific crab apple	9.8	0	9.8	18.9	≥41.5
CWHvm1/09[b]	SS	Sitka spruce / salmonberry	28.1	2.1	30.2	36.8	234.3
Total			42.6	2.3	44.9	61.4	43,255.3

NOTES:

Values may not sum to totals shown because of rounding, and spatial boundaries refer to the terrestrial LSA and RSA.

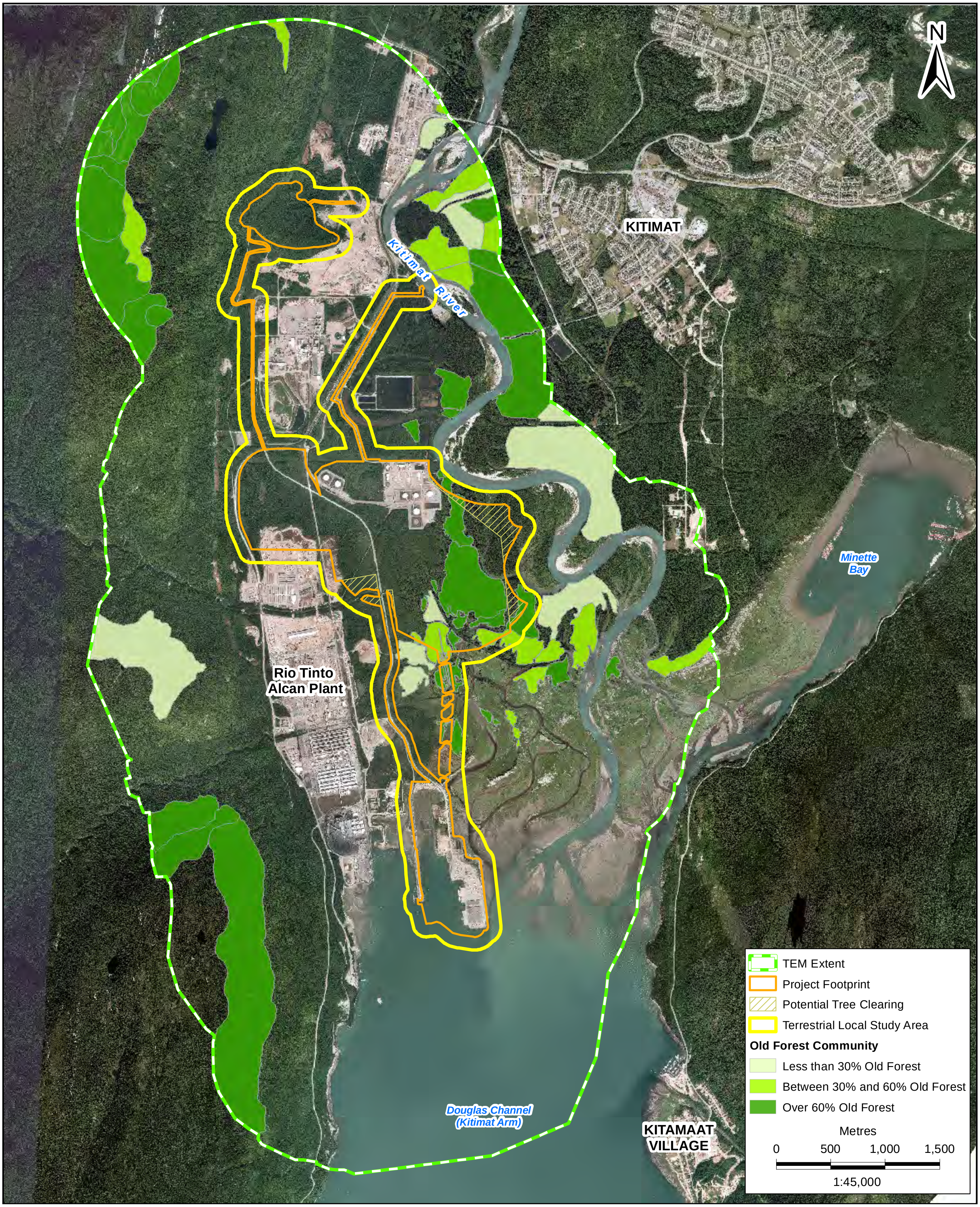
Summaries include area by ecological community with structural stage equal to seven (VRI age criteria of more than 250 years).

The total of old forest within the terrestrial RSA (the 63% with available VRI age data) is included for comparison; terrestrial RSA totals reflect the area of the VRI coverage within the terrestrial RSA; actual totals may be greater.

[a] blue-listed ecological community

[b] red-listed ecological community

Subtotals and totals of terrestrial RSA areas include all associations within the broad category. However, areas preceded with '≥' are not mapped by PEM in the terrestrial RSA, but are mapped in the TEM extent and provide a minimum area for the community in the terrestrial RSA



VEGETATION ENVIRONMENTAL EFFECTS ASSESSMENT	PROJECTION UTM9	DRAWN BY SS
OLD FOREST COMMUNITIES	DATUM NAD 83	CHECKED BY SW
LNG CANADA EXPORT TERMINAL KITIMAT, BRITISH COLUMBIA	DATE 22-AUG-14	FIGURE NO. **5.5-9**

V:\1231\active\EM123110458\gis\figures\EA\section_5.5_vegetation\fig_10458_ea_veg_05_05_09_old_forest_communities_LSA.mxd

8/22/2014 - 10:50:16 AM

5.5.3.2.10 Vegetation Mapping within the Emissions Study Areas

Baseline vegetation mapping used for the emissions study areas is the Kalum PEM, published in 2003 (Banner et al. 2003; Stantec 2014a). Broad ecosystem categories are assigned to each PEM site series/ecosystem type (map units) for the emissions study areas. The VRI age data are used to assign structural stages based on age criteria derived from *Describing Ecosystems in the Field Manual* (BC MOF and BC MOE 2010). Additional details about the vegetation mapping of the emissions study areas are provided in the Emissions Assessment of Soils and Vegetation TDR (Stantec 2014d).

Vegetated communities comprise approximately 54,893 ha (87%) and 405,281 ha (81%) of the emissions RSA and LSA, respectively (Table 5.5-13). Twenty-three vegetated broad ecosystem types occur in the emissions RSA (Stantec 2014d) and 19 of them occur in the emissions LSA; the majority is conifer-dominated upland forested units of various structural stages. Amabilis fir - western hemlock is the largest area and occurs at the lower elevations along the Kitimat River valley, from the Project footprint to Terrace. Agricultural lands comprise 4% and 6% of the emissions RSA and LSA, respectively.

Old forest comprises 21% and 5% of the emissions RSA and LSA, respectively (Stantec 2014d). Areas with no vegetation account for 14% and 8% in the emissions RSA and LSA, respectively. Areas with no age data available account for 28% in the emissions RSA. Pole/sapling, young forest and mature forest account for 4%, 6% and 6% of the emissions RSA area, respectively.

Table 5.5-13: Broad Ecosystems in the Emissions Study Areas

Broad Ecosystem	Emissions Study Area (ha)	
	LSA	RSA
Upland Forested		
Amabilis Fir – Western Hemlock	40,973.1	219,604.0
Coastal Western Hemlock – Lodgepole Pine	280.7	7,932.2
Coastal Western Hemlock – Western Redcedar	1,570.1	9,329.0
Mountain Hemlock – Amabilis Fir	155.2	2,220.4
Upland Forested Total	42,979.0	239,577.0
Upland Forested / Wetland Transition		
Mountain Hemlock - Amabilis Fir / Yellow-cedar Skunk Cabbage Swamp Forest	41.4	2,379.0
Upland Forested / Wetland Transition Total	41.4	2,379.0
Floodplain		
Alder-Willow Floodplain	1,157.2	8,759.7
Deciduous Shrub	97.3	206.3
Sitka Spruce - Black Cottonwood Riparian	1,326.2	4,140.2
Floodplain Total	2,580.6	13,106.2

Broad Ecosystem	Emissions Study Area (ha)	
	LSA	RSA
Wetland		
Cedars - Shore pine bog	669.6	6,417.0
Estuary	398.9	860.9
Western Redcedar Swamp	148.6	2,027.4
Wetland Unclassified	2,709.7	7,219.3
Yellow Cedar Bog Forest	1,379.2	3,469.7
Wetland Total	5,305.9	19,994.4
Montane, subalpine, alpine		
High Elevation Krummholz	301.6	32,806.5
High Elevation Meadow	14.8	13,555.4
Mountain Hemlock - Amabilis Fir	2,268.3	44,275.0
Mountain Hemlock - Yellow-Cedar	1,216.0	8,802.4
Montane, subalpine, alpine Total	3,800.8	100,139.5
Avalanche track		
Avalanche track	185.9	30,084.7
Avalanche track Total	185.9	30,084.7
Total vegetated	54,893.7	405,280.7
Unvegetated, sparsely vegetated, or anthropogenic		
Agriculture	3,635.3	18,001.7
Build-up	1,227.4	4,877.6
Large Lake	278.5	5,861.9
Low Elevation Unvegetated	64.7	236.2
Ocean	349.5	22,924.4
River	1,190.0	6,570.6
Rock	55.3	23,122.4
Urban	1,682.8	7,399.0
Unvegetated, sparsely vegetated, or anthropogenic Total	8,483.6	89,435.2
No PEM Total	41.8	5,300.0
Total	63,419.1	500,016.0

5.5.4 Project Interactions

Table 4.4-1 (Section 4) identifies potential interactions of concern between Project activities and each of the selected VCs that are assessed. The potential effects identified in Section 5.5.2.4 are ranked in Table 5.5-14.

A conservative approach is taken in assigning a Rank of 1, whereby interactions with a meaningful degree of uncertainty are assigned Rank 2 so that a more detailed assessment is conducted.

Table 5.5-14: Potential Effects on Vegetation Resources

Project Activities and Physical Works	Potential Effects		
	Change in Abundance of Plant Species of Interest[a]	Change in Abundance or Condition of Ecological Communities of Interest[a]	Change in Native Vegetation Health and Diversity[b]
Facility Activities and Works			
Construction			
Site preparation (clearing, grubbing, grading, levelling, and set-up of temporary facilities)	2	2	0
Onshore construction (installation of LNG facility, utilities, ancillary support facilities, access roads, and includes hydrotesting)	1	1	0
Vehicle and rail traffic (haul road upgrades, road use, vehicle traffic)	1	1	0
Operation			
LNG production (including natural gas treatment, condensate extraction, storage, and transfer), storage and loading	0	0	2
Vehicle and rail traffic (haul road upgrades, road use, vehicle traffic)	1	0	0

[a] assessed within the terrestrial study areas
[b] assessed within the emissions study areas

KEY:

0 = No interaction.

1 = Adverse effect requiring mitigation, but further consideration determines that any residual adverse effects will be eliminated or managed to negligible levels by codified practices, proven effective mitigation measures, or 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.

NOTE: Only activities with an interaction of 1 or 2 for at least one effect are shown

5.5.4.1 Justification of Interaction Rankings

5.5.4.1.1 Rank 0 Interactions

The interactions ranked 0 (see Table 4.4-1 and 5.5-14) do not involve clearing vegetation or species and ecological communities of interest, and they do not result in adverse effects on vegetation health and diversity due to air emissions. Therefore, they are not carried forward in the assessment.

5.5.4.1.2 Rank 1 Interactions

Interactions ranked 1 indicate that effects are likely to occur, but are well managed through standard operating procedures. The residual effect will be at acceptable levels through implementation of these operating procedures and no further assessment is warranted. However, effects resulting from interactions ranked 1 that have a potential to result in residual effects are considered in the cumulative effects assessment as part of the contribution of the Project.

Effects resulting from onshore construction activities (e.g., installation of facility, utilities, ancillary support facilities, and access roads) are ranked 1 because the majority of the activities are expected to occur within areas already disturbed by site preparation (i.e., site clearing and grading), so any additional effects on vegetation resources are expected to be minimal. Similarly, vehicular traffic during construction and operations is ranked 1 because associated effects (dust deposition and invasive species spread or establishment) can be managed through established and well understood standard mitigation measures.

The potential adverse effects of invasive species are of greatest concern during operations. Ground disturbance during the construction phase has the potential for invasive species to establish due to disturbed exposed soils with high light availability, which is favourable habitat for non-native invasive plants. However, there are well established standard operating procedures and the application of best management practices (e.g., BC MOFR 2010, ISCBC 2013, PRRD and ISCBC 2013) for invasive species are well understood. Given these procedures and practices, and LNG Canada's commitment to adhere to an Invasive Plant Management Plan, invasive plants are not assessed further, except in the cumulative effects assessment.

5.5.4.1.3 Rank 2 Interactions

Interactions ranked 2 associated with construction are due to site clearing activities that will remove all vegetation from the Project footprint including the removal of ecological communities and plants of interest (listed plants and traditional use plants) from the footprint. Once removed, these vegetation resources are permanently lost. No reclamation is planned for vegetation that is permanently removed from the Project footprint.

An interaction of 2 associated with LNG production during operations arises from the potential for air emissions to directly and indirectly affect soils and, in turn, vegetation heath and diversity in the area.

The residual effects of these Project activities and physical works are assessed in Section 5.5.5.

5.5.5 Assessment of Residual Effects from the LNG Facility

5.5.5.1 Assessment of Change in Abundance of Plant Species of Interest

5.5.5.1.1 Analytical Methods

Analytical Assessment Techniques

The analytical assessment for the change in abundance of plants of interest is quantified by overlaying the Project footprint onto plant occurrence data to determine the effect on plant species of interest. This analysis is conducted for the Project footprint and terrestrial LSA using plot data of known plant species of interest.

Potential edge effects are accounted for using the same method applied to the area in the terrestrial LSA falling outside the Project footprint. This includes a 120 m buffer from the edge of infrastructure, as well as the areas in between infrastructure. Therefore, the difference in area between the Project footprint and the terrestrial LSA is the maximum area of indirect disturbance (such as dust, invasive plants, change in soil moisture and light availability).

In the terrestrial RSA, coarser scales of mapping using the Kalum PEM and VRI age data are used, where possible, to make inferences regarding potential habitat for species of interest at a regional scale. Species *at risk* occurrence data available from public sources, such as CDC and UBC herbarium, were also identified in the terrestrial RSA to identify potential ranges of these species within the region.

Assumptions and the Conservative Approach

There are inherent uncertainties in undertaking evaluations of potential effects of the Project on plant species of interest; however, the ecosystem mapping and high field survey density reduce the uncertainties and provide a reasonable estimate of potential vegetation losses and disturbances.

5.5.5.1.2 Description of Project Effect Mechanisms for Change in Abundance of Plant Species of Interest

Vegetation clearing of the Project footprint during site preparation has the potential to remove provincially listed and traditional use plants.

5.5.5.1.3 Mitigation for Change in Abundance of Plant Species of Interest

Mitigation measures for plant species of interest in the terrestrial LSA and Project footprint are:

- 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).

The above mitigation measures will manage the magnitude and permanency of change in the abundance of plants of interest by limiting the number and area of species lost due to construction activities.

5.5.5.1.4 Characterization of Change in Abundance of Plant Species of Interest

The clearing of vegetation during the construction phase of the Project will result in a loss of plant species at risk. Three species were identified at four locations within, or near, the terrestrial LSA. Of these, two species (rock sandwort and long-leaved aster) occur in the Project footprint (one location per species) and cannot be avoided during construction. Eminent bluegrass was identified at two locations, both outside the Project footprint. One of these locations lies between infrastructure and will be vulnerable to potential indirect effects, primarily during construction and operation activities. The second location falls outside the terrestrial LSA by approximately 300 m and will not be affected by the Project.

According to the CDC, UBC Herbarium, and BC E-flora databases, there are six known occurrences of rock sandwort in BC, with the closest recorded near the BC-Alaska border. However, because not all known occurrences of plants are submitted to these databases, nor are all occurrences known, it is likely that this is not the exhaustive extent of the population in BC.

Of the multiple records of long-leaved aster occurrences in BC, the only one close to Kitimat is approximately 200 km southeast. However, CDC (2013b) reports that "although collections are few, the taxon occurs in remote areas with extensive appropriate habitat, and additional populations almost certainly occur." Types of recorded locations of long-leaved aster in BC include harvested forests, near a campsite, and beside an irrigation ditch, where human activities could cause further disturbance; or, it may be suited to disturbance regimes (CDC 2013b).

Suitable habitat for rock sandwort and long-leaved aster exists in the terrestrial RSA, based on the PEM and TEM. Though the presence of additional populations within the terrestrial RSA is not known, the availability of suitable habitat will increase the chance of successful translocation (Maslovat 2009). With successful mitigation, loss of the known occurrences is not anticipated and the viability of the species occurrence in the region will be maintained.

The potential loss of listed plant species is rated as moderate magnitude. There is some uncertainty regarding the full extent of the regional population; therefore, active management in the form of translocation will be used to improve sustainability of the known regional population. The residual effect is primarily restricted to the Project footprint; but it could extend to the terrestrial LSA in the case of eminent bluegrass because it is close to proposed Project infrastructure. The potential loss of listed species in the Project footprint will occur once during the construction phase. With mitigation, the loss will remain for the medium-term and will be reversible. These plant species have low resilience to the potential effects associated with site preparation activities. This is a conservative approach because they are listed species; but it is possible that the rock sandwort has higher resilience due to the existing disturbed conditions where the occurrence was identified. With mitigation in place, there is low likelihood of a residual effect on the abundance of listed plant occurrences located in both the Project footprint (long leaved aster and rock sandwort) and within the terrestrial LSA (eminent bluegrass).

Clearing of vegetation during the construction phase will result in the removal of 20 traditional use plant species in the Project footprint. However, these traditional use plants are not limited to habitat in the terrestrial LSA; they have an equal or greater abundance and are common species throughout the terrestrial RSA. Therefore, losses of traditional use plant species that are in the Project footprint are not anticipated to affect the viability of the species occurring in the terrestrial RSA. Thus, the magnitude of the residual effects on traditional use plants is rated as low due to the prevalence of the species throughout the region. The duration is assessed as permanent because decommissioning will likely revert the land to secondary industrial use and may not entail revegetation. The removal of these plants occurs in a single event, during construction, and, in the absence of reclamation, the residual effect is irreversible. Traditional use plants have moderate to high resilience to stress in the terrestrial LSA and the majority of these plants are found widely dispersed throughout the terrestrial LSA and RSA. Likelihood is high that reduced abundance of traditional use plants will occur in the terrestrial LSA and RSA due to the removal of these plants from the Project footprint.

5.5.5.1.5 Determination of Significance for Change in Abundance of Plant Species of Interest

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.

5.5.5.2 Assessment of Change in Abundance or Condition of Ecological Communities of Interest

5.5.5.2.1 Analytical Methods

Analytical Assessment Techniques

The assessment for the change in abundance of ecological communities of interest is quantified by overlaying the Project footprint onto baseline vegetation ecosystem mapping. Within the terrestrial LSA, existing disturbance areas based on government spatial data sources and digitization of observable disturbances from a 2012 colour orthophoto are accounted for. This analysis is conducted for the Project footprint and terrestrial LSA using the TEM.

In the terrestrial RSA, coarser scales of mapping using the Kalum PEM and VRI age data are used to estimate available ecological communities of interest. Baseline and foreseeable future disturbances within the terrestrial RSA are compiled to provide a baseline context for the cumulative effects assessment. These spatial data were obtained from publicly available sources including Natural Resources Canada's 1:50,000 scale Canvec data, Land and Resource Data Warehouse, BC Agency Agricultural Land Commission, BC MFLNRO, and MOE. Some assumptions were made to compile these large data sets, such as the assumption of disturbance hierarchy where disturbances overlapped (e.g., primary road disturbance is counted if it overlaps with agriculture land). Reasonable spatial buffers (e.g., road width) are applied to line and point spatial data based on available information and professional judgment to estimate the amount of disturbance.

TEM is available beyond the terrestrial LSA (to approximately 1.5 km from the terrestrial LSA) for wildlife habitat suitability mapping. To better determine the effects of the Project's activities on ecological communities of interest that are not mapped in the terrestrial RSA, their area within the TEM extent is compared, where appropriate.

Potential edge effects on vegetation are accounted for using overlay analysis applied to the area in the terrestrial LSA falling outside the Project footprint. This includes a 120 m buffer from the edge of infrastructure, as well as the areas in between infrastructure. Therefore, the difference in area between the Project footprint and the terrestrial LSA is the maximum area of indirect disturbance (such as dust, invasive plants, change in soil moisture, and light availability).

Assumptions and the Conservative Approach

The assessment takes a conservative approach in the disturbance estimates by treating all areas to be temporarily cleared the same as those to be permanently cleared. Temporary clearing does not have as great an adverse effect on vegetation as replacement of naturally vegetated areas with facility infrastructure because these areas typically leave the native soil and native vegetative components within the soil, which support passive revegetation and eventually restore ecosystem functions. However, to be conservative, temporarily cleared areas are included among the total areas of adverse effects because they do represent a medium-term, reversible, loss of vegetation resources.

Effects such as loss of old forest or listed ecological communities will be permanent since they require hundreds of years to re-establish. Most of the identified effects are theoretically reversible; however, in practical terms, the Project footprint is expected to revert to secondary industrial uses rather than full closure and reclamation. Therefore, to be conservative, effects within the Project footprint are assessed as irreversible.

5.5.5.2.2 Description of Project Effect Mechanisms for Change in Abundance or Condition of Ecological Communities of Interest

Clearing in the Project footprint during the construction phase will result in direct loss of vegetation and reduce the abundance of ecological communities of interest.

While the direct loss of vegetation will be restricted to the Project footprint, the condition of ecological communities could be affected due to edge effects and fragmentation. Edge effects could extend to the remaining area in the terrestrial LSA, including up to 120 m from the edge of the Project footprint. Edge effects could be due to changes in: sunlight; air temperature and humidity; soil temperature and moisture; plant competition; seed dispersion; regeneration; mortality rates; and levels of disease, insect attacks and/or windfall (Voller 1998). Fragmentation can be an indirect effect of the Project, which can reduce the function and condition of vegetation communities by separating intact continuous vegetation and creating a greater edge to core ratio.

5.5.5.2.3 Mitigation for Change in Abundance or Condition of Ecological Communities of Interest

Mitigation for Effects to Ecological Communities of Interest

The Project footprint will use existing disturbance areas in the design to limit vegetation clearing. The following mitigation measures will be implemented to restrict the loss of vegetation and to limit edge effects, thereby managing adverse effects on ecological communities of interest remaining in the terrestrial LSA:

- 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).

The above mitigation measures will be implemented during pre-construction and construction phases, and will remain effective throughout the life of the Project.

Mitigation for Loss of Wetlands and Associated Functions

The mitigation hierarchy of avoidance, mitigation, and compensation will be implemented to limit the loss of wetlands and associated functions due to construction (Table 5.5-15). This will be implemented during the pre-construction and construction phases. Legislation, regulations, and guidelines such as the *Federal Policy on Wetland Conservation* (Government of Canada 1991), FRPA, OGAA EMPR, *Environmental Protection and Management Guide* (BC OGC 2013), the *Water Act*, and *Wetland Ways* (WSP 2009), provide guidance on the protection of wetlands. Where the legislation does not apply directly, such as the FRPA, associated regulations serve as guidance for best management practices.

Table 5.5-15: Mitigation Measures to Avoid and Manage Effects on Wetlands

Mitigation Hierarchy	Mitigation Measures
Avoid loss of wetlands	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)
	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)
Manage loss of abundance and condition of wetlands and associated functions	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)
	Time activities to limit adverse effects on wildlife (see Section 5.6 for wildlife sensitive periods) (Mitigation 5.6-7; 5.6-11)
	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)
	A Surface Water Management Plan will be developed to address stormwater collection, treatment, and disposal during construction and operation (Mitigation 5.5-9)
	Any temporary workspace will be reclaimed as soon as practicable as per measures stated in the EMPs (Mitigation 5.5-4)
Compensation	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).

There will be permanent loss of wetland area and associated functions in the Project footprint due to construction. Where the loss of ecologically important wetland functions cannot be avoided, compensation will be provided. The marine Fisheries Habitat Offsetting Plan will provide approximately 8 ha of compensatory estuarine wetland. The remaining loss of ecologically important wetlands and their associated functions will be approximately 32 ha, of which estuarine and listed wetlands will be compensated at a 2:1 ratio totaling 63 ha of restored, enhanced or created (or both) wetlands as outlined in the Wetland Compensation Plan in order to achieve no net loss of wetland functions.

5.5.5.2.4 Characterization of Change in Abundance or Condition of Ecological Communities of Interest

The residual effects on ecological communities of interest include the reduced abundance of blue- and red-listed ecological communities, wetlands, floodplains, and old forest. Figure 5.5-5 to Figure 5.5-9 present the Project footprint overlay of the ecological communities of interest within the terrestrial LSA. The TEM extent of these communities is also displayed to show their distribution beyond the terrestrial LSA.

Measurable residual effects on vegetation will be limited to the 292 ha of vegetated area (including 21 ha from the tree clearing area where only trees will be removed) including portions of 26 ecological communities within the Project footprint. Indirect effects (e.g., edge and fragmentation effects) could potentially reduce the condition of up to 216 ha of vegetation communities in the terrestrial LSA (area outside of the facility footprint, but within the terrestrial LSA). However, with standard mitigation measures in place (restricting the disturbance to the footprint, clearly delineating (flagging) clearing limits, and adherence to relevant mitigation) and adherence to management plans, these edge effects can be managed to acceptable levels, such that these areas remain comparable to baseline condition.

Listed Ecological Communities

A total of 112 ha of listed ecological communities will be lost. Of this, 29 ha contain six blue-listed ecosystems, including two upland forest and four wetland communities (see Table 5.5-16). The total loss of blue-listed ecosystems is approximately 1% of their area in the terrestrial RSA. A total of 83 ha of six red-listed ecosystems will be lost, including five wetland and one floodplain community. The loss of red-listed ecosystems is approximately 8% of their terrestrial RSA baseline area.

Table 5.5-16: Direct Effects of the Project on Listed Ecological Communities in the Terrestrial Study Areas

Site Series / Wetland Code	Map Code	Type	Ecosystem Name	Baseline (ha)		Direct Loss Area (ha)			Change from Baseline (%)	
				LSA	RSA[a]	LNG Facility	Tree Clearing Area [b]	Project Footprint	LSA	RSA
Blue-listed Ecological Communities										
CWHvm1/08[c]	AD	Upland	amabilis fir – Sitka spruce / devils club	4.1	3,328.0	1.9	0	1.9	-46	0
CWHvm1/19[c]	SP		Sitka spruce / Pacific crab apple	20.2	≥50.3	10.2	0	10.2	-50	-20
CWHvm1/14[c]	RC	Wetland	western redcedar – Sitka spruce / skunk cabbage	8.3	1,040.2	5.7	0.1	5.8	-70	-1
CWHvm1/Em06	LD		Lyngbye's sedge / Douglas water hemlock estuary	2.8	≥74.8	1.4	0	1.4	-50	-2
CWHvm1/Wm05	CT		cattail marsh	6.8	≥6.8	2.6	0	2.6	-38	-38
CWHvm1/Wm50	PP		Sitka sedge / hemlock / parsley marsh	11.4	≥15.3	6.9	0	6.9	-61	-45
Total Blue-listed Ecological Communities				53.6	4,516.4	28.7	0.2	28.8	-53	-1
Red-listed Ecological Communities										
CWHvm1/09[c]	SS	Floodplain	Sitka spruce / salmonberry	84.3	895.4	52.7	7.6	60.3	-72	-7
CWHvm1/Ed01	TH	Wetland	tufted hairgrass / meadow barley estuary	5.0	≥5.1	1.6	0	1.6	-32	-31
CWHvm1/Ed02	TD		tufted hairgrass / Douglas aster estuary	10.8	≥87.4	2.5	0	2.5	-23	-3
CWHvm1/Em05	LY		Lyngbye's sedge estuary	13.1	≥78.3	7.6	0	7.6	-58	-10
CWHvm1/Wf52	SG		sweet gale / Sitka sedge fen	4.7	≥10.2	1.1	0	1.1	-23	-11
CWHvm1/Ws51	SW		Sitka willow / Pacific willow / skunk cabbage swamp	12.5	≥13.2	9.7	0.2	9.9	-79	-75
Total Red-listed Ecological Communities				130.4	1,089.6	75.1	7.8	82.9	-64	-8
Total Listed Ecological Communities				184	5,263.6	103.8	8.0	111.7	-61	-2

NOTES: Values may not sum to totals shown because of rounding, and spatial boundaries refer to the terrestrial LSA and RSA

[a] Subtotals and totals of terrestrial RSA areas include all associations within the broad category. Areas preceded with '≥' are not mapped by PEM in the terrestrial RSA, but are mapped in the TEM extent and provide a minimum area for the community in the terrestrial RSA.

[b] Only treed forested communities are counted as direct loss in the tree clearing portion of the footprint; see Section 5.5.3.2 for the totals of all units in the tree clearing area.

[c] Indicates forested plant communities where only structural stages greater than or equal to 6 are included

With the reduced abundance (area) of the combined 12 listed plant communities, none will be lost that do not also occur elsewhere within the terrestrial RSA, as measured by the terrestrial RSA PEM or the TEM within its full extent. The magnitude is rated moderate for the wetland communities because active management will be required to sustain wetland functions in the form of habitat compensation. Implementation of wetland compensation will offset a portion of the loss of provincially listed ecological communities; however, the exact amount depends on final design opportunities and constraints of the wetland compensation measures.

The effect of reduced abundance of listed ecological communities occurs within the terrestrial LSA, primarily in the LNG facility footprint. Only the listed forested ecological communities will be directly lost in the tree clearing portion of the footprint because only the trees will be cleared in this area, while lower structure vegetation will remain. Some of the remaining vegetation structure within the listed communities will remain when the trees are removed; however, the tree species are a key component of those particular listed ecological communities.

The residual effect occurs as a single event during construction clearing activities, and it remains permanent and irreversible, with no planned reclamation activities. The listed communities have low to high resilience: low for the listed wetland communities; moderate for the forested upland communities; and high for the floodplain communities. There is a high likelihood that a decline in the area of these listed communities will occur.

Wetlands

The loss of wetlands in the Project footprint during construction accounts for 84 ha of wetlands representing five classes (estuarine, fen, marsh, swamp, and shallow open water) and 13 wetland associations (Table 5.5-17 and Figure 5.5-7). This area includes 23 ha and 17 ha of red- and blue-listed wetland communities, respectively, that are also assessed in the previous section characterizing the direct effects of the Project on listed ecological communities. Less than 1% (84 ha) of the total estimated wetland area in the terrestrial RSA will be directly affected in the Project footprint. An additional 52 ha (less than 1%) of wetlands could be indirectly affected through edge effects or fragmentation. The total loss of wetlands is less than 1% of the wetland area in the terrestrial RSA.

One association, water sedge-beaked sedge (Wf01), is not mapped in the terrestrial RSA or the TEM extent outside the footprint; however, it is expected to occur in the terrestrial RSA because Wf01 wetlands are the most common and widespread sedge fen association in BC (MacKenzie and Moran 2004).

Table 5.5-17: Direct Effects of the Project on Wetlands in the Terrestrial Study Areas

Wetland Class	Map Code	Ecosystem Name	Baseline (ha)		Direct Loss Area (ha)			Change from Baseline (%)	
					Project Footprint				
			LSA	RSA	LNG Facility	Tree Clearing Area [a]	Total	LSA	RSA
Estuarine									
CWHvm1/Fl00	DW	dune wildrye –Pacific hemlock – parsley	0.9	≥21.2	0.3	0	0.3	-33	-1
CWHvm1/Em06	LD	Lyngbye's sedge – Douglas water hemlock	2.8	≥74.8	1.4	0	1.4	-50	-2
CWHvm1/Em05	LY	Lyngbye's sedge	13.1	≥78.3	7.6	0	7.6	-58	-10
CWHvm1/Ed02	TD	tufted hairgrass – Douglas aster	10.8	≥87.4	2.5	0	2.5	-23	-3
CWHvm1/Ed01	TH	tufted hairgrass – meadow barley	5.0	≥5.1	1.6	0	1.6	-32	-31
Estuarine Total			32.5	≥394.2	13.2	0	13.2	-41	-3
Fen									
CWHvm1/Wf52	SG	sweet gale – Sitka sedge	4.7	≥10.2	1.1	0	1.1	-23	-10
CWHvm1/Wf01	BK	water sedge - beaked sedge	0.1	≥0.1	0.1	0	0.1	-100	-100
Fen Total			4.8	≥10.3	1.2	0	1.2	-25	-12
Marsh									
CWHvm1/Wm05	CT	cattail	6.8	≥6.8	2.6	0	2.6	-38	-38
CWHvm1/Wm50	PP	Sitka sedge – hemlock – parsley	11.4	≥15.3	6.9	0	6.9	-61	-45
Marsh Total			18.2	≥22.1	9.5	0	9.5	-52	-43

Wetland Class	Map Code	Ecosystem Name	Baseline (ha)		Direct Loss Area (ha)			Change from Baseline (%)	
					Project Footprint				
			LSA	RSA	LNG Facility	Tree Clearing Area [a]	Total	LSA	RSA
Swamp									
CWHvm1/14[b]	RC	western redcedar – Sitka spruce – skunk cabbage	46.1	2,017.8	32.9	1.6	34.5	-75	-2
CWHvm1/Ws50	PS	hardhack – Sitka sedge	20.0	≥22.5	13.6	0.1	13.7	-69	-61
CWHvm1/Ws51	SW	Sitka willow – Pacific willow /skunk cabbage	12.5	≥13.2	9.7	0.2	9.8	-78	-74
Swamp Total			78.6	≥2,053.5	56.2	1.9	58.1	-74	-3
CWHvm1/00	OW	shallow open water	1.6	≥2.4	1.5	0	1.5	-94	-63
Total			135.6	≥17,082.4	81.6	1.9	83.5	-62	-<1

NOTES:

Values may not sum to totals shown because of rounding, and spatial boundaries refer to the terrestrial LSA and RSA.

NA = data not available

Subtotals and totals of terrestrial RSA areas include all associations within the broad category. However, areas with '≥' are not mapped by PEM in the terrestrial RSA, but are mapped in the TEM extent and provide a minimum area for the community in the terrestrial RSA.

[a] Only treed communities are counted as direct loss in the tree clearing portion of the Project footprint; see Section 5.5.3.2 for the totals of all units mapped in the tree clearing area.

[b] Total areas reported for the wetland class/map code; however, the totals in this table represent all structural stages, whereas only structural stage greater than or equal to 6 of forested communities are considered blue listed ecological communities.

The direct loss of wetland extent results in the loss of associated wetland functions in the Project footprint, including:

- hydrological functions
  - the augmentation of baseflows in smaller watercourses, and
  - the ability to moderate and absorb the energy (velocity) and volume of major flooding events from Kitimat River.
- biogeochemical functions
  - water quality improvement by retaining suspended sediments and absorbing excess nutrients (nitrogen)
  - storage of carbon in soils and biomass, and
  - nutrient cycling and biomass production.
- habitat functions
  - breeding, nesting, migrating, and non-breeding habitat for numerous species of waterfowl, wading birds, shorebirds, mammals, and reptiles (Stantec 2014b)
  - breeding and/or dispersal habitat for amphibians, such as the western toad, Columbia spotted frog, and northwestern salamander (Stantec 2014b)
  - seasonal foraging habitat for several species, including grizzly bear
  - support for federally- and provincially-listed wildlife species *at risk* identified in the wildlife technical data report, such as western toad; great blue heron; California gull; barn swallow; and grizzly bear (Stantec 2014b), and
  - contribution to habitat diversity, as indicated by supporting five red- and four blue-listed wetland communities.

A total of 40 ha of wetlands that are designated as ecologically important to the region in the form of red-listed, blue-listed, or estuarine wetlands will be lost; however, the implementation of the Wetland Compensation Plan will result in no net loss of wetland functions for these ecologically important wetlands (Environment Canada 2014a).

The loss of 44 ha of wetlands consisting of CWHvm1/Wf01 water sedge – beaked sedge fen, CWHvm1/00 shallow open water, CWHvm1/Ws50 hardhack – Sitka sedge swamp, and structural stages less than 6 of the CWHvm1/14 western redcedar – Sitka spruce – skunk cabbage swamp are not subject to the *Federal Policy on Wetland Conservation* goal of no-net-loss of wetland functions because they are not red- or blue-listed, or estuarine.

The magnitude of residual effects on wetlands is rated as moderate because active management in the form of habitat compensation will be required to sustain wetland functions of the ecologically important wetlands and low for the residual effects on the remaining wetlands because their regional area is sufficient to sustain these communities without active management.

With the implementation of mitigation measures, residual effects on wetlands are restricted to the Project footprint. The residual effect occurs as a single event during construction activities and remains permanent. The residual loss is irreversible within the Project footprint; however, with implementation of the Wetland Compensation Plan, the residual effect on wetland functions associated with the loss of ecologically important wetlands is reversible in the terrestrial RSA and the broader north coast regional area. The wetland communities are highly sensitive to disturbance and have low resilience. There is a high likelihood that a decline in wetland area will occur; however, due to the implementation of the Wetland Compensation Plan. there is a low likelihood that a loss of wetland functions (associated with the loss of ecologically important wetlands) will occur.

Floodplains

A total of 163 ha of floodplain associations will be lost in the Project footprint during construction (see Table 5.5-18). This includes 60 ha of the red-listed mature/old floodplain unit described in the summary of Project effects on listed ecological communities (Table 5.5-16). The loss of floodplains from the Project footprint represents 3% of the area of comparable flood communities in the terrestrial RSA.

Although there will be a reduced extent of these floodplain communities, they all occur elsewhere in the terrestrial RSA, as measured by the terrestrial RSA PEM or the TEM in the full TEM extent. The residual effect occurs as a single event during construction activities and remains permanent and irreversible, with no planned reclamation activities. The magnitude is moderate because there is inherent risk and uncertainty with respect to the regional sustainability of the red-listed floodplain community in the absence of active management. The floodplain communities have high resilience because these communities generally adapt to unstable conditions and recover from the disturbance of flood events. There is a high likelihood that a decline in the area of these floodplain communities will occur.

Old Forest

A total of 44.9 ha of old forest will be lost in the Project footprint (see Table 5.5-19). This includes 5 ha of the blue-listed CWHvm1/14 western redcedar – Sitka spruce / skunk cabbage unit and 30 ha of the red-listed CWHvm1/09 Sitka spruce / salmonberry unit (Table 5.5-16). The loss of old forest in the Project footprint is less than 1% of the total area of old forest in the terrestrial RSA. This represents a low magnitude effect on old forest because it is well below the high magnitude criterion of 87% that is the acceptable limit of change within these landscape units associated with other resource management industries (see Section 5.5.2.7 and BC MSRM 2004).

Table 5.5-18: Direct Effects of the Project on Floodplains in the Terrestrial Study Areas

Site Series / Ecosystem Unit	Map Code	Ecosystem Name	Baseline (ha)		Direct Loss (ha)			Change from Baseline (%)	
			LSA	RSA	LNG Facility	Tree Clearing Area	Project Footprint	LSA	RSA
High Fluvial Bench									
CWHvm1/09	SS	Sitka spruce / salmonberry	179.8	2,010.6	114.5	10.9	125.3	-70	-6
Mid Fluvial Bench									
CWHvm1/Fm00	PC	Pacific crab apple / false lily of the valley floodplain	2.2	≥5.6	0.9	0	0.9	-40	-16
CWHvm1/10	CD	cottonwood / red-osier dogwood	67.3	≥637.8	24.3	6.2	30.5	-45	-5
Low Fluvial Bench									
CWHvm1/Fl50	SF	Sitka willow / false lily of the valley floodplain	1.0	≥6.4	0.2	0.3	0.4	-40	-6
CWHvm1/11	CW	cottonwood / willow	10.3	≥194.5	4.1	1.6	5.7	-55	-3
Floodplain Total			260.6	5,055.4	143.9	18.9	162.8	-62	-3

NOTES:
Values may not sum to totals shown because of rounding, and spatial boundaries refer to the terrestrial LSA and RSA.
Subtotals and totals of RSA areas include all associations within the broad category. However, areas with '≥' are not mapped by PEM in the terrestrial RSA, but are mapped in the TEM extent and provide a minimum area for floodplain associations in the terrestrial RSA.

Table 5.5-19: Direct Effects of the Project on Old Forest in the Terrestrial Study Areas

Site Series	Map Code	Ecosystem Name	LSA	RSA	Direct Loss (ha)			Change from Baseline (%)	
					LNG Facility	Tree Clearing Area	Project Footprint	LSA	RSA
CWHvm1/14	RC	western redcedar – Sitka spruce / skunk cabbage	5.7	746.2	4.8	0.1	4.9	-86	-0.7
CWHvm1/19	SP	Sitka spruce / Pacific crab apple	18.9	≥41.5	9.8	0	9.8	-52	-24
CWHvm1/09	SS	Sitka spruce / salmonberry	36.8	234.3	28.1	2.1	30.2	-82	-13
Total			61.4	43,255.3	42.6	2.3	44.9	-73	-0.1

Notes:
Values may not sum to totals shown because of rounding, and spatial boundaries refer to the terrestrial LSA and RSA.
Subtotals and totals of RSA areas include all associations within the broad category. However, areas with '≥' are not mapped by PEM in the terrestrial RSA, but are mapped in the TEM extent and provide a minimum area for the community in the terrestrial RSA.

The reduced area of old forest will be limited to the Project footprint. The residual effect occurs as a single event during construction activities and remains permanent and irreversible, with no planned reclamation activities. In general, old forest in the Project footprint has moderate resilience, being adaptable to disturbance (e.g., floods); however, this can be dependent on the level of disturbance and the length of time to full recovery to baseline conditions, which will be greater than 250 years. There is a high likelihood that a decline in the area of old forest within the Project footprint will occur and a low likelihood that the condition of the remaining old forest in the terrestrial LSA will decline.

5.5.5.2.5 Determination of Significance for Change in Abundance or Condition of Ecological Communities of Interest

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.

5.5.5.3 Assessment of Change in Native Vegetation Health and Diversity due to Emissions

5.5.5.3.1 Analytical Methods

Analytical Assessment Techniques

Upland and wetland vegetation communities sensitive to sulphur dioxide fumigation and nitrogen, sulphate, and acid deposition are assessed. Individual plant species responses to either fumigation or deposition mechanisms will be highly variable because they depend on the particular species' sensitivities and other factors, such as competition. Because individual plant responses cannot be well defined, effects are assessed in terms of vegetation communities. Nitrogen and sulphate deposition act together to reduce soil pH (i.e., increase soil acidity) which indirectly affects vegetation. Sulphate deposition also reduces soil pH, which affects vegetation in a similar way as acid deposition. Results predicting where sulphate and acid deposition exceed critical loads occur within the same spatial boundaries. Therefore, sulphate deposition results are summarized with the acid deposition results. Additional details about the analytical methods used to assess this potential effect mechanism are contained in the Emissions Assessment on Soils and Vegetation TDR (Stantec 2014d).

Determining Empirical Critical Levels

Critical levels are thresholds above which direct adverse effects (e.g. disruption of photosynthesis, decreased growth rates, tissue lesions) are expected to occur on plant health through fumigation (i.e., increased atmospheric concentrations of sulphur dioxide and nitrogen dioxide due to emissions). Empirical critical levels are identified and used for evaluating potential effects from nitrogen dioxide and sulphur dioxide fumigation and are expressed as atmospheric concentrations (µg/m^3/y) (Table 5.5-20). BC MOE does not have established critical levels; however, Alberta Environment (AENV 2011a; AENV 2011b) and the World Health Organization (WHO; 2000) have established critical levels.

Table 5.5-20: Empirical Critical Levels from Canadian and International Agencies

Source	Sulphur Dioxide (µg/m^3/y)	Nitrogen Dioxide (µg/m^3/y)
AENV	20	45
WHO	10	30

SOURCES: AENV 2011a, AENV 2011b; WHO 2000

Alberta Environment (AENV 2011a) has established a critical level of annual average sulphur dioxide concentration of 20 µg/m^3/y for vegetation. This critical annual average for sulphur dioxide follows the WHO (2000) critical levels for forests and natural vegetation. The WHO also recognizes a more sensitive critical annual average sulphur dioxide concentration of 10 µg/m^3/y for certain lichen species (WHO 2000). Additional available considerations regarding critical levels of sulphur dioxide are provided in Table 5.5-21.

Table 5.5-21: Ranges of Critical Levels for Sulphur Dioxide from Canadian and International Agencies

Critical Level (µg/m^3/y)	Application	Local condition applies
15 [a]	Recommended for forests and natural vegetation communities when the accumulated temperature sum above +5°C is <1000°C days per year.	No, 1681°C days per year [b]
10 [a]	Recommended for lichen communities.	Yes
1 [a]	Recommended for forests where ground level cloud is present 10% or more of the time.	No [b]
20 [c]	Recommended for forests and natural vegetation communities.	Yes

NOTES:
[a] WHO (2000)
[b] 1981 to 2010 Canadian Climate Normals station data (Environment Canada 2014b)
[c] AENV (2011a)

Because ground level cloud cover is not present for 10% or greater of the year in the emissions RSA (Stantec 2014d) and lichen species are present and are sensitive to fumigation, the WHO (2000) critical level of 10 µg/m^3/y is used to assess the potential effects from sulphur dioxide.

Determining Empirical Critical Loads

Critical loads of contaminants from Project emissions that can affect ecosystem structure and function are expressed as annual deposition rates (kg/ha/y or keq/ha/y). Effects of nitrogen deposition are assessed in terms of critical loads that affect vegetation indirectly through excessive soil fertilization (or eutrophication). Likewise, effects of acid deposition are assessed for critical loads that affect vegetation indirectly through soil acidification (reduced pH). Refer to the Emissions Assessment on Soils and Vegetation TDR (Stantec 2014d) for details of the soils mapping and supporting soil sensitivity analysis that are used for this assessment. Results from air quality CALPUFF modelling are compared to screening values (empirical critical loads) of nitrogen, sulphate and acid deposition. The screening values include:

- BC MOE guidance (2013b) for sulphate and nitrogen deposition (7.5 kg/ha/y and 5 kg/ha/y, respectively) and acid deposition (0.15 keq/ha/y),
- United Nations Economic Commission for Europe (UNECE 2007) for nitrogen deposition (5 kg/ha/y to 8 kg/ha/y), and
- Alberta Environment (AENV 2011a and 2011b) for acid deposition (0.25 keq/ha/y to 1.0 keq/ha/y) (Table 5.5-22).

Table 5.5-22: Empirical Critical Loads from Canadian and International Agencies

Source	Sulphate (kg/ha/y)	Nitrogen (kg/ha/y)	Acid Deposition (keq/ha/y)
BC MOE	7.5	5	0.15
UNECE	-	5 to 8	-
AENV	-	-	0.25 to 1.0[a]

NOTES:
[a] 0.25 for sensitive soils; 0.5 for moderately sensitive soils; 1.0 for soils of low sensitivity
- No critical load recommended.
SOURCES: BC MOE 2013b; UNECE 2007; AENV 2011a, AENV 2011b;

Air Quality Modelling and Soils Modelling

To assess the effects of air emissions on vegetation health and diversity, air quality dispersion models were run using the methods outlined in the Air Quality TDR (Stantec 2014c) for three year average annual nitrogen dioxide and sulphur dioxide concentration levels, and nitrogen, sulphate, and acid deposition rates. Four cases are considered in the air quality modelling:

- Base case for the regional emission sources considers the current regional sulphur dioxide and nitrogen oxides emission sources for the RTA facility and the Kitimat LNG Terminal, including supporting marine vessels.
- Project-alone case considers the Project's emission sources only.
- Application case considers results of the base case plus the Project-alone case.
- Cumulative case considers the results of the application case plus emissions from the three specific foreseeable future projects identified by the air quality team, Enbridge Northern Gateway, Douglas Channel LNG and Kitimat Clean projects, including supporting marine vessels. This case is discussed in Section 5.5.7.

The air quality model results are compared to empirical critical levels for nitrogen dioxide (Table 5.5-20) and sulphur dioxide (Table 5.5-20 and Table 5.5-21) concentrations from the scientific literature, and the BC MOE's guidance on critical loads assessment (Table 5.5-22) for acid, nitrogen, and sulphate deposition (BC MOE 2013b).

Results of air dispersion modelling indicate that air emissions will be less than the empirical critical level for nitrogen dioxide, using the conservative level of 30 $\mu g/m^3/y$ (Table 5.5-20). Therefore, no further analysis related to nitrogen dioxide is required.

If the dispersion model indicates that deposition for the application and cumulative cases exceeds the pertinent government guidance or empirical critical load from the literature, a more detailed additional assessment is conducted. The more detailed additional assessment entails soil modelling. Soil mapping is used to guide the collection of soils field samples that are sent to a laboratory to assess and correlate the soil map units' cation exchange capacity, total sulphur, nitrogen, organic carbon and pH. Critical loads for each soil map unit are calculated using a simple mass balance (SMB) calculation following the ICP Mapping Manual methodology (UBA 2014) and MOE (2013) guidance.

The areas where critical levels and calculated critical loads are modelled to be exceeded are identified from the air quality modelling (Stantec 2014c) and soils study results (Stantec 2014d). These areas are overlaid on regional soils and vegetation maps (including the Kalum PEM and VRI) to determine which ecosystems have potential to be adversely affected. Results for each parameter and case are provided in the Emissions Assessment on Soils and Vegetation TDR (Stantec 2014d) and are summarized in the following subsections.

5.5.5.3.2 Assumptions and the Conservative Approach

Conservative empirical critical levels are applied that are protective of lichens, regardless of ecosystem type (e.g., even if lichen is not likely present). Conservative model inputs are used in the critical loads analysis (Stantec 2014d). The base cation to aluminum (BC:Al) ratio of 1 is used as a key input to the critical loads analysis (soils modelling calculations) to determine potentially affected areas where conifer forests occur, whereas the BC:Al ratio of 6 is used for deciduous forests (Stantec 2014d). Conservative values for BC:Al ratios are derived from Sverdrup and Warfvinge (1993) and are comparable with a recent study in the Kitimat airshed by ESSA Technologies et al. (2014). The BC:Al ratio of 1 has also been applied in Europe (UBA 2004) and in previous Canadian studies (including the western provinces and Rio Tinto Alcan studies (ESSA Technologies et al. 2013; ESSA Technologies et al. 2014; UBA 2004; Alberta Research Council 2009).

5.5.5.3.3 Description of Project Effect Mechanisms for Change in Native Vegetation Health and Diversity due to Emissions

Project air emissions during operations have the potential to affect vegetation health and diversity through the following pathways:

- sulphur dioxide fumigation (direct effect)
- nitrogen deposition (indirect effect of eutrophication), and
- sulphate and acid deposition (indirect effect).

Sulphur dioxide fumigation can have negative effects on the biochemical processes of plants, including photosynthesis and respiration. The effects depend on plant species and ecological conditions and can affect plant growth, alter plant sensitivity to other environmental stresses, and contribute to declined vegetation health (particularly for lichen and moss species due to their lack of a protective cuticle layer) (WHO 2000; Tripathi et al. 1993). The critical level of atmospheric sulphur dioxide associated with negative effects on vascular plants and mosses is an annual mean of 20 $\mu g/m^3$ (WHO 2000). The critical level protective for lichen, above which direct adverse effects are expected, is an annual mean of 10 $\mu g/m^3$ (Arctic Monitoring and Assessment Program 2006).

Nitrogen, sulphate, and acid deposition have indirect effects on vegetation, all of which can decrease diversity through interspecies competition and mortality or declined health in some species through increased susceptibility to secondary stress factors (WHO 2000). These stress factors include disease, insects, frost and drought.

The effect of acidification (decrease in pH) on vegetation is mainly attributable to sulphur oxides, sulphates (sulphuric acid), nitrogen oxides, nitrates (nitric acid), and ammonium compounds (Arctic Monitoring and Assessment Program 2006). Lowered soil pH can reduce the availability of nutrients and increase the solubility of toxic metals, such as aluminum (Blank et al. 1992). Soil types differ in their sensitivity to acid deposition depending on their pH and base saturation or cation buffering capability. Terrestrial soils which have a low pH, low cation exchange capacity, and/or a coarse-texture are particularly sensitive to acid deposition. Acidifying compounds can be deposited in wet and dry forms, both of which can negatively affect vegetation, though wet deposition has the greatest effect.

5.5.5.3.4 Mitigation for Change in Native Vegetation Health and Diversity due to Emissions

Air quality modelling results are based on the mitigated emissions rates for individual contaminants. These mitigation measures are outlined in the Air Quality TDR (Stantec 2014c) and include measures such as: adhering to the Air Quality Management Plan (Mitigation 5.2-6); manage, through Project engineering design and operational procedures, the continuous nitrogen oxides emissions associated with the gas turbine exhaust to meet regulatory requirements (Mitigation 5.2-5); and the use of low-sulphur fuel for diesel fired equipment (Mitigation 5.2-7).

5.5.5.3.5 Characterization of Change in Native Vegetation Health and Diversity due to Emissions

Details of vegetation in each exceedance area and for the four cases (base, Project-alone, application, and cumulative) are presented in the Emissions Assessment on Soils and Vegetation TDR (Stantec 2014d). The following analysis is focused on the application case during operations, which considers existing (base case) emissions plus Project emissions.

Sulphur Dioxide Fumigation, Application Case

The spatial area where sulphur dioxide exceeds 10 $\mu g/m^3/y$ in the base case is 3,297 ha (Stantec 2014d), of which 2,942 ha (89%) is vegetated communities (Table 5.5-23; Figure 5.5-10). The vegetated area where sulphur dioxide exceeds 10 $\mu g/m^3/y$ in the application case is another 268 ha more than the base case area.

Although any plant species can be affected by uptake of sulphur dioxide fumigation through stomata, the pathway is more limited in vascular plants because they have a protective cuticle (WHO 2000). Lichens and bryophytes are particularly sensitive because they lack a protective cuticle and receive most of their nutrients from the atmosphere. Within the application case exceedance area, communities that support a relatively high abundance of lichen species are considered to be particularly sensitive; these include drier upland and montane communities plus old forests of varying moisture regimes (e.g., hair lichens are typically abundant in old forests of this region). ESSA Technologies et al. (2014) conducted a study, including field assessments, and noted that lichen communities to the east of Minette Bay are healthy at baseline, while those on the west side have been affected by industry.

Table 5.5-23: Sulphur Dioxide Exceedance Area in the Emissions RSA, Application Case

Broad Ecosystem Name	Exceedance Area (ha)			Extent in Baseline RSA (ha)	Percentage of RSA Exceeded in Application Case (%)
	Base Case	Application Case	Change from Base Case to Application Case		
Upland Forested					
Amabilis Fir - Western Hemlock[a]	1,998.2	2,227.5	229.2	219,604	1
Coastal Western Hemlock - Western Redcedar[a, d]	374.4	403.8	29.4	9,329.0	4
Mountain Hemlock - Amabilis Fir[a]	3.5	3.6	<0.1	2,220.4	<1
Total Upland Forested	2,376.2	2,634.8	258.6	239,577.0	1
Floodplain					
Deciduous Shrub	7.6	9.1	1.5	206.3	4
Sitka Spruce - Black Cottonwood Riparian[a]	16.5	18.0	1.4	4,140.2	<1
Total Floodplain	24.2	27.1	2.9	13,106.2	<1
Wetland					
Cedars - Shore Pine Bog[a, d]	33.2	44.2	11.0	6,417.0	1.0
Western Redcedar Swamp[a]	2.3	7.0	4.7	2,027.4	<1
Wetland Unclassified	53.2	16.5	-36.7	7,219.3	<1
Yellow Cedar Bog Forest[a, d]	147.9	164.1	16.1	3,469.7	5
Total Wetland	236.6	231.7	-4.9	19,994.4	1
Montane, Subalpine, or Alpine					
Mountain Hemlock - Amabilis Fir[a, d]	17.9	22.8	5.0	44,275.0	<1
Mountain Hemlock - Yellow Cedar[a]	16.6	18.9	2.3	8,800.2	<1
Total Montane, Subalpine, or Alpine	34.5	41.8	7.3	100,131.0	<1
Avalanche Track	57.8	61.8	4.1	30,084.7	<1
Total Vegetated	2,729.2	2,997.3	268.0	405,280.7	1
Total Unvegetated	157.6	299.5	162.2	89,443.7	1
Total	2,886.8	3,296.7	409.9	500,016.0[c]	1

NOTES:

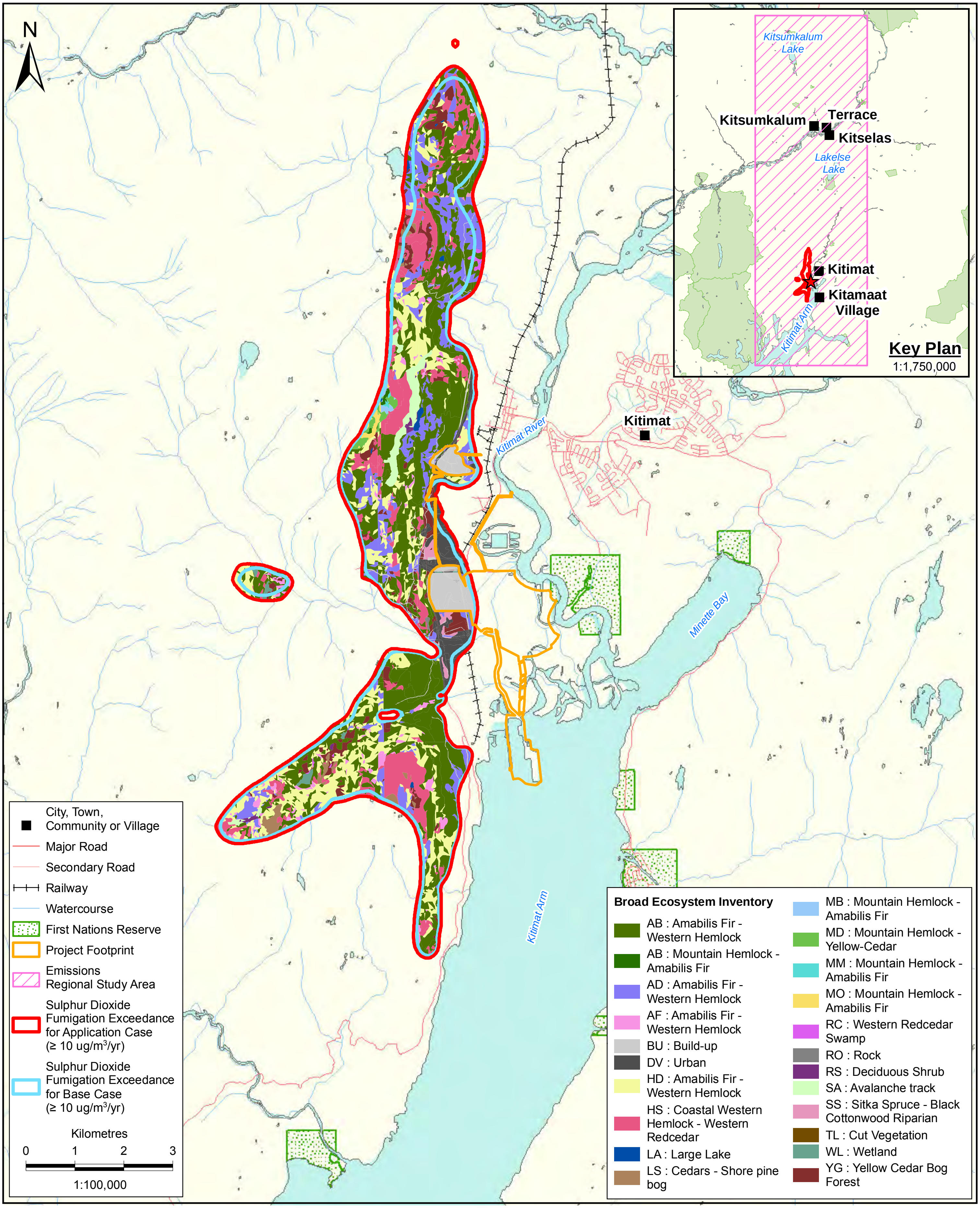
Spatial boundaries refer to the emissions RSA

[a] areas with highest percentage of coniferous tree species (within varying structural stages)

[b] negative numbers indicate areas where the Project footprint will remove ecological communities in the application case

[c] the areas of vegetated and unvegetated units contained within the emissions RSA sums to 500,016 ha, although the terrestrial study area is 500,000 ha. This is due to the different map projections of the original spatial datasets (VRI, PEM and BEC).

[d] indicates that the broad ecosystem contains communities that have been identified as sensitive to sulphur dioxide concentrations (Stantec 2014d).



Stantec

LNG CANADA
Opportunity for British Columbia. Energy for the world

VEGETATION ENVIRONMENTAL EFFECTS ASSESSMENT

SULPHUR DIOXIDE EXCEEDANCE AREA - APPLICATION CASE

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION	DRAWN BY
UTM9	SS
DATUM	CHECKED BY
NAD 83	SW
DATE	FIGURE NO.
22-AUG-14	**5.5-10**

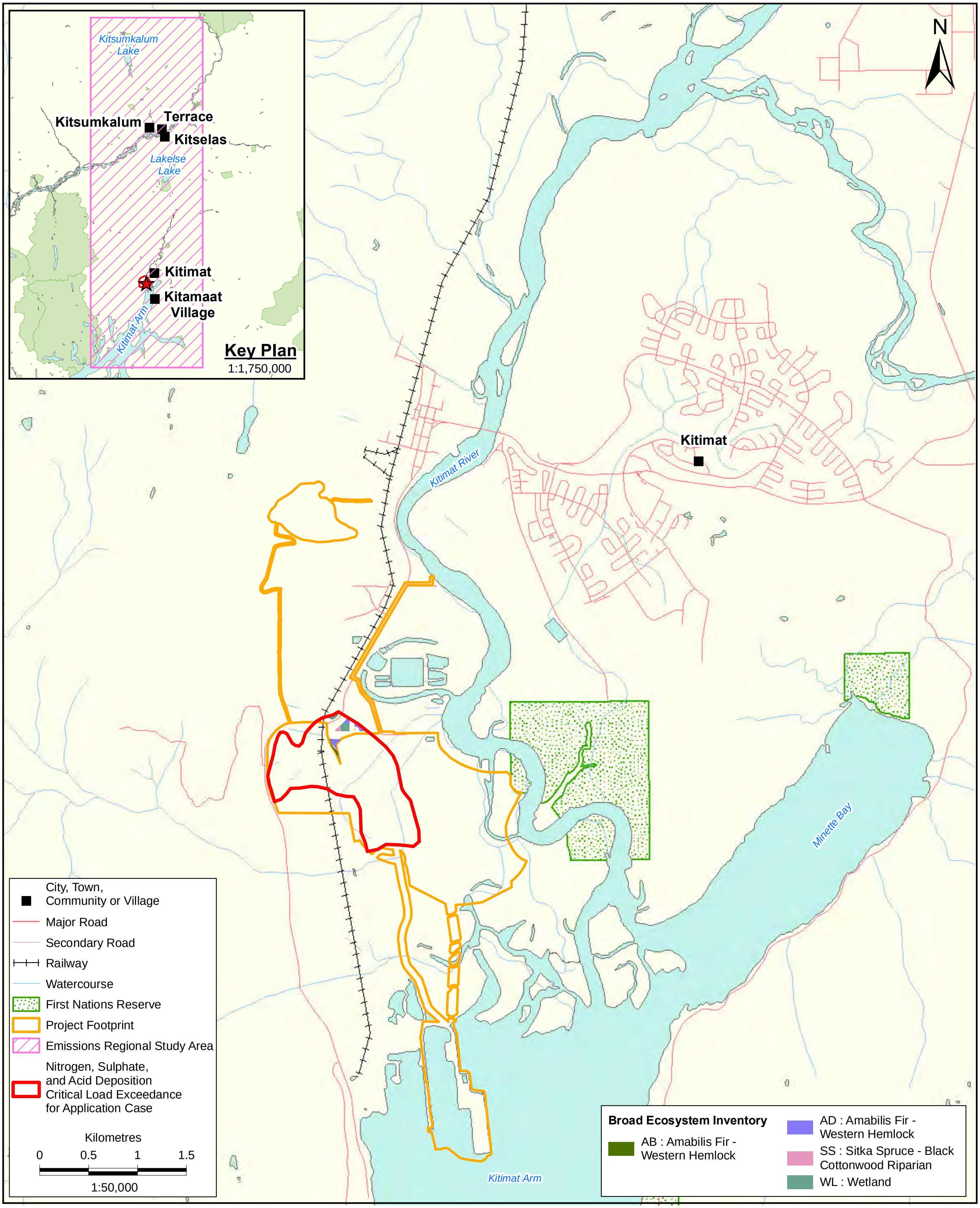
8/22/2014 - 10:51:36 AM V:\1231\active\EM1231110458\gis\figures\EA\section_5.5_vegetation\fig_10458_ea_veg_05_05_10_empirical_sulphur_dioxide_application.mxd

Within the sulfur dioxide exceedance area in the application case, the largest proportion of an ecosystem's extent within the emissions RSA is represented by yellow cedar bog forest (5%), followed by coastal western hemlock - western redcedar and deciduous shrub floodplain (4% each); the remaining ecosystem types are 1% or less of their RSA extent (Table 5.5-23). The application case exceedance area consists of approximately 604 ha (18%) of drier upland and montane forested communities and 1,008 ha (31%) of old forest (see the Emissions Assessment on Soils and Vegetation TDR (Stantec 2014d) for detailed summaries). The sulphur dioxide exceedance area for the application case extends into Haisla and Kitselas traditional territories.

The change in native vegetation health and diversity due to sulphur dioxide emissions will be low magnitude in the emissions LSA, long-term, continuous and reversible. The sensitive ecosystems are moderately resilient to such disturbance. There is a medium likelihood that a decline in the vegetation health and diversity will occur from sulphur dioxide fumigation in the emissions LSA because operations will exceed critical levels. However, there is uncertainty as to exactly how native vegetation will respond in the operation timeframe. The Kitimat Airshed study (ESSA Technologies et.al. 2014) and the Rio Tinto Alcan studies (ESSA Technologies et al. 2013) reported an overall low rating for the direct effects of sulphur dioxide to vegetation, with effects very unlikely and of minor-medium consequence.

Nitrogen Deposition, Application Case

In the application case, the Project will have been constructed and the base case vegetated area within the Project footprint will be replaced with infrastructure. Calculated critical loads for nitrogen deposition are not exceeded in the base case (Stantec 2014d). The critical load for nitrogen deposition is exceeded in the application case in approximately 4 ha of vegetated communities, most of which is amabilis fir – western hemlock forest (Table 5.5-24; Figure 5.5-11; Stantec 2014d). The vegetation communities within the exceedance area are primarily located adjacent to the Project footprint, with a minor portion coinciding with the tree clearing area that falls within the Project footprint. In the 4 ha exceedance area, wetlands have notable sensitivity to eutrophication and occupy 1 ha (40% of the exceedance area; Stantec 2014d). The majority of the 4 ha exceedance area is composed of young and pole-sapling forest (Stantec 2014d). The nitrogen deposition exceedance for the application case occurs in the Haisla traditional territory.



V:\1231\active\EM1231104 58\gis\figures\EA\section_5.5_vegetation\fig_10458_ea_veg_05_05_11_nitrogen_sulphate_acid_application.mxd

8/22/2014 - 10:52:54 AM

Stantec

LNG CANADA — Opportunity for British Columbia. Energy for the world

VEGETATION ENVIRONMENTAL EFFECTS ASSESSMENT

CRITICAL LOAD EXCEEDANCE AREA – APPLICATION CASE

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION	DRAWN BY
UTM9	SS
DATUM	CHECKED BY
NAD 83	SW
DATE	FIGURE NO.
22-AUG-14	**5.5-11**

Table 5.5-24: Nitrogen Deposition Exceedance Area in the Emissions RSA, Application Case

Broad Ecosystem Name		Exceedance Area (ha)			Extent in Baseline RSA (ha)	Percentage of RSA Exceeded in Application Case (%)
		Base Case	Application Case	Change from Base Case to Application Case		
Upland Forested	Amabilis Fir - Western Hemlock	0	1.9	1.9	219,604.0	<0.1
Floodplain	Sitka Spruce - Black Cottonwood Riparian [a]	0	0.3	0.3	4,140.2	<0.1
Wetland	Wetland Unclassified	0	1.4	1.4	7,219.3	<0.1
Total Vegetated		0	3.6	3.6	405,280.7	<0.1

NOTES:
Spatial boundaries refer to the emissions RSA
[a] In this instance, this broad ecosystem type is only composed of the Sitka spruce- salmonberry community, which is conifer-dominated rather than a mixed forest that is the name applied to this broad ecosystem unit (Stantec 2014d).

The change in native health and diversity due to nitrogen deposition will be low magnitude in the emissions LSA, long-term, continuous, and reversible. The sensitive ecosystems are moderately resilient to such disturbance. There is a medium likelihood that a decline in the vegetation health and diversity will occur from nitrogen deposition in the emissions LSA because operation will exceed calculated critical loads for nitrogen deposition. There is a degree of uncertainty as to how native vegetation will respond within the operation timeframe.

Acid and Sulphate Deposition, Application Case

In the application case, the Project will have been constructed and the base case vegetated area within the Project footprint will be replaced with infrastructure. Calculated critical loads for acid and sulphate deposition are not exceeded in the base case (Stantec 2014d). Approximately 4 ha of vegetation communities occur in the area where sulphate and acid deposition exceed critical loads in the application case (Table 5.5-25; Figure 5.5-11). This is the same 4 ha of vegetated communities within the nitrogen deposition exceedance area.

Old forest can support an abundance of lichen species, which are sensitive to acid deposition (BC MOE 2013b); however, old forest does not occur in the exceedance area. The forests in the application case where acid deposition exceeds critical loads are either young or pole sapling forest (Stantec 2014d). The sulphate and acid deposition exceedance for the application case occurs in the Haisla traditional territory.

Table 5.5-25: Acid and Sulphate Deposition Exceedance Area in the Emissions RSA, Application Case

Broad Ecosystem Name		Exceedance Area (ha)			Extent in Baseline RSA (ha)	Percentage of RSA Exceeded in Application Case (%)
		Base Case	Application Case	Change from Base Case to Application Case		
Upland Forested	Amabilis Fir - Western Hemlock	0	1.9	1.9	219,604.0	<0.1
Floodplain	Sitka Spruce - Black Cottonwood Riparian [a]	0	0.3	0.3	4,140.2	<0.1
Wetland	Wetland Unclassified	0	1.4	1.4	7,219.3	<0.1
Total Vegetated		0	3.6	3.6	405,280.7	<0.1

NOTES:

Spatial boundaries refer to the emissions RSA

[a] In this instance, this broad ecosystem type is only composed of the Sitka spruce- salmonberry community, which is conifer-dominated rather than a mixed forest that is the name applied to this broad ecosystem unit (Stantec 2014d).

One reason for the exceedances is that for the base case, the air quality-modelled deposition values for sulphate and acid are close to the calculated critical loads (99% of the critical load for sulphate deposition and 99% of the critical load for acid deposition) (Stantec 2014d). Therefore, only a slight increase in sulphate and acid deposition from the base case to the application case is required to exceed critical loads in the application case for the more sensitive soil map polygons.

The Kitimat Airshed study (ESSA Technologies et.al. 2014) and the Rio Tinto Alcan study (ESSA Technologies et al. 2013) that were conducted in the same airshed report larger areas (ha) of exceedances than predicted in this assessment. However, predictive modelling incorporates a combination of input variables and assumptions to consider when comparing results. For example, one scenario (G_76.2) in the Kitimat Airshed study is similar to the application case emissions and sources considered in this assessment. Emissions concentrations of NO2 and SO2 considered in that scenario are approximately 73% and 20% higher, respectively, than those considered in this assessment (Section 5.2.3.2). With these discrepancies and other differences in dispersion modelling (e.g. meterological inputs) these results are not directly comparable to LNG Canada Project's application case results. Also, the Rio Tinto study used different emissions and dispersion modelling data which affects the results (see Section 8.4 in the Air Quality TDR, Stantec 2014c for a comparison of the modelling methods between Rio Tinto Alcan study). The assumptions and inputs used in the critical loads analysis were as close as possible to those used in the ESSA Technologies et.al. (2013) modelling (Stantec 2014d). Different vegetation mapping products were used in those studies than in this assessment as well, contributing to the difficulty in directly comparing results.The change in native vegetation health and diversity due to acid and sulphate deposition will be low magnitude in the emissions LSA, long-term, continuous and reversible. The ecosystems within the exceedance area are moderately resilient to such disturbance. There is a low likelihood that a decline in the vegetation health and diversity will occur from acid deposition in the emissions RSA because the effect to native vegetation is restricted to 4 ha, which is less than 1% of the emissions RSA; however, there is a degree of uncertainty regarding how native vegetation will respond to this change within the operation timeframe.

5.5.5.3.6 Determination of Significance of Change in Native Vegetation Health and Diversity due to Emissions

The yellow cedar bog forest is the broad ecosystem type with the greatest proportion of its RSA extent within the area where sulphur dioxide exceeds critical levels (5%). The majority of the remaining ecosystem types within the sulfur dioxide exceedance area account for 1% or less of their RSA extents.

Calculated critical loads for nitrogen, acid and sulphate deposition were not exceeded at base case but are exceeded within the same 4 ha of the emissions LSA in the application case, located adjacent to the Project footprint. The broad ecosystem type comprising the greatest proportion of the exceedance area for nitrogen, acid and sulphate deposition is amabilis fir – western hemlock upland forest. The number of hectares of each ecosystem within the exceedance area represents less than 1% of their extent within the emissions RSA.

Modelling incorporates conservative assumptions, both in the dispersion modelling and in the calculated critical loads for mineral soils within the emissions RSA. 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.

5.5.6 Summary of Residual Effects

The Project may result in the following residual effects from construction and operation of the LNG facility:

- change in abundance of plant species of interest, including the potential reduction of two occurrences of provincially listed plant species, and local reduction in traditional use plants,
- change in abundance or condition of ecological communities of interest, including a reduction within the local area of red- and blue-listed wetland and floodplain communities, and old forest. There will be no loss of wetland functions associated with the ecologically important wetlands due to implementation of the Wetland Compensation Plan, and
- change in native vegetation health and diversity due to air emissions effects of sulphur dioxide fumigation, nitrogen deposition, and acid deposition.

Table 5.5-26 summarizes the overall characterization and significance prediction for effects of the Project on vegetation resources. With the implementation of mitigation measures, the residual effects on vegetation resources are not significant. Although there is high confidence in the reliability of site specific and regional information collected in support of this effects assessment, there is moderate confidence, overall, given the uncertainty of the actual vegetation responses to air emissions over the minimum 25-year operation phase.

5.5.7 Assessment of Cumulative Effects

Cumulative effects are considered for each Project-specific residual effect. Three stages are involved: (1) establishing context by providing an overview of the cumulative effects of other projects and activities on the VC; (2) determining the potential for Project-specific residual effects to interact with the 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 overall cumulative effect, and characterizing the Project's contribution to the change in cumulative effects.

5.5.7.1 Stage 1, Cumulative Effects Context

Cumulative effects on vegetation resources have been assessed (1) within the terrestrial RSA for cumulative change in abundance or condition of ecological communities or plants of interest and (2) within the emissions RSA for the cumulative effects from emissions on the change of native vegetation health and diversity.

These analyses are discussed separately because there is a difference in potential area of effects.

5.5.7.1.1 Change in Abundance or Condition of Plant Species and Ecological Communities of Interest

Spatial data are acquired from government sources to estimate the level of past, present and foreseeable future disturbance in the terrestrial RSA (Stantec 2014d). Table 5.5-27 provides the approximate area of baseline and reasonably foreseeable future disturbances in the terrestrial RSA from other projects and activities. The area of baseline disturbance in the terrestrial RSA is approximately 13,602 ha (11% of the terrestrial RSA). Harvested cutblocks and cutlines are the largest baseline disturbance, approximately 8,159 ha (6%) of the terrestrial RSA landscape. Reasonably foreseeable future disturbances will lead to the loss of 470 ha (less than 1%) of vegetation in the terrestrial RSA.

Approximately 12,865 ha (10%) of the terrestrial RSA are in protected areas. Old growth management areas are spatially designated areas that are managed to maintain old growth attributes and cover 4,708 ha (4%) of the terrestrial RSA.

Table 5.5-26: Summary of Residual Effects on Vegetation Resources

Project Phase	Mitigation Measures	Residual Effects Rating Criteria						Likelihood of Residual Effects	Significance	Prediction Confidence	Follow-up and Monitoring
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context				
Facility Works and Activities											
Change in Abundance of Plant Species of Interest: Clearing of vegetation may reduce the abundance of red- and blue-listed plants and will reduce the abundance of traditional use plants in the terrestrial LSA											
Construction	▪ Mitigation 5.5-1 ▪ Mitigation 5.5-2 ▪ Mitigation 5.5-3 ▪ Mitigation 5.5-5 ▪ Mitigation 5.5-6	M/L	PF	MT/P	S	R/I	L-H	L-H	N	M-H	
Residual effect for all phases		M/L	PF	MT/P	S	R/I	L-H	L-H	N	M-H	No follow -up programs are proposed for vegetation resources.
Change in Abundance or Condition of Ecological Communities of Interest: Clearing of vegetation will result in a reduction of and may indirectly reduce the condition of ecological communities of interest in the terrestrial LSA											
Construction	▪ Mitigation 5.5-1 ▪ Mitigation 5.5-5 ▪ Mitigation 5.5-10 ▪ Mitigation 5.6-7 ▪ Mitigation 5.6-11 ▪ Mitigation 5.5-9	L-M	PF / LSA	P	S	I	L-H	H	N	M-H	
Residual effect for all phases		L-M	PF	P	S	R	L-H	H	N	M-H	No follow -up programs are proposed for vegetation resources.

Project Phase	Mitigation Measures	Residual Effects Rating Criteria						Likelihood of Residual Effects	Significance	Prediction Confidence	Follow-up and Monitoring
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context				
Change in Native Vegetation Health and Diversity due to air emissions: LNG operations will produce air emissions that could potentially reduce native vegetation health and diversity within the emissions LSA through acidification of sensitive soils and flora, and change in nutrients due to nitrogen dioxide and sulphur dioxide addition to the soil and/or foliage uptake.											
Operation	Adherence to the mitigation measures described in the air quality assessment (Section 5.2)	L	LSA	LT	C	R	H	L-M	N	M	
Residual effect for all phases		L	LSA	LT	C	R	H	M	N	M	No follow -up programs are proposed for vegetation resources.

KEY

MAGNITUDE:

N = Negligible—no measurable change in plant species or ecological communities of interest.

L = Low—measurable change in plant species or ecological communities of interest affecting a portion of the regional population or community; regional population density or community's extent sufficient to sustain that population or community without active management.

M = Moderate—measurable change in plant species or ecological communities of interest affecting a portion of the regional population or community; uncertainty or risk associated with regional population density or community extent's ability to sustain that population or community; requires active management to ensure regional sustainability of population or community.

H = High—measurable change in plant species or ecological communities of interest relative to baseline conditions that would affect the entire local occurrence population or community (see exceptions below).

A high magnitude effect for wetlands is one that results in an unmitigated net-loss of wetland functions associated with wetlands designated as ecologically-important to the region (Environment Canada 2014a).

A high magnitude effect for old forest is a reduction in abundance from baseline area that exceeds 87% of the estimated old forest mapped within the terrestrial RSA. This is in line with the provincial non-spatial old growth order, which establishes a minimum retention target of 13% old forest area for the Wedeene landscape unit (BC MSRM 2004).

GEOGRAPHIC EXTENT:

PF = Project footprint—residual effects are restricted to the Project footprint

LSA—residual effect extends into the LSA

RSA—residual effect extends into the RSA

DURATION:

ST = Short-term—effect restricted to one growing season

MT = Medium-term—effect extends through the operational timeframe of the Project

LT= Long-term—effect extends beyond closure

P = Permanent—measureable parameter unlikely to recover to baseline

FREQUENCY:

S = Single event—occurs once

MI = Multiple irregular event (no set schedule —occurs sporadically at irregular intervals throughout construction, operation, or decommissioning phases

MR = Multiple regular event—occurs on a regular basis and at regular intervals throughout construction, operation, or decommissioning phases

C = Continuous—occurs continuously throughout the life of the Project

REVERSIBILITY:

R = Reversible—will recover after closure and reclamation

I = Irreversible— permanent

CONTEXT:

L= Low resilience—low capacity for vegetation resources to recover from a perturbation, with consideration of the baseline level of disturbance

M = Moderate resilience—moderate capacity for vegetation resources to recover from a perturbation, with consideration of the baseline level of disturbance

H = High resilience—high capacity for vegetation resources to recover from a perturbation, with consideration of the baseline level of disturbance

SIGNIFICANCE:

S = Significant

N = Not Significant

PREDICTION CONFIDENCE:

Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation, and assumptions made.

L = Low level of confidence

M = Moderate level of confidence

H = High level of confidence

LIKELIHOOD OF RESIDUAL EFFECT OCCURRING:

Based on professional judgment

L= Low—low likelihood that there will be a residual effect

M = Medium—moderate likelihood that there will be a residual effect

H = High— high likelihood that there will be a residual effect

Table 5.5-27: Existing and Foreseeable Future Disturbance in the Terrestrial RSA

Disturbance Type	Baseline Conditions (ha)[a]	Reasonably Foreseeable Future Disturbances (ha)[b,c]	Total Cumulative Disturbance (ha)[b]
Agriculture	1,144.3	0.0	1,144.3
Build-up[d]	486.5	99.6	586.2
Cutblocks and Cutlines	8,158.7	-7.5	8,151.1
Hydrographic	19.6	-0.6	19.0
Major Roads	133.2	0.0	133.2
Oil and Gas	1,018.5	381.1	1,399.6
Other Industries	36.3	-0.6	35.7
Power line	125.4	-1.0	124.4
Railway	31.0	0.0	31.0
Recreation	1,515.8	0.0	1,515.8
Secondary Road	637.0	-1.1	635.8
Tertiary/Access Road	296.0	-0.5	295.5
Total Disturbance	13,602.1	469.5	14,071.6

NOTES:

[a] baseline projects including Sandhill 7 Parcels, Former Eurocan Pulp and Paper Co., Former Moon Bay Marina Site, and MK Bay Marina Site (Figure 5.5-12).

[b] Where area (ha) by disturbance type decreases, this indicates that some of the area is predicted to be disturbed due to a second source (e.g. road is a greater level disturbance type than cutblock). Such overlapping disturbances are not counted twice and area is assigned only to one category for the total cumulative disturbance.

[c] Reasonably foreseeable future disturbance includes the Enbridge Northern Gateway, Coastal GasLink Pipeline, Pacific Northern Gas Looping, and Pacific Trail Pipeline, Douglas Channel, and Kitimat LNG Terminal.

[d] Build-up includes buildings, towers and, residential/urban areas.

Based on reported data available from past, present, and foreseeable future projects, the following summarizes key conditions in the terrestrial RSA:

- One species, eminent bluegrass, was previously reported to occur within the mouth of Bish Cove near the Kitimat LNG Terminal development. During site-specific surveys for the Kitimat LNG Terminal by Jacques Whitford (2006), the location of this species was not confirmed and no other listed or traditional use plants were reported.
- Given the ecology of the traditional use plants and their common distribution, it is anticipated that there will be a loss of traditional use plants from within the footprints of these other projects in the terrestrial RSA.
- One invasive plant species, oxeye daisy, was reported to occur in the spatial boundaries of the terrestrial RSA (Enbridge Northern Gateway Pipelines 2010).

- Approximately 22 ha of two provincially listed ecological communities are reported to occur in the clearing limits of the Kitimat LNG Terminal: the red-listed Sitka spruce – salmonberry floodplain (CWHvm1/09; 2 ha) and the blue-listed amabilis fir – Sitka Spruce/devil's club (CWHvm1/08; 21) (Jacques Whitford 2006; Jacques Whitford 2005; BC EAO et al. 2006). These communities occupy 2,011 ha (blue-listed) and 12,424 ha (red-listed), throughout the terrestrial RSA, based on the Kalum PEM.
- A minimum of 595 ha of mapped ecological communities in the terrestrial RSA will be cleared for the construction of the Enbridge Northern Gateway project, approximately 42 ha of which are two blue-listed communities, CWHvm1/03 (31 ha) and CWHvm1/08 (11 ha), within the Gateway Kitimat Terminal portion of the footprint (Enbridge Northern Gateway Pipelines 2010).
- Floodplain was not identified as an ecosystem of interest in other projects. However, the results from the Kitimat LNG Terminal assessment confirm the loss 2 ha of the Sitka spruce – salmonberry floodplain unit (CWHvm1/09).
- Approximately 267 ha of mapped ecological communities were lost due to the Sandhill Materials – Aggregate Processing, none of which were reported in available online resources as listed (Arthon Industries Ltd. 2013).
- A minimum estimate of 251 ha of old forest will be lost due to clearing activities associated with the future projects in the area (Enbridge Northern Gateway Pipelines 2010; BC EAO et al. 2006; ESSA Technologies et al. 2013; BC EAO 2013).
- Approximately 6 ha of wetlands and associated wetland functions are reported to be lost due to foreseeable future projects: 5 ha of bog and 1 ha of fen for the Gateway Kitimat Terminal (Enbridge Northern Gateway Pipelines 2010). However, wetland compensation will be implemented and therefore, no residual effects are anticipated (AMEC 2012).

The baseline condition of the terrestrial RSA is a predominantly intact forested landscape with some existing anthropogenic disturbances from current timber production activities and urban and industrial developments totaling approximately 10% of the terrestrial RSA. A comparable amount of the terrestrial RSA is also protected from development through designations such as old growth management areas, parks, and protected areas. The estimated area of disturbance attributable to foreseeable future projects is less than 1% of the terrestrial RSA.

5.5.7.1.2 Change in Native Vegetation Health and Diversity due to Air Emissions

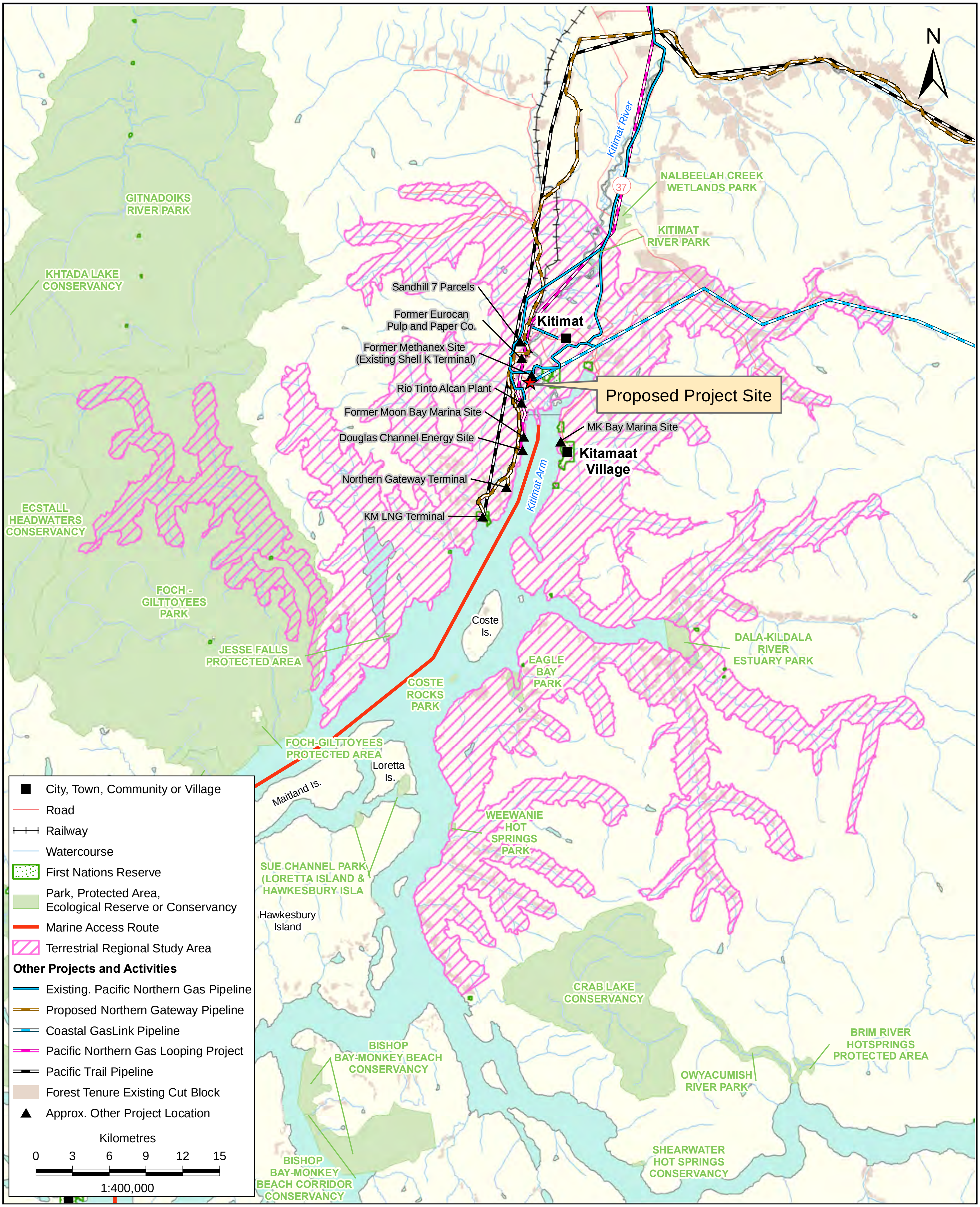
Based on reported data available from past, present, and foreseeable future projects, the following summarizes conditions in the emissions RSA:

- Results from a risk assessment conducted for the Rio Tinto Alcan Aluminum Smelter and Modernization project, reported no U.S. EPA National Secondary Air Quality Standard, exceedances for sulphur dioxide pollutants expected—and that only a few hours per growing season at a small number of sites—will exceed the *Canadian National Ambient Air Quality Guidelines and Objectives* (ESSA Technologies et al. 2013). Vegetation as a receptor was predicted to be at low risk for both direct and indirect effects by sulphate deposition to soils (ESSA Technologies et al. 2013). The characterized predicted effects on vegetation from sulphur fumigation and deposition is low and with rare occurrence of vegetation damage from emissions (ESSA Technologies et al. 2013).
- The predicted area of vegetation classes that the empirical critical level for sulphur dioxide (10 $\mu g/m^3/y$) that will be exceeded from the Enbridge Northern Gateway Project in the application case was 7,310 ha (Enbridge Northern Gateway Project 2010). Although that project used a different study area, much of that area falls within the Project's emissions RSA; associated emissions from the Enbridge Northern Gateway Project are included in the Project's cumulative case modelling.

Based on the Stantec air quality modelling, sulphur dioxide is predicted to exceed critical levels at base case (including the Rio Tinto Alcan Aluminum Smelter and Modernization project and Kitimat LNG Terminal) and in the cumulative case from foreseeable future projects (including Enbridge Northern Gateway project and Kitimat Clean West Coast Refinery). Based on the air quality modelling and soils critical load modelling, nitrogen, sulphate and acid deposition are not modelled to exceed calculated critical loads at base case, but they are exceeded in the cumulative case.

5.5.7.2 Stage 2, Determination of Potential Cumulative Interactions

Seven projects and activities have potential to interact with the residual effects of the Project that could possibly result in cumulative effects on vegetation resources in the terrestrial RSA or emissions RSA (Table 5.5-28, Figure 5.5-12).



\\cd1183-f04\workgroup\1231\active\EM\123110458\gis\figures\EA\section_5.5_vegetation\fig_10458_ea_veg_05_05_12_cumulative_effects.mxd

6/27/2014 - 2:27:57 PM

Stantec | LNG CANADA — Opportunity for British Columbia. Energy for the world

VEGETATION ENVIRONMENTAL EFFECTS ASSESSMENT

OTHER PROJECT AND ACTIVITIES – CUMULATIVE EFFECTS

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION: UTM9	DRAWN BY: SS
DATUM: NAD 83	CHECKED BY: SW
DATE: 27-JUN-14	FIGURE NO. **5.5-12**

Table 5.5-28: Potential for Cumulative Effects on Vegetation Resources

Other Projects and Activities with Potential for Cumulative Effects	Potential Cumulative Effects		
	Change in Abundance of Plant Species of Interest	Change in Abundance or Condition of Ecological Communities of Interest	Change in Native Vegetation Health and Diversity due to Air Emissions
Kitimat Area Project/Facility			
Coastal GasLink Pipeline Project	✓	✓	✓
Rio Tinto Alcan Facility and Modernization Project	✓	✓	✓
Kitimat LNG Terminal Project	✓	✓	✓
Douglas Channel LNG Terminal (also known as BC LNG)	✓	✓	✓
Enbridge Northern Gateway Project	✓	✓	✓
Former Methanex/Cenovus Terminal	✓	✓	✓
Sandhill Materials – Aggregate Processing	✓	✓	✓
Pacific Trail Pipelines Project	✓	✓	✓
Pacific Northern Gas Pipeline (includes proposed looping)	✓	✓	✓
Kitimat Clean			✓
Former Moon Bay Marina (footprint only)	✓	✓	
MK Bay Marina	✓	✓	
Activities			
Forestry Activities	✓	✓	✓

NOTES:
✓ **=** those “other projects and activities” whose effects have potential to interact cumulatively with the Project’s residual effects.

5.5.7.2.1 Change in Abundance or Condition of Plant Species and Ecological Communities of Interest

The total disturbance area of past, present and foreseeable future projects is estimated to be approximately 11% of the terrestrial RSA (14,072 ha). The Project will contribute an additional area of disturbance that equals less than 1% (429 ha) of the terrestrial RSA, of which 292 ha (less than 1% of the terrestrial RSA) are vegetated. The Project residual effects are summarized below along with interactions from other past, present or foreseeable projects or activities.

Change in Abundance of Plant Species of Interest

Residual effects on the abundance of plant species of interest include:

- removal of traditional use plants (food, medicinal and materials) from 36 genus or species present in the Project footprint

- potential loss of one known occurrence of the blue-listed rock sandwort, and
- potential loss of one known occurrence of the red-listed long-leaved aster.

With mitigation, these residual effects can be managed.

There is a potential interaction between the Project's residual effects and those of other projects within the terrestrial RSA pertaining to plant species of interest; however, based on the available information, no cumulative effects on plant species of interest are expected.

Although effects on traditional use plants were not reported in the effects assessments for other projects in the terrestrial RSA, the traditional use species identified within the terrestrial LSA are common and abundant throughout the terrestrial RSA; therefore, cumulative effects on traditional use plant species are expected; however, the regional populations will be sustained.

Among the past, present, and foreseeable future projects with reported results of listed plant species, none were reported that fall within the terrestrial RSA (Enbridge Northern Gateway Pipelines 2010; Arthon Industries Ltd. 2013; Jacques Whitford 2006; Jacques Whitford 2005; BC EAO et al. 2006); therefore, no cumulative effects on listed plant species will occur.

While invasive species are expected to occur in the terrestrial RSA and may be associated with other past, present, or foreseeable projects, the resulting effect is well understood and can be managed to acceptable levels through standard operating procedures or through the application of best management or codified practices. Negligible cumulative effects from invasive plant species will occur.

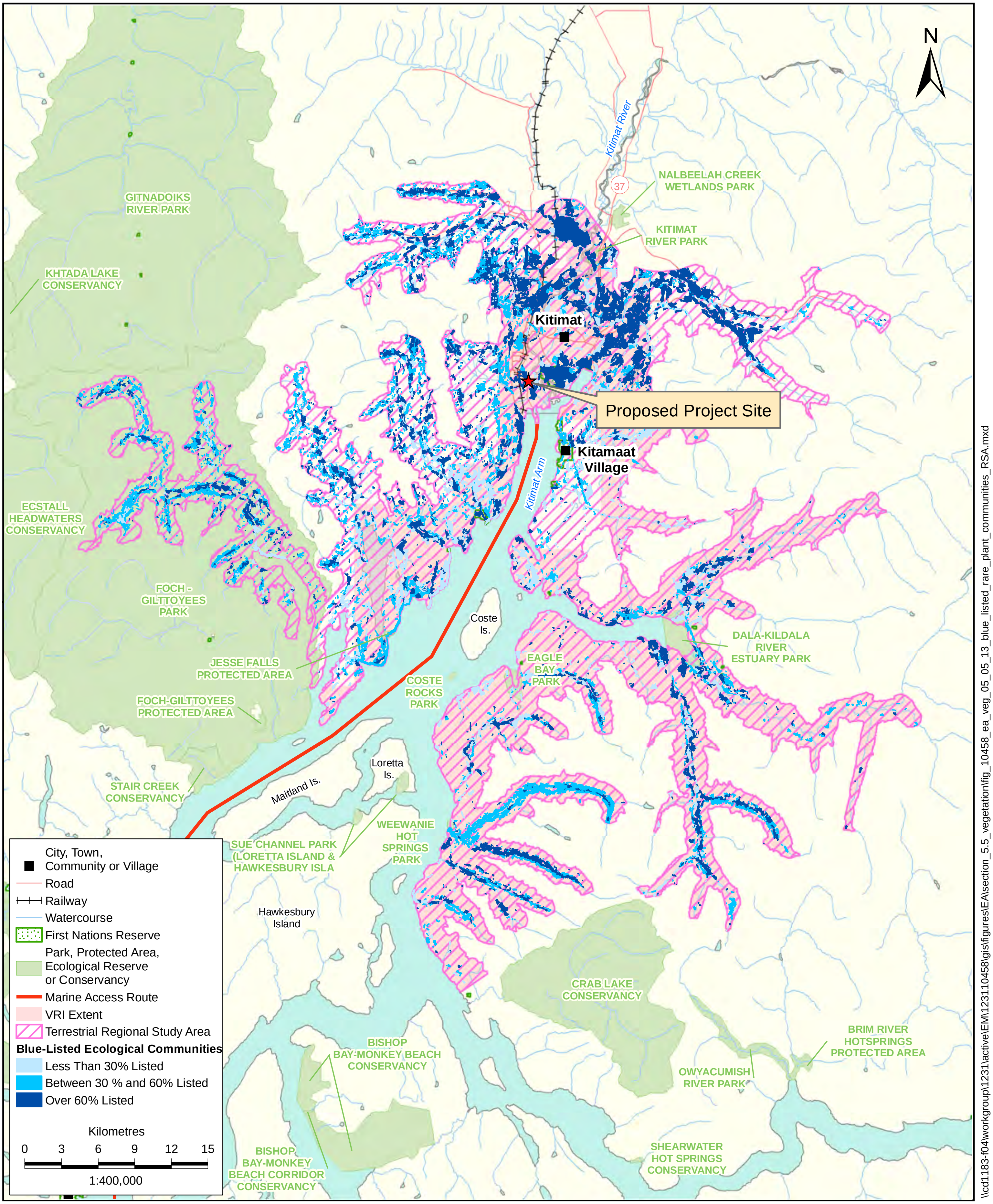
Change in Abundance or Condition of Ecological Communities of Interest

The following are estimated Project-related decreases in areas of ecological communities of interest in the Project footprint:

- 29 ha of six blue-listed communities and 83 ha of six red-listed communities
- 44 ha of wetland communities (while 40 ha of wetlands designed as ecologically important to the region would be replaced by wetland compensation measures)
- 163 ha of five floodplain communities
- 45 ha of old forest.

Some of the areas of the measurable parameters (community types) associated with the Project's residual effects listed here are inclusive of others. For example, 30 ha of the old forest area are also included among the total area of red-listed communities and total area of floodplain communities in the Project footprint.

The distribution of ecological communities of interest in the terrestrial RSA is presented in Figure 5.5-13 through Figure 5.5-17 and is based on the PEM and VRI data.



7/4/2014 - 1:52:49 PM

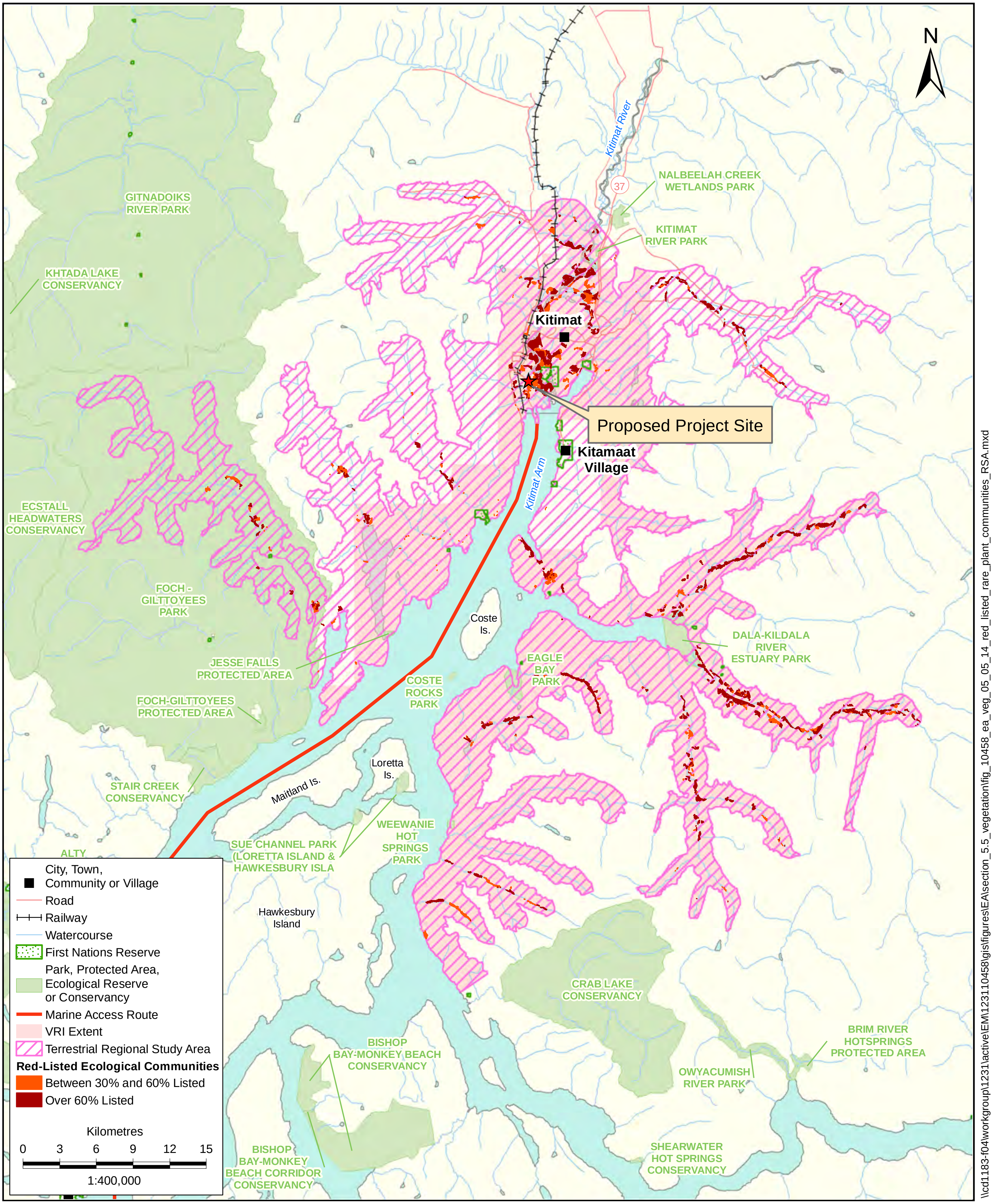
Stantec | LNG CANADA — Opportunity for British Columbia. Energy for the world

VEGETATION ENVIRONMENTAL EFFECTS ASSESSMENT

BLUE-LISTED ECOLOGICAL COMMUNITIES IN THE TERRESTRIAL RSA

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION	DRAWN BY
UTM9	SS
DATUM	CHECKED BY
NAD 83	SW
DATE	FIGURE NO.
04-JUL-14	5.5-13



Stantec

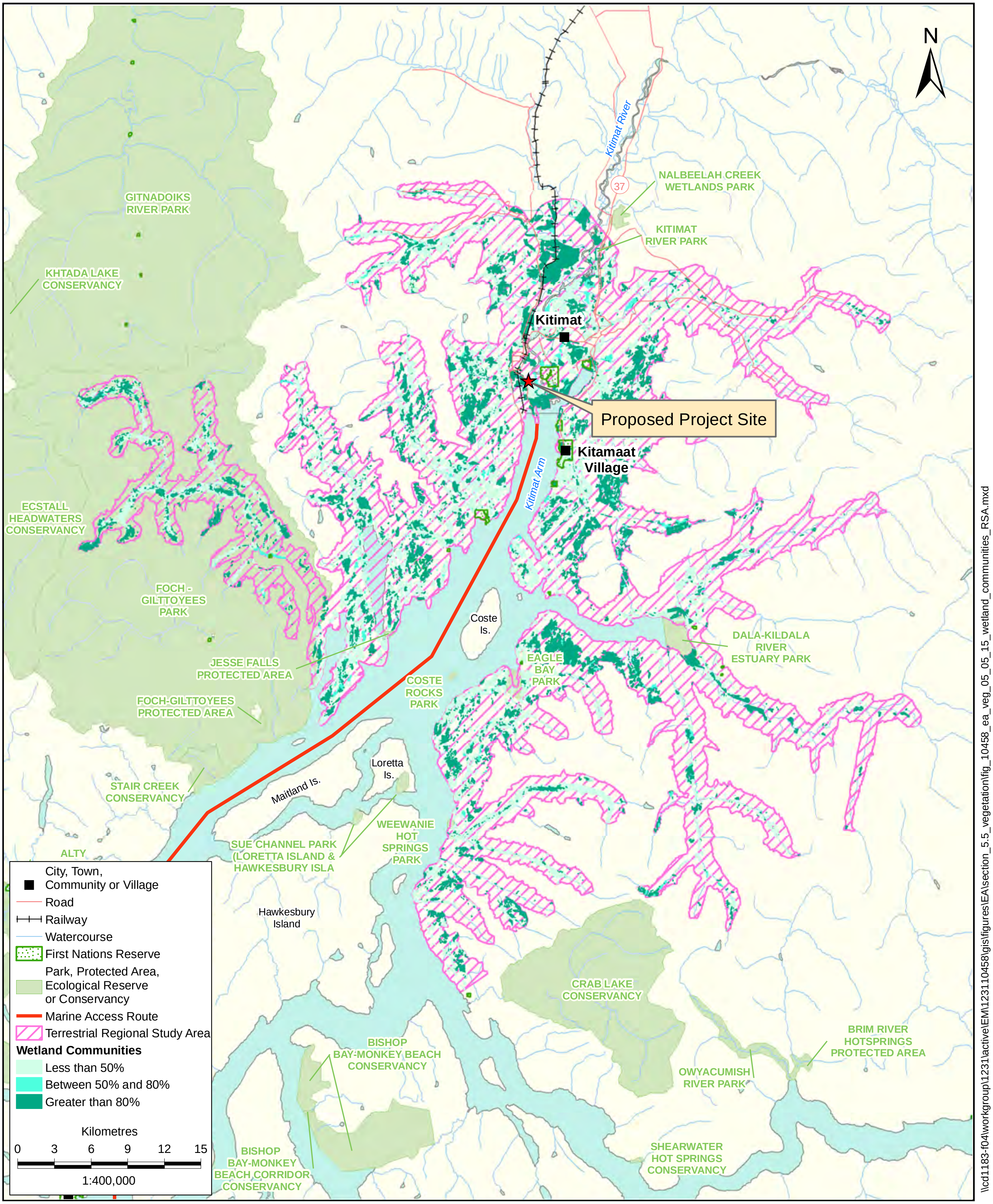
LNG CANADA
Opportunity for British Columbia. Energy for the world

VEGETATION ENVIRONMENTAL EFFECTS ASSESSMENT

RED-LISTED ECOLOGICAL COMMUNITIES IN THE TERRESTRIAL RSA

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION	DRAWN BY
UTM9	SS
DATUM	CHECKED BY
NAD 83	SW
DATE	FIGURE NO.
04-JUL-14	**5.5-14**



Stantec

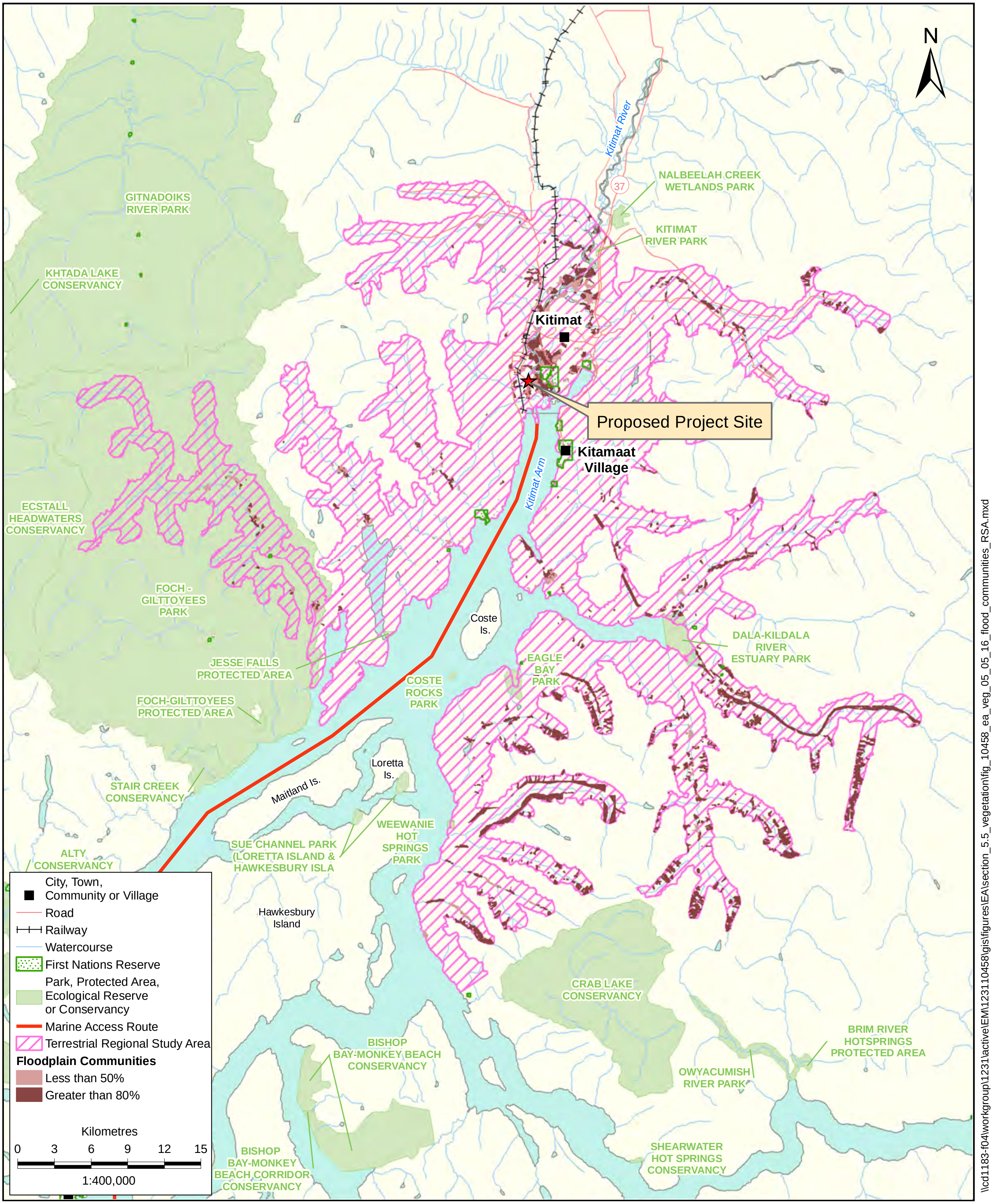
LNG CANADA
Opportunity for British Columbia. Energy for the world

VEGETATION ENVIRONMENTAL EFFECTS ASSESSMENT

WETLAND COMMUNITIES IN THE TERRESTRIAL RSA

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION	DRAWN BY
UTM9	SS
DATUM	CHECKED BY
NAD 83	SW
DATE	FIGURE NO.
27-JUN-14	**5.5-15**



Stantec

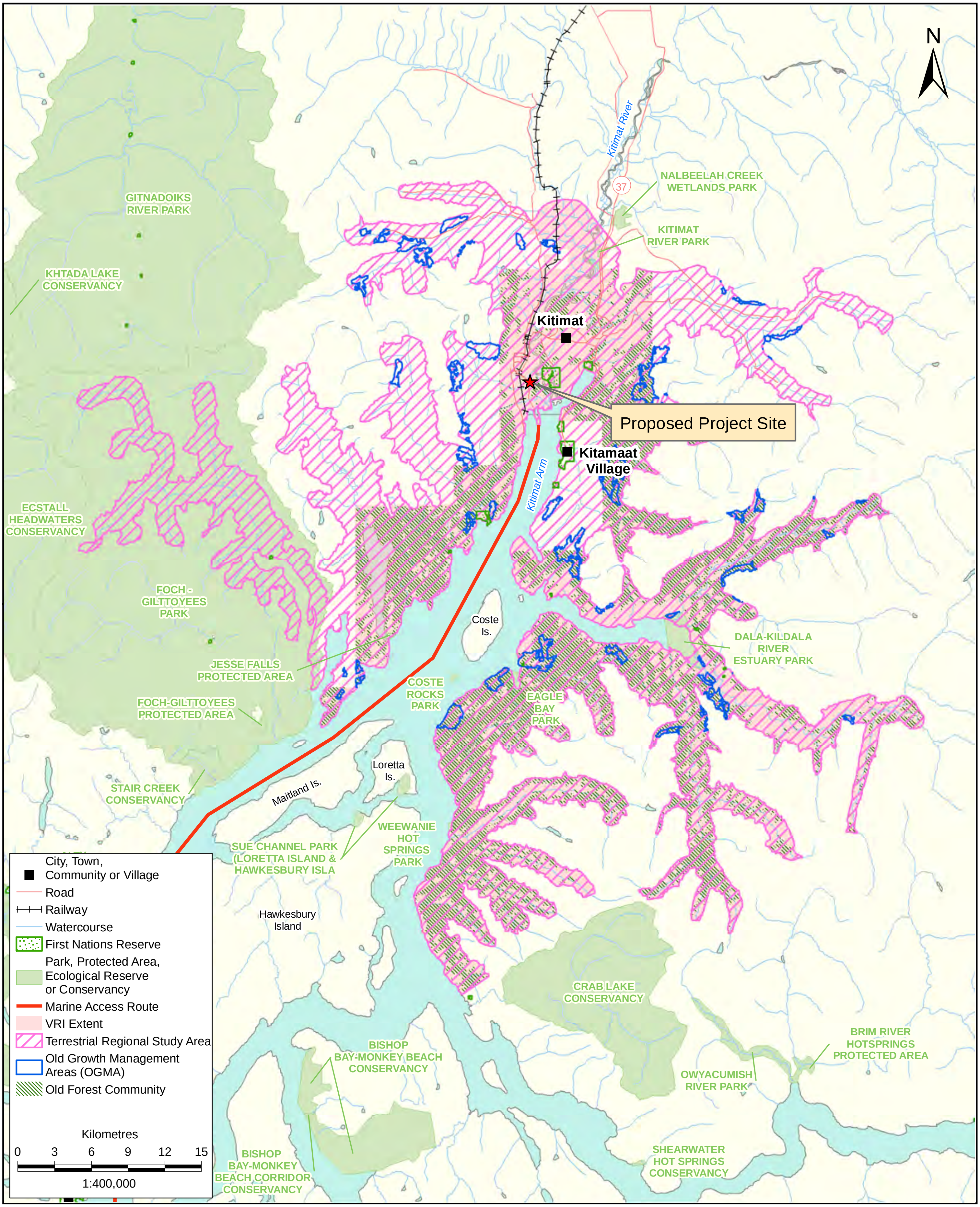
LNG CANADA
Opportunity for British Columbia. Energy for the world

VEGETATION ENVIRONMENTAL EFFECTS ASSESSMENT

FLOODPLAIN COMMUNITIES IN THE TERRESTRIAL RSA

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION UTM9	DRAWN BY SS
DATUM NAD 83	CHECKED BY SW
DATE 27-JUN-14	FIGURE NO. **5.5-16**



\\cd1183-f04\workgroup\1231\active\EM\123110458\gis\figures\EA\section_5.5_vegetation\fig_10458_ea_veg_05_05_17_old_forest_communities_RSA.mxd

6/27/2014 - 2:36:23 PM

Stantec | LNG CANADA Opportunity for British Columbia. Energy for the world

VEGETATION ENVIRONMENTAL EFFECTS ASSESSMENT

OLD FOREST COMMUNITIES IN THE TERRESTRIAL RSA

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION UTM9	DRAWN BY SS
DATUM NAD 83	CHECKED BY SW
DATE 27-JUN-14	FIGURE NO. **5.5-17**

The Project-specific loss of red- and blue-listed communities will interact with the loss of listed ecological communities affected by the Kitimat LNG Terminal and Northern Gateway projects (Jacques Whitford 2005; BC EAO et al. 2006; Enbridge Northern Gateway Pipelines 2010). This interaction will result in a cumulative loss of approximately 344.4 ha of listed ecological communities in the terrestrial RSA, which is 7% of the estimated area for listed communities in the terrestrial RSA.

With the implementation of the Wetland Compensation Plan, the Project will not contribute to cumulative effects on wetland functions of ecologically important wetlands, although there will be a loss (44 ha) of wetlands in the Project footprint that are not classified as ecologically important. Similarly, compensation is anticipated for the reported 6 ha of wetland loss associated with other Projects, and therefore, no interaction of residual effects will occur (AMEC 2012).

The Project-specific loss of floodplains will interact with the estimated loss of 1.5 ha of Sitka spruce – salmonberry floodplain affected by the Kitimat LNG Terminal (Jacques Whitford 2006; Jacques Whitford 2005; BC EAO et al. 2006). This interaction will result in a cumulative loss of approximately 164 ha, which is 3% of the estimated area for floodplains in the terrestrial RSA.

The Project-specific loss of old forest will interact with the estimated loss of old forest affected by foreseeable projects in the terrestrial RSA (Enbridge Northern Gateway Pipelines 2010; BC EAO et al. 2006; ESSA Technologies et al. 2013). This interaction will result in an estimated 297 ha (minimum) of cumulative loss of old forest in the terrestrial RSA, which is less than 1% of the terrestrial RSA.

5.5.7.2.2 Change in Native Vegetation Health and Diversity due to Air Emissions

Sulphur Dioxide Fumigation, Cumulative Case

Sulphur dioxide concentration exceeds 10 $\mu g/m^3/y$ in the cumulative case within 3,367 ha (Stantec 2014d), of which 3,042 ha (89%) are vegetated communities (Table 5.5-29; Figure 5.5-18). The vegetated area where sulphur dioxide exceeds 10 $\mu g/m^3/y$ in the cumulative case (i.e., application case plus future projects) is 45 ha more than in the application case, and 313 ha more than in the base case. The sulphur dioxide exceedance area for the cumulative case falls within the Haisla and Kitselas traditional territories.

The more sensitive communities supporting a relatively high abundance of lichen species include 614 ha (18%) drier upland and montane forested communities, and 1,016 ha (30% of the exceedance area) of old forest (details provided in Stantec 2014d).

Table 5.5-29: Sulphur Dioxide Fumigation in the Emissions RSA, Cumulative Case

Broad Ecosystem Name	Exceedance Area (ha)			Extent in Baseline RSA (ha)	Percentage of RSA Exceeded in Cumulative Case (%)
	Application Case	Cumulative Case	Change from Application Case to Cumulative Case		
Upland Forested					
Amabilis Fir - Western Hemlock[a]	2,227.5	2,259.9	32.4	219,604	1
Coastal Western Hemlock - Western Redcedar[a, c]	403.8	408.2	4.5	9,329.0	4
Mountain Hemlock - Amabilis Fir [a]	3.6	3.6	0.0	2,220.4	<1
Total Upland Forested	2,634.8	2,671.7	36.9	239,577.0	1
Floodplain					
Deciduous Shrub	9.1	9.3	0.2	206.3	5
Sitka Spruce - Black Cottonwood Riparian [a]	18.0	18.0	0.1	4,140.2	<1
Total Floodplain	27.1	27.3	0.2	13,106.2	<1
Wetland					
Cedars - Shore Pine Bog [a, c]	44.2	45.4	1.2	6,417.0	1
Western Redcedar Swamp [a]	7.0	7.6	0.6	2,027.4	<1
Wetland Unclassified	16.5	17.3	0.8	7,219.3	<1
Yellow Cedar Bog Forest[a, c]	164.1	167.9	3.8	3,469.7	5
Total Wetland	231.7	238.2	6.5	19,994.4	1
Montane, Subalpine, or Alpine					
Mountain Hemlock - Amabilis Fir [a, c]	22.8	23.8	0.9	44,275.0	<1
Mountain Hemlock - Yellow Cedar [a]	18.9	19.2	0.3	8,800.2	<1
Total Montane, Subalpine, or Alpine	41.8	43.0	1.2	100,131.0	<1
Avalanche Track	61.8	62.2	0.4	30,084.7	<1
Total Avalanche Track	61.8	62.2	0.4	30,084.7	<1
Total Vegetated	2,997.2	3,042.4	45.2	405,280.7	<1
Total Unvegetated	299.5	324.8	25.3	89,443.7	<1
Total	3,296.7	3,367.2	70.5	500,016.0[b]	<1

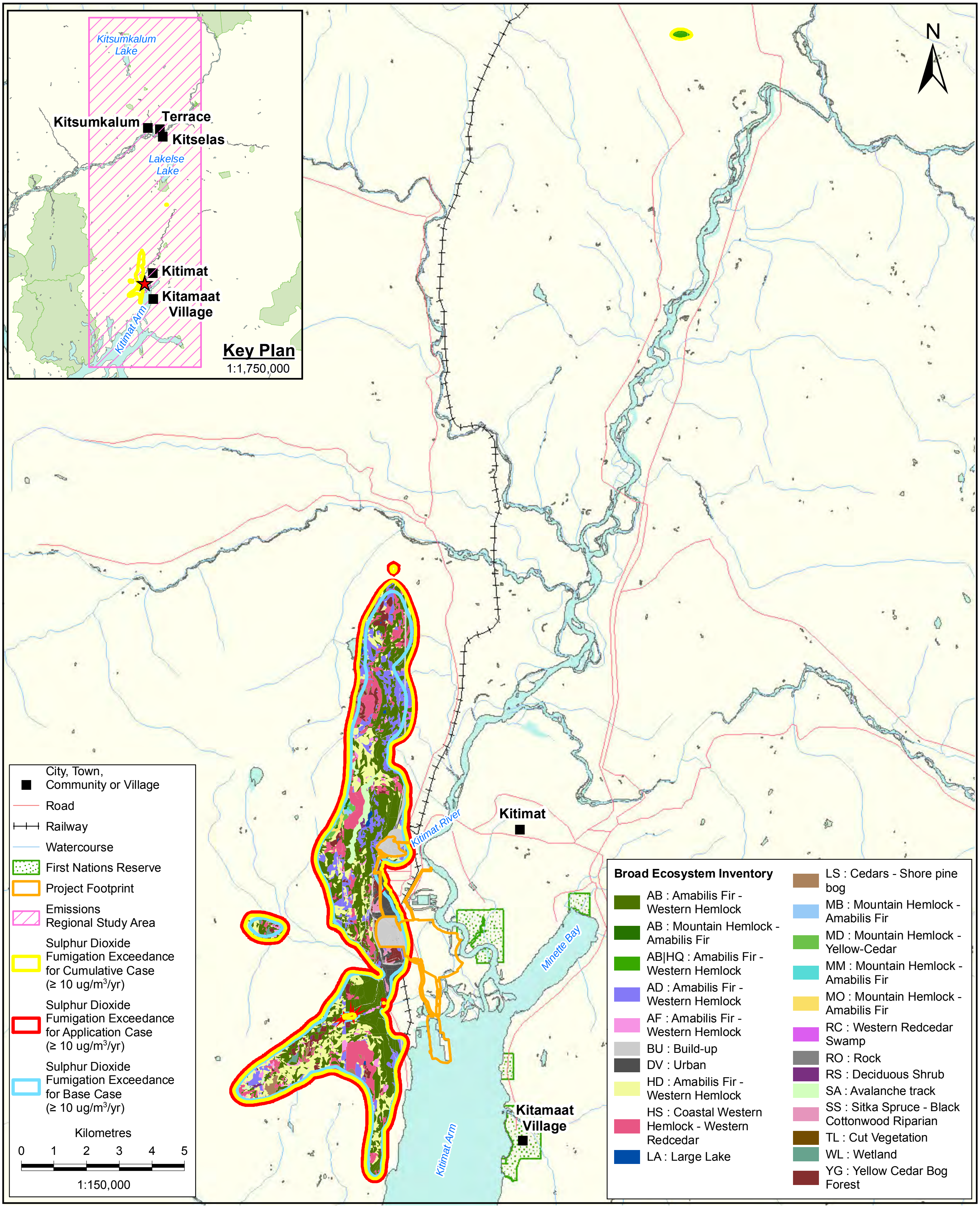
NOTES:

Spatial boundaries refer to the Emissions RSA

[a] areas with highest percentage of coniferous tree species (within varying structural stages)

[b] the areas of vegetated and unvegetated units contained within the emissions RSA sums to 500,016 ha, although the terrestrial study area is 500,000 ha. This is due to the different map projections of the original spatial datasets (VRI, PEM and BEC).

[c] indicates that the broad ecosystem contains communities that have been identified as sensitive to sulphur dioxide concentrations (Stantec 2014d).



Stantec

LNG CANADA
Opportunity for British Columbia. Energy for the world

VEGETATION ENVIRONMENTAL EFFECTS ASSESSMENT

SULPHUR DIOXIDE
EXCEEDANCE AREA – CUMULATIVE CASE

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION	DRAWN BY
UTM9	SS
DATUM	CHECKED BY
NAD 83	SW
DATE	FIGURE NO.
22-AUG-14	**5.5-18**

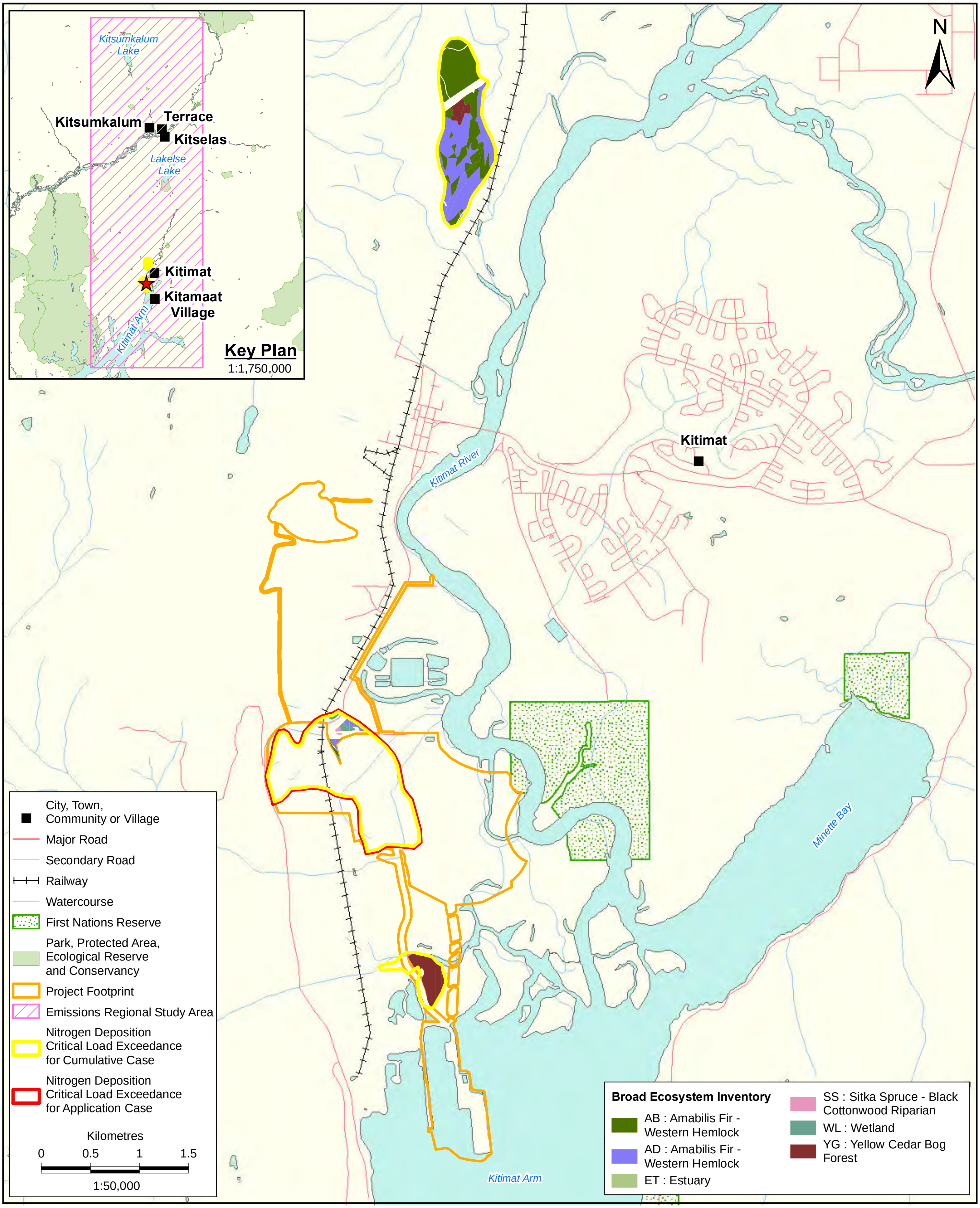
Nitrogen Deposition, Cumulative Case

The area modelled to exceed calculated critical loads for nitrogen deposition is 86 ha of vegetation communities (Table 5.5-30; Figure 5.5-19). This is an increase of 82 ha from the application case. The amabilis fir – western hemlock broad ecosystem type comprises the majority (69 ha) of the change from the application case to the cumulative case, comprised mainly of young and pole-sapling forest (Stantec 2014d). Within the cumulative case, wetlands have notable sensitivity to eutrophication and comprise 15 ha within the exceedance area, which is less than 1 % of the wetland area in the emissions RSA. The nitrogen deposition exceedance for the cumulative case occurs in the Haisla traditional territory.

Table 5.5-30: Calculated Critical Load Nitrogen Deposition in the Emissions RSA, Cumulative Case

Broad Ecosystem Name		Exceedance Area (ha)			Extent in Baseline RSA (ha)	Percentage of RSA Exceeded in Cumulative Case (%)
		Application Case	Cumulative Case	Change from Application Case to Cumulative Case		
Upland Forested	Amabilis Fir - Western Hemlock	1.9	70.3	68.7	219,604.0	<0.1
Floodplain	Sitka Spruce - Black Cottonwood Riparian	0.3	0.4	0.1	4,140.2	<0.1
Wetland	Estuary	-	-0.1	0.1	860.9	<0.1
	Wetland Unclassified	1.4	1.4	1.4	7,219.3	<0.1
	Yellow Cedar Bog Forest	-	13.5	1.5	3,469.7	<0.1
	Total Wetland (all classes)	1.4	15	13.6	19,994.4	<0.1
Total Vegetated		3.6	85.7	82.1	405,280.7	<0.1

NOTE:
Spatial boundaries refer to the Emissions RSA



Stantec

LNG CANADA
Opportunity for British Columbia. Energy for the world

VEGETATION ENVIRONMENTAL EFFECTS ASSESSMENT

NITROGEN DEPOSITION EXCEEDANCE AREA – CUMULATIVE CASE

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION	DRAWN BY
UTM9	SS
DATUM	CHECKED BY
NAD 83	SW
DATE	FIGURE NO.
22-AUG-14	**5.5-19**

V:\1231\active\EM1231\10458\gis\figures\EA\section_5.5_vegetation\fig_10458_ea_veg_05_05_19_nitrogen_cumulative.mxd

8/22/2014 - 10:48:50 AM

Acid and Sulphate Deposition, Cumulative Case

Acid and sulphate deposition exceeded the calculated critical loads in the cumulative case; however, there is no increase in the spatial extent where this occurs relative to the application case (Table 5.5-31; Figure 5.5-20; Stantec 2014d). This result occurs because the modelled sensitive soils are within one particular soil map polygon; the polygon is adjacent to, and overlaps with, the Project footprint (Stantec 2014d). The acid and sulphate deposition exceedance for the cumulative case occurs in the Haisla traditional territory.

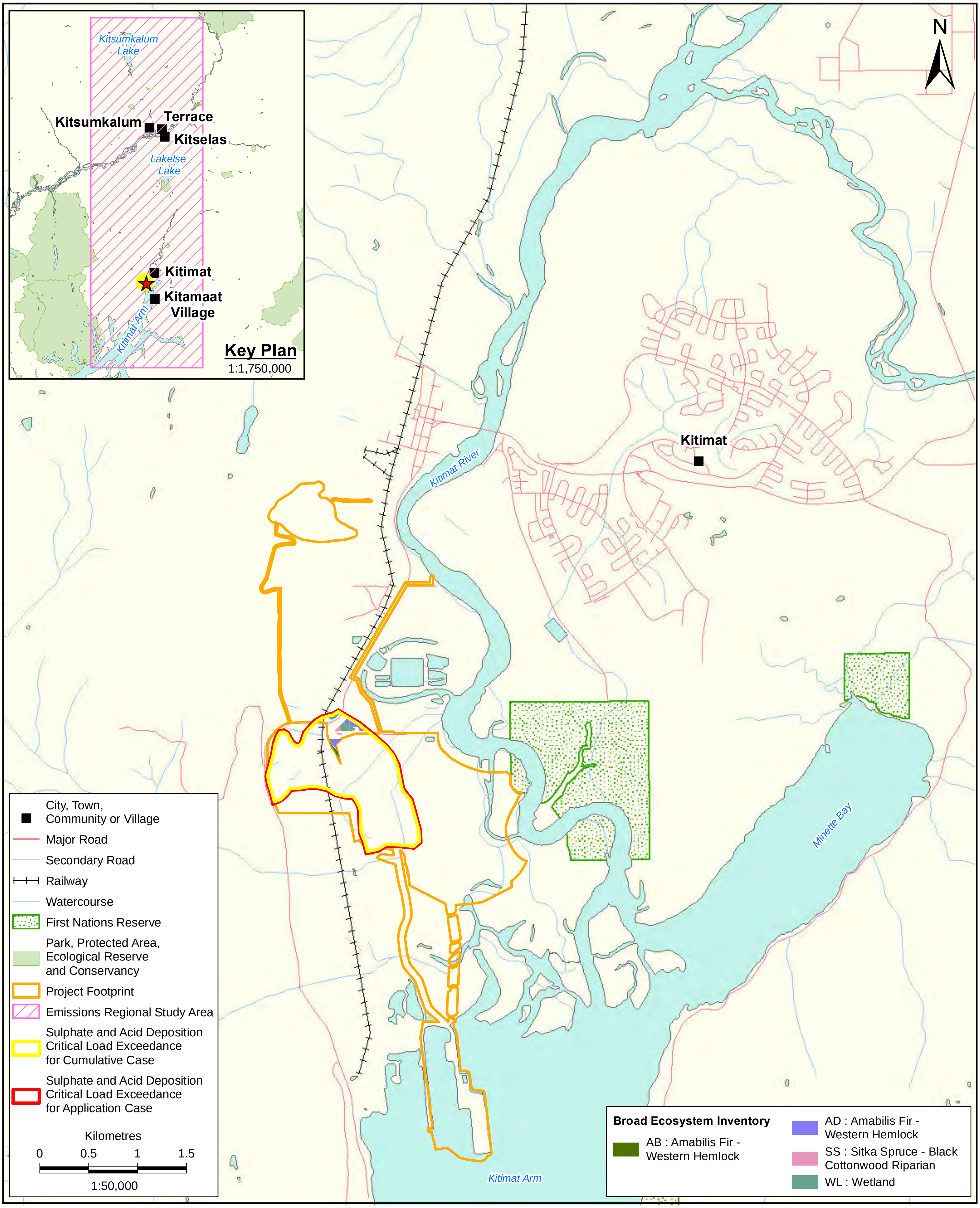
Table 5.5-31: Calculated Critical Load Acid Deposition in the Emissions RSA, Cumulative Case

Broad Ecosystem Name		Exceedance Area (ha)			Extent in Baseline RSA (ha)	Percentage of RSA Exceeded in Cumulative Case (%)
		Application Case	Cumulative Case	Change from Application Case to Cumulative Case		
Upland Forested	Amabilis Fir - Western Hemlock	1.9	1.9	0	219,604.0	<0.1
Floodplain	Sitka Spruce - Black Cottonwood Riparian [a]	0.3	0.3	0	4,140.2	<0.1
Wetland	Wetland Unclassified	1.4	1.4	0	7,219.3	<0.1
Total Vegetated		3.6	3.6	0	405,280.7	<0.1

NOTES:

Spatial boundaries refer to the Emissions RSA

[a] In this instance, this broad ecosystem type is only composed of the Sitka spruce- salmonberry community, which is conifer-dominated rather than a mixed forest that is the name applied to this broad ecosystem unit (Stantec 2014d).



V:\1231\active\EM1231104 58\gis\figures\EA\section_5_5_vegetation\fig_10458_ea_veg_05_05_20_sulphate_acid_cumulative.mxd

8/22/2014 - 10:55:10 AM

Stantec | LNG CANADA — Opportunity for British Columbia. Energy for the world

VEGETATION ENVIRONMENTAL EFFECTS ASSESSMENT

SULPHATE AND ACID DEPOSITION EXCEEDANCE AREA – CUMULATIVE CASE

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION	DRAWN BY
UTM9	SS
DATUM	CHECKED BY
NAD 83	SW
DATE	FIGURE NO.
22-AUG-14	**5.5-20**

5.5.7.3 Stage 3, Determining Significance of Cumulative Effects

Vegetation resources will be affected by other projects and activities, and interactions will occur with the Project, as discussed above; however, the Project's contribution to cumulative change in abundance of plants and ecological communities of interest is a small percentage of the terrestrial RSA for each measurable parameter. The magnitude of cumulative effects on plant species and communities of interest will be moderate. There is a measurable change in various parameters and there is some uncertainty associated with estimates of regional populations or community areas. Active management may be required to maintain regional sustainability of the potentially affected plant species and communities of interest.

The cumulative effects on species or communities will occur multiple times from other projects in the terrestrial RSA, according to each project's construction schedule, and the effects will persist permanently (i.e., beyond closure and decommissioning) for effects such as loss of old forest or listed ecological communities, which require hundreds of years to re-establish. Most of the identified cumulative effects are reversible, with active management; however, it the Project footprint and others in the terrestrial RSA will revert to secondary industrial uses. Therefore, cumulative effects will be irreversible.

The terrestrial RSA is currently moderately disturbed due to existing development activities, and most of the potentially affected vegetation measurable parameters in the terrestrial RSA exhibit relatively low resilience to the kinds of disturbance associated with projects in the terrestrial RSA. Cumulative effects on ecological communities of interest will occur and cumulative effects on plant species of interest have a low likelihood of occurring, with Project mitigation in place.

The Project footprint uses existing footprints and previously disturbed land designated for industrial activities (Stantec 2013). The geographic area of the residual effects is limited to 292 ha of vegetated land, which is 67% of the Project footprint (429 ha). Furthermore, the Wetland Compensation Plan will result in no net loss of wetland functions associated with wetlands designated as ecologically important to the region. Given the low to moderate magnitude of the Project's residual effects and the mitigation measures, the Project's contribution to cumulative effects will not reduce the sustainability of vegetation resources in the terrestrial RSA. Consequently, the Project's contribution to cumulative effects will be not significant and the overall cumulative effects are assessed as not significant on vegetation resources.

Project emissions will interact cumulatively with other past, present, and foreseeable future projects; however, the Project's contribution to the deposition of nitrogen, sulphate, and acid deposition above calculated critical loads is a relatively small contribution. For example, the area of exceedance for acid, sulphate and nitrogen deposition at the application case is nominal at only 4 ha, all of which is located within the industrial areas of Kitimat. Areas of exceedance for acid and sulphate deposition did not increase in the cumulative case, while the area of exceedance for nitrogen deposition in the cumulative case was modelled to increase by 82 ha.

Although the vegetated area of exceedance for sulphur dioxide is modelled to increase by 268 ha from base case to application case, critical levels of sulphur dioxide were already exceeded within 2,729 ha of vegetated area in the base case. The area of sulphur dioxide exceedance in the cumulative case includes an additional 45 ha of vegetated area. Based on the monitoring reported in the nearby Rio Tinto Alcan Aluminum Smelter and Modernization project, only rare occurrences of damaged vegetation have been detected from sulphur dioxide or sulphate deposition, results corresponding to the base case in this assessment (ESSA Technologies et al. 2013).

All ecological communities affected by each parameter (sulphur dioxide, nitrogen, sulphate and acid deposition) are anticipated to persist within the emissions RSA, although the health and vigor may be reduced in sensitive communities for the duration of operation. With these considerations, residual effects from sulphur dioxide fumigation and nitrogen and acid deposition are assessed as not significant.

5.5.7.4 Summary of Cumulative Effects

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. Table 5.5-32 provides a summary and characterization of the cumulative effects.

5.5.8 Prediction Confidence and Risk

The level of confidence in these conclusions is based on:

- scale and availability of ecosystem mapping
- availability of data for disturbances of past, present, and foreseeable future projects and activities
- OCP zoning designations within the Kitimat municipal boundary
- LRMP information
- professional knowledge and understanding of the ecosystems and plants of the region, and
- scientific certainty and professional judgment of the mitigation measures.

Based on these sources of data and considerations, prediction confidence is rated as moderate for the effects of change in abundance of plant species of interest and change in abundance or condition of ecological communities of interest. It is moderate to high because information was obtained from detailed mapping (1:5,000 scale) and included a large number of samples during field studies in the Project footprint.

Confidence related to the cumulative effects on ecological communities in the terrestrial RSA is moderate. Although there are limitations to some of the available spatial data, the effects are generally well understood and a conservative approach is incorporated into quantifying the area of effects.

With respect to the effect of change in native vegetation health and diversity from sulphur dioxide fumigation, nitrogen deposition, sulphate, and acid deposition, confidence is moderate. There is some uncertainty pertaining to the actual response of sensitive communities to modelled rates of nitrogen sulphate, and acid deposition and sulphur dioxide fumigation. However, the assessment takes a conservative approach in prediction modelling and the results indicate a low potential for adverse residual effects from air emissions on vegetation.

Table 5.5-32: Summary of Cumulative Effects on Vegetation Resources

Effect	Other Projects, Activities and Actions	Cumulative Effects Characterization					
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context
Facility Works and Activities							
Cumulative change in abundance of plant species of interest							
Cumulative effect with the Project and other projects, activities and actions ▪ Vegetation clearing from past and future projects and activities, along with Project clearing activities, results in the loss of plants species of interest; however, the regional populations will be sustained.	▪ Coastal GasLink Pipeline Project ▪ Rio Tinto Alcan Facility and Kitimat Modernization Project ▪ Kitimat LNG Terminal Project ▪ Douglas Channel LNG Terminal (also known as BC LNG) ▪ Enbridge Northern Gateway Project ▪ Former Methanex/Cenovus Terminal ▪ Sandhill Materials – Aggregate Processing ▪ Pacific Trail Pipelines Project ▪ Pacific Northern Gas Pipeline (includes proposed looping) ▪ Former Moon Bay Marina (footprint only) ▪ MK Bay Marina ▪ Forestry Activities	M/L	RSA	MT/P	C	R	H
Contribution from the Project to the overall cumulative effect ▪ Clearing activities during Project construction contributes to cumulative loss of plant species of interest		M/L	PF	MT/P	S	R/I	L-H

Effect	Other Projects, Activities and Actions	Cumulative Effects Characterization					
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context
Cumulative change in abundance or condition of ecological communities of interest							
Cumulative effect with the Project and other projects, activities and actions ▪ Vegetation clearing from past and future project construction, along with Project clearing activities, results in the loss of ecological communities of interest; however, the regional communities' extent will be sustained. ▪ Total disturbance area of past, present and foreseeable future projects is estimated to be ~ 11% of terrestrial RSA	▪ Coastal GasLink Pipeline Project ▪ Rio Tinto Alcan Facility and Kitimat Modernization Project ▪ Kitimat LNG Terminal Project ▪ Douglas Channel LNG Terminal (also known as BC LNG) ▪ Enbridge Northern Gateway Project ▪ Former Methanex/Cenovus Terminal ▪ Sandhill Materials – Aggregate Processing ▪ Pacific Trail Pipelines Project ▪ Pacific Northern Gas Pipeline (includes proposed looping) ▪ Former Moon Bay Marina (footprint only) ▪ MK Bay Marina ▪ Forestry Activities	L-M	RSA	P	C	R	L-H
Contribution from the Project to the overall cumulative effect ▪ Less than 1% of the ecological communities of interest within the terrestrial RSA will be attributed to Project clearing activities		L-M	PF	P	S	R	L-H

Effect	Other Projects, Activities and Actions	Cumulative Effects Characterization					
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context
Cumulative Change in Native Vegetation Health and Diversity due to Air Emissions							
Cumulative effect with the Project and other projects, activities and actions ▪ Vegetation health and diversity will be affected from current and future project's operations contributing to air emissions that exceed critical level concentrations for sulphur dioxide and critical loads for nitrogen, sulphate, and acid deposition ▪ Less than 1% of the vegetated area within the emissions RSA will be affected from the combined current, future, and Project air emissions.	▪ Coastal GasLink Pipeline Project ▪ Rio Tinto Alcan Facility and Kitimat Modernization Project ▪ Kitimat LNG Terminal Project ▪ Douglas Channel LNG Terminal (also known as BC LNG) ▪ Enbridge Northern Gateway Project ▪ Former Methanex/Cenovus Terminal ▪ Sandhill Materials – Aggregate Processing ▪ Pacific Trail Pipelines Project ▪ Pacific Northern Gas Pipeline (includes proposed looping) ▪ Kitimat Clean Energy ▪ Forestry Activities	L	RSA	LT	C	R	H
Contribution from the Project to the cumulative effect ▪ Project operations will contribute to air emissions exceeding critical levels and loads. ▪ The area where vegetation health and diversity will be affected by air emissions exceeding critical levels and loads will increase from the Project's contribution.		L	LSA	LT	C	R	H

KEY

MAGNITUDE:

N = Negligible—no measurable change in plant species or ecological communities of interest.

L = Low—measurable change in plant species or ecological communities of interest affecting a portion of the regional population or community; regional population density or community's extent sufficient to sustain that population or community without active management.

M = Moderate—measurable change in plant species or ecological communities of interest affecting a portion of the regional population or community; uncertainty or risk associated with regional population density or community extent's ability to sustain that population or community; requires active management to ensure regional sustainability of population or community.

H = High—measurable change in plant species or ecological communities of interest relative to baseline conditions that would affect the entire local occurrence population or community (see exceptions below).

A high magnitude effect for wetlands is one that results in an unmitigated net-loss of wetland functions associated with wetlands designated as ecologically-important to the region (Environment Canada 2014a).

A high magnitude effect for old forest is a reduction in abundance from baseline area that exceeds 87% of the estimated old forest mapped within the terrestrial RSA. This is in line with the provincial non-spatial old growth order, which establishes a minimum retention target of 13% old forest area for the Wedeene landscape unit (BC MSRM 2004).

GEOGRAPHIC EXTENT:

PF = Project footprint—residual effects are restricted to the Project footprint

LSA—residual effect extends into the LSA

RSA—residual effect extends into the RSA

DURATION:

ST = Short-term—effect restricted to one growing season

MT = Medium-term—effect extends through the operational timeframe of the Project

LT= Long-term—effect extends beyond closure

P = Permanent—measureable parameter unlikely to recover to baseline

FREQUENCY:

S = Single event—occurs once

MI = Multiple irregular event (no set schedule —occurs sporadically at irregular intervals throughout construction, operation, or decommissioning phases

MR = Multiple regular event—occurs on a regular basis and at regular intervals throughout construction, operation, or decommissioning phases

C = Continuous—occurs continuously throughout the life of the Project

REVERSIBILITY:

R = Reversible—will recover after closure and reclamation

I = Irreversible— permanent

CONTEXT:

L= Low resilience—low capacity for vegetation resources to recover from a perturbation, with consideration of the baseline level of disturbance

M = Moderate resilience—moderate capacity for vegetation resources to recover from a perturbation, with consideration of the baseline level of disturbance

H = High resilience—high capacity for vegetation resources to recover from a perturbation, with consideration of the baseline level of disturbance

SIGNIFICANCE:

S = Significant

N = Not Significant

PREDICTION CONFIDENCE:

Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation, and assumptions made.

L = Low level of confidence

M = Moderate level of confidence

H = High level of confidence

LIKELIHOOD OF RESIDUAL EFFECT OCCURRING:

Based on professional judgment

L= Low—low likelihood that there will be a residual effect

M = Medium—moderate likelihood that there will be a residual effect

H = High— high likelihood that there will be a residual effect

5.5.9 Follow-up Program and Compliance Monitoring

No follow-up programs are proposed for vegetation resources. Compliance monitoring to be implemented through Environmental Management Plans is described in Section 5.5.10, Section 12 and Section 21 (Table 21.3-1).

5.5.10 Summary of Mitigation Measures

To avoid and limit the effects on vegetation resources, LNG Canada commits to the following mitigation measures:

- 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).
- 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)
- 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 reclamation (Mitigation 5.5-7)
- 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).
- A Surface Water Management Plan will be developed to address stormwater collection, treatment, and disposal during construction and operation (Mitigation 5.5-9).
- 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).

5.5.11 Conclusion

Project-specific effects from construction activities on vegetation resources will be local in extent and are not significant. With adherence to recommended mitigation measures, construction activities will affect less than 1% (292 ha) of the vegetation resources in the terrestrial RSA. LNG Canada will comply with federal and provincial regulations and policies, including compensation for loss of wetland functions associated with wetlands designated as ecologically important to the region. The residual effects from Project-specific activities are not anticipated to adversely affect the sustainability of regional occurrence of the plants and communities of interest. Prediction confidence is high for Project-specific effects due to construction activities because the potential for effects from facility construction is generally well understood.

The Project contribution to cumulative effects on vegetation resources within the terrestrial RSA is assessed as not significant. Because design information for a number of reasonably foreseeable future projects is preliminary, the confidence in the prediction for cumulative effects is moderate.

Project residual effects from air emissions on vegetation resources are not significant. In the emissions RSA, the areas where critical loads will be exceeded are relatively small percentages (less than 1%) of the total area occupied by ecological communities. However, there is some uncertainty pertaining to the exact response of sensitive communities to modelled rates of sulphur dioxide fumigation and nitrogen, sulphate, and acid deposition.