Appendix F.4
Terrestrial Wildlife and Marine Birds
Information Request #6, 7 and 9

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Catherine Ponsford
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Dear Ms. Ponsford:

Reference: Assessment of Terrestrial Wildlife and Marine Species-at-Risk
Information Request #6, #7 and #9

This letter responds to the request for Outstanding Information received from the Canadian Environmental Assessment (CEA) Agency on August 14, 2014 and the Elaboration on the Outstanding Information on September 11, 2014.

Information Request #6

Government of Canada –Outstanding Information:
See Terrestrial Wildlife and Marine Birds IR # 9 regarding the assessment of effects to species at risk.

Information Request #7

Government of Canada –Outstanding Information:
See Terrestrial Wildlife and Marine Birds IR # 9 regarding the assessment of effects to species at risk.

Information Request #9

Government of Canada –Outstanding Information:
CEA Agency: *Aside from three species at risk, the proponent did not provide an effects assessment specific to any other species at risk. Habitats were described generally for the remaining species and effects assessed through a general ecological community modelling. Even though the proponent states that the conclusions considered listed species, it is hard to determine potential effects to species at risk. No information is provided to contextualise what the loss of habitat on Lelu Island would mean to specific species at risk and how effects of other projects combined with this project would affect the sustainability of species at risk in the region.*

Environment Canada: *For each species listed under the Species at Risk Act or designated under COSEWIC potentially affected by the Project (including marine species) provide: a description of habitats in the LAA and RAA including residences, movement corridors and key habitat areas; general life history; an assessment of project effects; and mitigation measures consistent with available recovery strategies. This information needs to be provided on a species-by-species basis and not as part of a general assessment on wildlife. All species recorded during field studies and potentially occurring in the LAA based on literature review or other studies need to be assessed. The cumulative effects assessment should also be updated to reflect the information provided for species at risk.*

The proponent is encouraged to contact the Species at Risk Recovery Unit of the Canadian Wildlife Service to request additional information on the SARA listed species found within the Project RAA; specifically, information relating to draft recovery strategies.

Elaboration on Information Request #9
Eulachon are included in the marine species designated under COSEWIC that are potentially affected by the Project, and therefore form part of this request.

Pacific NorthWest LNG Limited Partnership (PNW LNG) – Response:
Section 79 of the *Species at Risk Act* (SARA) requires that, as part of the assessment of environmental effects, project proponents identify a project's potential adverse effects on listed wildlife species and their designated critical habitat, and to mitigate and monitor anticipated effects if the project is approved.

The Environmental Impact Statement (EIS) for the Pacific NorthWest LNG Project (the Project) assessed the effects on Terrestrial Wildlife and Marine Birds and Marine Resources valued components in Sections 11 and 13 of the EIS. For terrestrial wildlife and marine birds, a combination of ecological community and habitat suitability modelling was completed to quantify change in habitat (ha) for species-at-risk. For marine resources, species-at-risk were included in the assessment of each valued component: marine fish and fish habitat and marine mammals. Change to fish habitat was assessed by identifying the location, area (m^2), and type of habitat that will be lost or altered as a result of project activities in marine riparian, intertidal and subtidal zones. Direct mortality or physical injury was assessed based on the presence of the organism in the area affected and the ability of the organism to move away from in-water activities. This effect also addresses pressure-related injuries to fish caused by noise impulses resulting from blasting, which are determined based on established thresholds. Effects due to underwater noise were assessed based on predictive underwater acoustic modelling. Because no behavioural thresholds exist for fish, the assessment of change in behaviour is qualitative in nature, determined based on timing (seasonal) and duration.

As per the Section 79 requirement (and as requested by the above summarized information requests), the information presented in this technical memo provides, on a species-by-species basis for species, an assessment of potential adverse effects. An evaluation was completed for terrestrial wildlife and marine birds, and marine resource species listed on SARA Schedule 1, 2, and 3 and for the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated species likely to occur in the local and regional assessment areas for either valued component. The memo considers the following information as part of the overall evaluation for each species:

- Presence of suitable habitat in local and regional assessment areas
- Description of habitat requirements and general life history
- Assessment of interaction with project activities and potential effects
- Mitigation measures consistent with any applicable recovery strategy and action plans
- Update to residual and cumulative effects assessments, as applicable
- Overall prediction of significance for each species.

Assessment of Species-at-Risk

In this technical memo, the assessment for species-at-risk within each valued component is conducted in two stages. The first stage presents a list of potentially occurring species-at-risk expected to occur in the local and regional assessment area, based on results from baseline surveys and a review of regional occurrence records. For terrestrial wildlife and marine birds, this information is presented in Appendix H and Section 11.3 of the EIS. Appendix M and Section 13.3 of the EIS provide a summary of potentially occurring species-at-risk for marine resources. For each species, a screening exercise was performed to identify whether there is a potential pathway for interaction with a project effect. Species that have potential for an interaction with a project effect (i.e., at least one project effect has been identified) are carried forward to the second stage for a detailed assessment of project effects.

Terrestrial Wildlife and Marine Birds Species-at-Risk

The information presented in this technical memo provides details on how a project activity has potential to cause an adverse effect on species at risk, on a species by species basis. Project activities identified in Table 11-7 of the EIS that could potentially cause a significant adverse effect to one or more species of terrestrial wildlife or marine birds were ranked as 2, and were carried forward in the assessment. These activities will not affect all species (including species at risk) equally. The potential for effects will depend on each species' individual biology, distribution, habitat preferences, and susceptibility to disturbance. However in the screening for potential adverse effects, some generalizations can be made, and are described below. For project activities with potential to cause an adverse effect, these effects are described on a species-by-species basis. Residual effects following the application of mitigation measures are characterized using the terns described in Table 11-3 of the EIS.

The assessment also considers interactions between species and project activities that are identified as having project interactions but manageable with standard operating procedures or codified practices; these activities are ranked as a one, and have been assessed for terrestrial wildlife and marine birds in Section 11.4 of the EIS. Activities ranked as a 0 are expected to have negligible effects on terrestrial wildlife and marine birds. In Table 1, No Interaction (NI) has been denoted for a potential project effect for each species-at-risk if there is negligible potential for interaction with a project activity that is expected to result in either change in habitat, change in mortality, and/or change in movement. Justification has been provided for those project activities that are unlikely to result in an interaction, on a species-by-species basis in the discussion following Table 1.

Assessment of project interactions are supported for all species with baseline survey data and regional occurrence records presented in Appendix H of the EIS, known habitat requirements from published literature (including applicable Recovery Strategies, COSEWIC assessment reports, and Action Plans where available), and professional judgment. This approach is consistent with *Environmental Impact Statement Guidelines* (CEAA 2013) and *Guideline for the Selection of Valued Components and Assessment of Potential Effects* (EAO 2013).

For potential effects to wildlife habitat, site preparation (land-based) in the project development area (PDA) during construction could affect terrestrial wildlife through direct alteration or loss of terrestrial habitats that are used to meet breeding, foraging, roosting, hibernation, or other life history requirements. Onshore and marine construction activities could indirectly affect habitat use adjacent to the PDA, and would have the greatest effect on marine species that use shoreline and nearshore habitats for foraging and staging. During operations and decommissioning, the liquefied natural gas (LNG) facility and supporting infrastructure will indirectly affect habitat use by terrestrial wildlife using areas adjacent to the PDA, generally through noise-based disturbance associated with operational activities. The operations and decommissioning of the marine terminal and operational vessel traffic will have similar effect on marine birds. Dredging and disposal of dredged material at sea could have a similar effect on marine birds and their habitat

Mortality effects to terrestrial wildlife could result from site preparation (land-based) during project construction with vegetation clearing potentially causing incidental mortality of wildlife with limited mobility (e.g. small mammals, amphibians, and young birds), though this effect will be mitigated by restricting vegetation clearing activities during the spring and summer. Dredging and marine construction could result in mortality of marine birds should individuals be present in areas adjacent to blasting activities. Light-induced mortality (discussed in the technical memo *Potential Effects of Project Lighting on Songbirds, Marine Birds, and Bats*) is also a potential source of mortality for birds flying around the LNG facility, supporting infrastructure, and the suspension bridge; mitigations to reduce the potential for this effect is discussed, as applicable, throughout this memo.

Visual and auditory disturbance from land-based site preparation and onshore construction could cause terrestial wildlife species to alter their movements and avoid the PDA and surrounding area. Dredging and marine construction could have a similar effect on marine birds. Disturbance during LNG facility operations and decommissioning, marine terminal operations and decommissioning (including vessel activity) could have a similar effect to terrestrial wildlife and marine birds, respectively.

Table 1: Screening of Potential Project Effects for Terrestrial Wildlife and Marine Bird Species-at-Risk Potentially Occurring the Local and Regional Assessment Area. ✓ = Potential interaction; NI = No interaction predicted.

Species Name	Scientific Name	BC Status	SARA Status	Schedule	Habitat Present in the LAA or RAA?	Habitat Requirements in the LAA and RAA	Supporting Ecological Communities Present in the LAA	Potential Project Effects[a]		
								Change in Wildlife Habitat Availability	Change in Mortality	Alteration of Movement
Mammals										
Little Brown Myotis	*Myotis lucifugus*	Yellow	Endangered (COSEWIC)	–	LAA RAA	Summer roosts in buildings, tree cavities, and under the bark of trees; winter hibernation sites are typically located within 200 km of summer roosting colonies (Nagorsen and Brigham 1993).	Anthropogenic Forest—Old Coniferous Forest—Seral Coniferous Forest—Seral Deciduous Wetland—Aquatic Wetland—Estuarine Marsh Wetland—Estuarine Meadow Wetland—Estuarine Tidal Flat Wetland –Shrub Dominated Bog Wetland—Treed Swamp or Bog	✓	✓	NI
Keen's Long-eared Myotis	*Myotis keenii*	Red	Data deficient	Schedule 2/3: Lack of data	LAA RAA	Occurs in coastal mature to old-growth forests, as far north as the Stikine River (Klinkenberg 2012) and roosts in tree cavities and caves near, or even below, the high tide line (Boland et al. 2009; Firmen et al. 1993).	Anthropogenic Forest—Old Coniferous Forest—Seral Coniferous Forest—Seral Deciduous Wetland—Aquatic Wetland—Estuarine Marsh Wetland—Estuarine Meadow Wetland—Estuarine Tidal Flat Wetland –Shrub Dominated Bog Wetland—Treed Swamp or Bog	✓	✓	NI
Wolverine, *luscus* subspecies	*Gulo gulo luscus*	Blue	Special Concern (COSEWIC)	Schedule 3: Vulnerable	RAA	Occurs from sea-level to alpine where prey is abundant year-round; den sites are typically under avalanche debris or large boulders in undisturbed Engelmann spruce and sub-alpine fir forests (Krebs and Lewis 2000). This Habitat is generally, not found in the LAA.	Forest—Old Coniferous	NI	NI	NI
Grizzly Bear	*Ursus arctos*	Blue	Special Concern (COSEWIC)	Schedule 3: Vulnerable	RAA	Occurs in a range of habitat types from sea-level coastal rainforests to tundra and alpine elevations (COSEWIC 2002a). As a habitat generalist, they have large ranges and migrate seasonally with resource distribution (Mace et al. 1999). Movement corridors are not likely to overlap with the LAA, but may do so on the mainland in the RAA.	Forest—Old Coniferous Forest—Seral Coniferous Forest—Seral Deciduous Wetland—Estuarine Meadow Wetland—Shrub Dominated Bog Wetland—Treed Swamp or Bog	NI	NI	NI
Amphibians										
Coastal Tailed Frog	*Ascaphus truei*	Blue	Special Concern	Schedule 1	RAA	Year-round resident of cool, fast flowing, rocky streams on the West and East slopes of the Coast Mountains (BCMWLAP 2004). Unlikely to occur in the PDA but might occur on the mainland within the RAA.	Forest—Old Coniferous Forest—Seral Coniferous Forest—Seral Deciduous	NI	NI	NI

Species Name	Scientific Name	BC Status	SARA Status	Schedule	Habitat Present in the LAA or RAA?	Habitat Requirements in the LAA and RAA	Supporting Ecological Communities Present in the LAA	Potential Project Effects[a]		
								Change in Wildlife Habitat Availability	Change in Mortality	Alteration of Movement
Western Toad	*Bufo boreas*	Blue	Special Concern	Schedule 1	RAA	Breeding occurs in ponds, stream edges and shallow lake margins while tadpoles and toadlets congregate in warm, shallow water (Olson 2001). Adults will disperse into forested areas, shrublands and subalpine meadows with dense shrub cover and access to moisture (Poll et al. 1984). Has not been documented on Lelu Island but is known to occur on Ridley Island within the RAA.	Forest—Old Coniferous Forest—Seral Coniferous Forest—Seral Deciduous Wetland—Aquatic Wetland—Shrub Dominated Bog Wetland—Treed Swamp or Bog	NI	NI	NI
Birds										
Ancient Murrelet	*Synthliboramphus antiques*	Blue	Special Concern	Schedule 1	RAA	Breeds in mature or old-growth coniferous forests on islands from 20 to 2,000 ha in size (Campbell et al. 1990a; Gaston 1994). Nest sites are located within 300-400 m of the shoreline. Occurs in offshore locations of the LAA and RAA where suitable breeding or winter habitat exists.	Marine—Ocean	✓	✓	✓
Band-tailed Pigeon	*Patagioenas fasciata*	Blue	Special Concern	Schedule 1	LAA RAA	Breeds in low-elevation (< 1,000 m) mixed wood forests, especially pine-oak, spruce, Douglas-fir, Western Hemlock, Cedar and alder (Braun 1994). Occur within the LAA and RAA year-round.	Anthropogenic Forest—Old Coniferous Forest – Seral Coniferous Forest – Seral Deciduous	✓	✓	NI
Barn Swallow	*Hirundo rustica*	Blue	Threatened (COSEWIC)	–	RAA	Breeds in abandoned buildings, barns and other and sheltered structures, frequently near water (Hilty and Brown 1986). Occurs during breeding season within the RAA and LAA.	Anthropogenic Forest—Seral Coniferous Forest—Seral Deciduous	NI	NI	NI
Common Nighthawk	*Chordeiles minor*	Yellow	Threatened	Schedule 1	LAA RAA	Breeds in open habitat devoid of vegetation (i.e., rocky outcrops, sand dunes, beaches, forest clearings and logged areas) (COSEWIC 2007c). One individual detected during baseline studies, although not previously recorded in LAA (Appendix H of the EIS).	Anthropogenic Wetland – Aquatic Wetland – Estuarine Marsh Wetland – Estuarine Meadow Wetland – Estuarine Tidal Flat	✓	NI	NI
Great Blue Heron, *fannini* subspecies	*Ardea herodias fannini*	Blue	Special Concern	Schedule 1	LAA RAA	Breeding pairs or small colonies occur in mature forests along the coastline; intertidal and shallow coastal waters are used for feeding (Campbell et al. 1990b) Occurs year-round along the coast of the LAA and RAA.	Forest—Old Coniferous Forest—Seral Coniferous Wetland—Aquatic Wetland—Estuarine Marsh Wetland—Estuarine Tidal Flat Marine—Ocean	✓	NI	✓
Horned Grebe	*Podiceps auritus*	Yellow	Special Concern (COSEWIC)	–	LAA RAA	Occurs along the coast during spring and fall migration and over winter (Stedman 2000).	Marine—Ocean Wetland—Estuarine Tidal Flat	✓	NI	✓
Marbled Murrelet	*Brachyramphus marmoratus*	Blue	Threatened	Schedule 1	LAA RAA	Occur from sea-level to 1,500 m elevation and nest in mature to old-growth forests up to 50 km from shore (Burger 2001). Forage year-round within 2 km of shore. Detected in nearshore marine habitats within the LAA.	Forest—Old Coniferous Wetland—Treed Swamp or Bog Wetland—Estuarine Tidal Flat Marine—Ocean	✓	✓	✓
Northern Goshawk, *laingi* subspecies	*Accipiter gentilis laingi*	Red	Threatened	Schedule 1	LAA RAA	Forest dwelling raptor that requires mature to old-forests for breeding (Doyle 2003) but forages in a wide range of habitat types. May occur within suitable habitat in the RAA and LAA.	Forest—Old Coniferous Forest—Seral Coniferous Forest—Seral Deciduous	✓	✓	✓

Species Name	Scientific Name	BC Status	SARA Status	Schedule	Habitat Present in the LAA or RAA?	Habitat Requirements in the LAA and RAA	Supporting Ecological Communities Present in the LAA	Potential Project Effects[a]		
								Change in Wildlife Habitat Availability	Change in Mortality	Alteration of Movement
Olive-sided Flycatcher	*Contopus cooperi*	Blue	Threatened	Schedule 1	LAA RAA	Breeds in mature to old-growth forests with natural openings. Prefers foraging and singing from dead standing trees (AOU 1983).	Forest—Old Coniferous Wetland—Treed Swamp or Bog	✓	✓	✓
Peregrine Falcon *pealei* subspecies	*Falco peregrinus pealei*	Blue	Special Concern	Schedule 1	RAA	Rarely breed on mainland cliffs, more often on rocky island cliffs, usually near seabird colonies and occur year-round feeding in coastal waters within the LAA and RAA (Campbell et al. 1990b).	Marine—Ocean	NI	NI	NI
Rusty Blackbird	*Euphagus carolinus*	Blue	Special Concern	Schedule 1	RAA	Breeds in inland moist coniferous forests near wetlands, bogs or other small bodies of water (AOU 1983).	Forest—Old Coniferous Forest—Seral Coniferous Wetland—Aquatic Wetland—Shrub Dominated Bog Wetland—Treed Swamp or Bog	NI	NI	NI
Short-eared Owl	*Asio flammeus*	Blue	Special Concern	Schedule 1	LAA RAA	Breeds in open land with low vegetation, often in fresh and saltwater marshes, dunes near foraging areas with high small mammal densities (Campbell et al. 1990b). In winter, roost communally in low brush or shallow depressions in the ground (Clark 1975). Suitable habitat uncommon within the RAA.	Wetland—Estuarine Marsh Wetland—Shrub Dominated Bog	NI	NI	NI
Western Grebe	*Aechmophorus occidentalis*	Red	Special Concern (COSEWIC)	–		Nests on large inland bodies of water near deep water (Ehrlich et al. 1992). Detected along the coast and in sheltered waters and bays within the LAA and RAA during winter season (AOU 1983).	Marine—Ocean Wetland—Estuarine Tidal Flat	✓	NI	✓
Western Screech-Owl, *kennicottii* subspecies	*Megascops kennicottii kennicottii*	Blue	Special Concern	Schedule 1		Breeds in tree cavities in forests, especially in riparian zones, found at lower elevations (COSEWIC 2002b). Detected during baseline studies within the LAA.	Forest—Old Coniferous Wetland—Treed Swamp or Bog	✓	✓	✓

Individual species for which no interaction has been determined for all three potential project effects (e.g., wolverine) are unlikely to occur in the local assessment area (LAA) based on habitat requirements, range, and/or known occurrence records or if a given species is expected to have negligible likelihood for interaction with project related activities based on occurrence and patterns in habitat use. Seven species are determined to have no interatction with the Project (Table 1). Rationale is provided on a species-by-species basis, below:

- **Wolverine –** Table 1 identifies that old coniferous forest within the LAA has the potential to support wolverine use. However, wolverines typically occur at higher elevation, undisturbed subalpine forests (Krebs and Lewis 2000). The LAA is located at sea level, so use of the LAA is expected to be rare. In addition, the proximity of Port Edward is likely a deterrent, as wolverines typically avoid areas near human habitations (BC MWLAP 2004). Thus, the Project is not expected to interact with the species
- **Grizzly Bear –** Table 1 identifies six ecological communities in the LAA with the potential to support grizzly bear based on habitat characteristics (e.g. forage availability) present within those communities. However, the North Coast Land and Resource Management Plan (BC MSRM 2005) states that grizzly bear do not occur on the coastal islands near the Prince Rupert mainland. Grizzly bears are also unlikely to occur in proximity to Port Edward, as they typically avoid areas of human habitation (McLellan 1998; Apps et al. 2004). Consistent with range and habitat requirements, there are no detections of grizzly bear across both regional and project datasets (Appendix H of the EIS). Thus, despite the presence of suitable habitat in the LAA for grizzly bears, the species is not expected to occur and no interaction is expected
- **Coastal Tailed Frog –** As discussed within Appendix H of the EIS, tailed frogs are unlikely to occur on Lelu Island due to habitat requirements. Tailed frogs require permanent, fast-flowing, forested mountain streams with a moderate gradient, cobble or rock substrates, and consistent flow rate throughout the year for breeding and juvenile rearing (BCMWLAP 2004; Corkran and Thoms 2006). Many drainages on Lelu Island are shallow-sloped ephemeral drainages that are not suitable for breeding (see Appendix I of the EIS). Adult tailed frogs are rarely observed more than a few hundred metres from suitable stream habitat (BCMWLAP 2004), and thus are not expected to occur in any location that does not contain suitable streams. Further, baseline surveys completed for the Project did not record detection of tailed frog (Appendix H of the EIS). Collectively, habitat requirements and absence of occurrence records support the conclusion that tailed frogs are not expected to interact with project related activities
- **Western Toad –** Western toads have been frequently detected on Ridley Island, likely due to suitable breeding habitat including larger pond wetlands with variable water depths and neutral pH (Stantec 2011a, b). Wetland ecological communities on Lelu Island have the potential to support western toad as identified within Table 1, however no western toad were observed during systematic amphibian surveys conducted on Lelu Island (see Appendix H of the EIS).Wetlands on Lelu Island are predominantly shallow peat bogs that lack sandy substrates and tend to have a lower than average pH. Bogs and swamps are not commonly used as breeding habitat by western toad (BC CDC 2014), as this species prefers small ponds, stream margins, or other shallow bodies of fresh water with a sandy substrate for breeding (COSEWIC 2002c; Corkran and Thoms 2006; Matsuda et al. 2006). The type of wetland habitat present on Lelu Island, combined with the absence of detections of adult toads or signs of breeding (e.g., egg masses or tadpoles) indicate that western toad do not breed on Lelu Island. project related activities are unlikely to result in an effect to habitat, mortality, or movement for this species
- **Barn Swallow –** Barn swallows have the potential to occur in the LAA and regional assessment area (RAA) during the breeding season (BC CDC 2014; British Columbia Breeding Bird Atlas 2014). This

species typically nests in buildings and other anthropogenic structures, usually foraging within a few hundred metres of nests (BC CDC 2014). The anthropogenic features mapped within the ecological community modelling for the EIS include roads, railways, and the town of Port Edward on the mainland. Port Edward is the only location where structures may be present that provide opportunities for nesting, and none of those will be affected by the Project. Open habitat on Lelu Island (e.g., shrub-dominated bog and aquatic areas) could provide foraging opportunities for barn swallows, however no barn swallows were observed during breeding bird surveys for the Project (Appendix H of the EIS). This suggests that Lelu Island may be too far from suitable nesting habitat to be used by barn swallows for foraging. Accordingly, barn swallows are not expected to interact with project related activities

- **Peregrine Falcon –** Peregrine falcons are typically found in areas with good prey resources in close proximity to rocky cliffs or bluffs that provide suitable nest sites (COSEWIC 2007e). Several regional datasets include detections of peregrine falcon, although abundance is very low (Appendix H of the EIS). Suitable nesting habitat in the LAA for peregrine falcon is restricted to a small, high elevation, rocky outcrop on the mainland. Ecological communities on Lelu Island do not support breeding habitat, and although marine habitat surrounding Lelu Island contains suitable prey (e.g., marine birds) for peregrines, preferred foraging habitat during the breeding season is typically located close to active nest sites (Beebe 1960; COSEWIC 2007e). No peregrine falcons were observed within the LAA during baseline surveys (Appendix H of the EIS). This species has a low likelihood of interacting with the Project due to limited potential use of habitats on or near Lelu Island
- **Rusty Blackbird** – Rusty blackbirds typically breed in inland moist coniferous forests near wetlands, bogs or other small bodies of water (AOU 1983). Although Lelu Island contains ecological communities that could potentially support rusty blackbird, the LAA is located outside the typical range for this species. Rusty blackbirds are uncommon in coastal BC and have not been recorded breeding there (B.C. CDC 2014; British Columbia Breeding Bird Atlas 2014; Klinkenberg 2014). There have been no occurrence records of rusty blackbird across regional datasets (see Appendix H of the EIS). Based on range and absence of occurrence records, rusty blackbird is not expected to occur in the LAA and is not expected to interact with project related activities
- **Short-Eared Owl** – Short-eared owls typically breed in southwest BC, central BC and the Peace River lowlands, though a few individuals have been recorded in northwest BC, and none during the winter (Campbell et al. 1990b). The nearest potential (but unconfirmed) breeding record in relation to the LAA is along the Stikine River near Kitwanga, close to Terrace (British Columbia Breeding Bird Atlas 2014). Based on limited potential for occurrence in the LAA, the Project is not expected to interact with short-eared owls.

Individual terrestrial wildlife and marine bird species for which an interaction with the Project is expected have been discussed in more detail below. Residual effects have been characterized for each species-effect interaction identified in Table 1. A summary of all residual effects characterizations is located in Table 7.

Little Brown Myotis

Baseline Conditions

Little brown myotis is a medium-sized bat that can be found in a wide range of habitats throughout BC (Nagorsen and Brigham 1993). It is currently yellow-listed in BC (BC CDC 2014) and designated as Endangered by the COSEWIC. In February 2012, the species was recommended for an emergency listing to the SARA by COSEWIC due to declining populations from the spread of white-nose syndrome in eastern North America (COSEWIC 2013c). Little brown myotis is currently not listed on the SARA and thus no recovery strategy or action plans have been developed, critical habitat has not been identified, and residences for the species are not protected.

Habitat preferences for little brown myotis vary depending on the time of year. In the summer, individuals typically roost during the day in buildings, under bridges, within tree cavities and rock crevices, and under the bark of trees (Nagorsen and Brigham 1993; COSEWIC 2013c). At night they forage over areas of still water, rivers, in openings of coniferous or deciduous forest stands, along forested edges, or along trails (COSEWIC 2013c). The species appears to use old forests more than younger ones, possibly due to a greater density of suitable roost sites (Nagorsen and Brigham 1993). In the fall, little brown myotis undergo localized migrations (up to 200 km) to winter hibernacula sites in caves or abandoned mines (Nagorsen and Brigham 1993). No suitable hibernation sites have been identified within the LAA.

Effects Assessment
Many of the ecological communities within the LAA and RAA have the potential to support little brown myotis in their summer roosting and foraging requirements (Table 1). Project activities (e.g., vegetation clearing for site preparation, onshore construction, site clean-up and reclamation) and decommissioning (e.g., dismantling of the LNG facility and supporting infrastructure) will affect several of these ecological communities (Table 2).

Table 2 Total Area of each Ecological Community used by Little Brown Myotis Removed by Clearing within the Project Development Area

Ecological Community	Area Affected in PDA (ha)
Anthropogenic	0
Forest – Old Coniferous	44
Forest – Seral Coniferous	0
Forest – Seral Deciduous	0
Wetland – Aquatic	1
Wetland – Estuarine Marsh	0
Wetland – Estuarine Meadow	0
Wetland – Estuarine Tidal Flat	3
Wetland – Shrub Dominated Bog	76
Wetland – Treed Swamp or Bog	43

The Wetland Habitat Compensation Plan will be implemented to offset the net loss of wetland habitat removed during clearing. Priority for compensation opportunities will be given to creating or restoring wetlands that replace wetland functions (including habitat functions for bats) removed by construction of the Project. Wetland compensation activities that replace treed swamp or bog, or shrub-dominated bog communities will mitigate for bat roosting and foraging habitat removed during construction of the PDA. Other measures that will be implemented to mitigate change in habitat include: locating the Project adjacent to existing infrastructure where feasible to reduce habitat fragmentation and edge effects, limiting clearing and temporary work spaces to within the PDA to reduce the final overall footprint, and instituting measures to reduce noise effects and disturbance of individuals using habitat adjacent to the PDA.

Change in availability of terrestrial ecological communities that potentially support little brown myotis will be moderate in magnitude (167 ha affected). Direct habitat removal will occur once during vegetation clearing for the PDA and will persist unless the PDA is reclaimed following decommissioning of the Project. Indirect effects of habitat avoidance caused by noise during the construction phases may extend to adjacent habitats in the LAA. It is expected that little brown myotis populations will demonstrate moderate or high

resilience to changes in habitat availability caused by the Project, as populations of this species remain secure (i.e., are yellow-listed) within BC (BC CDC 2014). The likelihood of a residual effect occurring is high as vegetation clearing for construction of Project components will change habitat for little brown myotis. With mitigation measures applied, the residual effects from the change in habitat availability are not expected to affect the sustainability of regional populations of this species. Consequently, change in habitat availability from the Project is predicted to be not significant. The confidence in this prediction is moderate based on the current understanding of little brown myotis habitat requirements and occurrence in the LAA and the effectiveness of mitigation options.

Construction and operations of the Project may also result in a change in mortality risk to little brown myotis. Vegetation clearing during site preparation, and decommissioning could result in the incidental destruction of occupied roost sites. However, the Project will implement a restricted activity period to avoid clearing and construction of the PDA during the spring and summer when bats are roosting and breeding in the LAA to reduce the potential for mortality of little brown myotis. Light-induced mortality from the LNG facility during operations is expected to be negligible and is described in detail in the technical memo *Potential Effects of Project Lighting on Songbirds, Marine Birds, and Bats*. Mortality to little brown myotis is expected to be low in magnitude (i.e., limited to a small number of individuals) since clearing will be completed outside the period when bats are expected to be roosting in the LAA. Clearing will be a single event occurring during initial site preparation within the PDA. Potential effects of mortality from clearing will be long-term due to the long lifespan (20 years) and low population recruitment rate (one offspring per year) of little brown myotis (Nagorsen and Brigham 1993). It is expected that little brown myotis populations will demonstrate moderate resilience to changes in mortality caused by the Project. With mitigation measures applied, residual effects from the change in mortality risk are not expected to affect the sustainability of regional little brown myotis populations and are predicted to be not significant. The confidence in this prediction is moderate based on the current understanding of the species' presence and distribution in the LAA and the effectiveness of mitigation options.

Because little brown myotis are highly mobile, it is anticipated that their movements will not be impeded by Project infrastructure. Thus, the Project will not result in residual effects on local and regional movement patterns of bat species and will not contribute to cumulative effects to regional populations.

Cumulative Effects Assessment

The Project is likely to contribute to cumulative changes in habitat for little brown myotis. Cumulative loss or alteration will result in the greatest change to availability of seral coniferous forest, shrub-dominated bog wetlands and treed swamp or bog wetlands within the RAA (Table 11-3 of the EIS Addendum). It is not expected that the Project's contribution to habitat change will affect long-term sustainability of regional little brown myotis populations. Accordingly, the Project's contribution to cumulative effects on habitat for little brown myotis is determined to be not significant.

The Project is also likely to contribute to cumulative changes to mortality risk for the species. However after the application of appropriate mitigation, the Project's contribution to cumulative risk of mortality is not expected to affect the sustainability of regional populations.

Keen's Myotis

Baseline Conditions

Keen's myotis is a medium-sized bat found mainly in coastal BC. This species is blue-listed (i.e., special concern) in BC and is an Identified Wildlife species provincially (Nagorsen and Brigham 1993; BC CDC 2014; BC MWLAP 2004). Federally, the species is considered Data Deficient by COSEWIC and is listed on Schedule 3 of SARA. Schedule 3 identifies species that require reassessment, but provides no legislated protection for individuals, residences, or critical habitat of that species. No recovery strategy or action plans have been developed, nor has critical habitat been identified for Keen's myotis.

Keen's myotis is understood to be associated with mature to old-growth forests, and is found as far north as the Stikine River (Klinkenberg 2012). Roosts have been identified in caves, tree cavities, rock crevices and manmade structures. Limited observations of hibernating Keen's indicate they use caves during the winter (Firmen et al. 1993; COSEWIC 2003a; Boland et al. 2009). Due to limited occurrence records for this species, detailed information on life history traits for Keen's myotis are poorly described, which is why the species remains Data Deficient.

Effects Assessment

Many of the ecological communities within the LAA and RAA potentially support Keen's myotis in their summer roosting and foraging requirements (Table 1). Project activities (e.g., vegetation clearing for site preparation, onshore construction, site clean-up and reclamation) and decommissioning (e.g., dismantling of the LNG facility and supporting infrastructure) will affect several of these ecological communities (Table 3).

Table 3 Total Area of each Ecological Community used by Keen's Myotis Removed by Clearing within the Project Development Area

Ecological Community	Area Affected in PDA (ha)
Anthropogenic	0
Forest – Old Coniferous	44
Forest – Seral Coniferous	0
Forest – Seral Deciduous	0
Wetland – Aquatic	1
Wetland – Estuarine Marsh	0
Wetland – Estuarine Meadow	0
Wetland – Estuarine Tidal Flat	3
Wetland – Shrub Dominated Bog	76
Wetland – Treed Swamp or Bog	43

The Wetland Habitat Compensation Plan will be implemented to offset the net loss of wetland habitat removed during clearing. Priority for compensation opportunities will be given to creating or restoring wetlands that replace wetland functions (including habitat functions for bats) removed by construction of the Project. Wetland compensation activities that replace treed swamp or bog, or shrub-dominated bog communities will mitigate for bat roosting and foraging habitat removed during construction of the PDA. Other measures that will be implemented to mitigate change in habitat include: locating the Project adjacent to existing infrastructure where feasible to reduce habitat fragmentation and edge effects, limiting clearing and temporary work spaces to within the PDA to reduce the final overall footprint, and instituting measures to reduce noise effects and disturbance of individuals using habitat adjacent to the PDA.

Change in availability of terrestrial ecological communities that potentially support Keen's myotis will be moderate in magnitude (167 ha affected). Direct habitat removal will occur once during vegetation clearing for the PDA and will persist unless the PDA is reclaimed following decommissioning of the Project. Indirect effects of habitat avoidance caused by noise during the construction phases may extend to adjacent habitats in the LAA. Little is known of Keen's myotis occurrence in BC, but given the limited observations of the species in the province to-date it potentially occurs at low densities and has conservatively been assessed as a low-resilience species. The likelihood of a residual effect occurring is high as vegetation clearing for construction of project components will reduce habitat for Keen's myotis. With mitigation measures applied, the residual effects from the change in habitat availability are not expected to affect the sustainability of regional populations of this species. Consequently, change in habitat availability from the Project is predicted to be not significant. The confidence in this prediction is moderate based on the uncertainty surrounding Keen's distribution and habitat requirements in the LAA and the effectiveness of mitigation options.

Construction and operations of the Project may also result in a change in mortality risk to Keen's myotis. Vegetation clearing during site preparation, and decommissioning could result in the incidental destruction of occupied roost sites. However, the Project will implement a restricted activity period to avoid clearing and construction of the PDA during the spring and summer when bats are roosting and breeding in the LAA. This will reduce the potential for mortality of Keen's myotis. Light-induced mortality from the LNG facility during operations is expected to be negligible and is described in detail in the technical memo *Potential Effects of Project Lighting on Songbirds, Marine Birds, and Bats*. Risk of mortality to Keen's myotis is expected to be low in magnitude (i.e., limited to a small number of individuals) since clearing will be completed outside the period when bats are expected to be roosting in the LAA. Clearing will be a single event occurring during initial site preparation within the PDA. Potential effects of mortality from clearing will be long-term due to a lifespan estimated to average at least 10-20 years and low population recruitment rate (one offspring per year) of Keen's myotis (COSEWIC 2003a). Little brown myotis is conservatively estimated to have low resilience to changes in mortality, due to potentially low densities across its range in BC. With mitigation measures applied, residual effects from the change in mortality risk are not expected to affect the sustainability of regional Keen's myotis populations and are predicted to be not significant. The confidence in this prediction is moderate based on uncertainty surrounding Keen's distribution, habitat requirements and life history, and the effectiveness of mitigation options.

Like little brown myotis, Keen's myotis are likely highly mobile and it is anticipated that their movements will not be impeded by project infrastructure. Thus, the Project will not result in residual effects on local and regional movement patterns of bat species and will not contribute to cumulative effects to regional populations.

Cumulative Effects Assessment

The Project is likely to contribute to cumulative changes in habitat for Keen's myotis through loss or alteration of ecological communities, that combined with habitat loss in the RAA will result in the greatest change to availability of seral coniferous forest, shrub-dominated bog wetlands and treed swamp or bog wetlands within the RAA (Table 11-3 of the EIS Addendum). Based on the availability of these communities in the RAA, it is not expected that the cumulative change in habitat will affect long-term sustainability of regional Keen's myotis populations and is determined to be not significant. The confidence in this prediction is moderate based on uncertainty surrounding Keen's distribution, habitat requirements and life history requirements in the RAA.

The Project is also likely to contribute to cumulative changes to mortality risk for the species. However after the application of appropriate mitigation, the Project's contribution to cumulative risk of mortality is not expected to affect the sustainability of regional populations. Through adherence to appropriate mitigations measures, cumulative risk of mortality in the RAA is expected to be not significant. The confidence in this

prediction is moderate based on uncertainty surrounding seasonal timing of habitat removal and mitigation measures implemented by other proponents in the RAA.

Ancient Murrelet

Baseline Conditions

Ancient murrelets are small alcids that spend much of their life at sea (BC MWLAP 2004). Currently blue-listed and designated as Identified Wildlife species in BC, the ancient murrelet was also designated Special Concern by COSEWIC in 2004 and was added to Schedule 1 of SARA in 2006 (BC CDC 2014; BC MWLAP 2004). As a Special Concern species, a recovery plan with designated critical habitat has been produced for this species.

Ancient murrelets breed on Haida Gwaii (COSEWIC 2004a), nesting in burrows at the base of trees within mature forests (BC MWLAP 2004). Nesting typically occurs on islands within 300 to 400 m of the shoreline (BC MWLAP 2004). Rearing of young regularly occurs in Dixon Entrance, Hecate Strait, northern Queen Charlotte Sound and west of Dixon Entrance between late May and late July (Sealy et al. 2013). Regional occurrence records for ancient murrelet are limited to two individuals; no ancient murrelets were observed during baseline studies for the Project (Appendix H of the EIS).

Effects Assessment

Since ancient murrelets do not breed on Lelu Island, ocean habitat is the only ecological community within the LAA and RAA with potential to support this species. Five hectares of ocean habitat will be removed during construction to support marine infrastructure associated with the Project. The Fish Habitat Offsetting Plan will be implemented to offset the net loss of marine bird foraging habitat removed during construction. The Project will also be located adjacent to existing infrastructure to reduce marine habitat construction requirements.

Change in availability of ocean habitat will be low in magnitude. Direct habitat removal will occur once during construction for the PDA and will persist unless marine habitat is reclaimed following decommissioning of the marine infrastructure. Indirect effects of habitat avoidance caused by noise during the construction, operations, and decommissioning phases may extend to adjacent habitats in the LAA. There is a high likelihood that construction will result in loss of marine ecological communities. However, based on the extent of change (i.e., 5 ha), residual effects from change in habitat are predicted to be not significant for ancient murrelet. The confidence in this characterization is high because there is limited potential for an interaction to occur based on the absence of ancient murrelet occurrences in nearshore waters surrounding Lelu Island. Ancient murrelets are expected to exhibit high resilience to changes in habitat in the LAA.

Lighting associated with the Project may result in a change in mortality risk to ancient murrelet. Effects from light-induced mortality from the LNG facility and the marine terminal are described in detail in Section 11.5.3 of the EIS and in the technical memo *Potential Effects of Project Lighting on Songbirds, Marine Birds, and Bats*; these effects apply to ancient murrelet. Lighting mitigations will be applied to reduce the dispersal of light from the LNG facility and the marine terminal. PNW LNG will provide wildlife education and awareness training to employees and contractors regarding periods of increased mortality risk (e.g., during migration). Potential for mortality risk from project lighting will be long-term (i.e., will occur throughout the operational lifetime of the Project) and extend to the LAA. With lighting mitigation measures applied, risk of mortality is expected to be low in magnitude, limited to areas of the LAA where lit infrastructure occurs, and is expected to be reversible following decommissioning. Based on occurrence records, mortality is expected to be a multiple irregularly occurring event. Regional populations are expected to show high resilience to infrequent mortality events. Lighting mitigations will reduce the likelihood of a residual effect from light-induced mortality to moderate. Accordingly, mortality risk is predicted to be not significant. The confidence in this prediction is moderate based on the current understanding of the species' presence and distribution in the LAA and the effectiveness of lighting mitigation.

Because the nearshore waters adjacent to the marine terminal are expected to receive limited use by ancient murrelets, it is anticipated that their movements will not be impeded by project infrastructure. Effects on ancient murrelet movement will be greatest as individuals occupying waters along the shipping route may be displaced by transiting vessels during project operations. Effects to marine bird movement, including ancient murrelets, are described in detail in the technical memo *Effects of Shipping on Marine Bird Movement*. Effects on movement will be mitigated by vessel maintaining controlled speeds along the shipping routes to reduce underwater noise propagation. Effects on ancient murrelet movement will be restricted to individuals in the marine LAA and will be low to moderate in magnitude, depending on the time of year. Marine birds in the RAA are already exposed to vessel traffic from a variety of activities, including shipping of cargo on tankers, barges and tugboats among others. Based on the level of vessel traffic at baseline conditions, marine birds are expected to demonstrate a moderate degree of resilience to the Project's contribution to increased vessel traffic (approximately one LNG carrier per day). Disturbance will be short-term as vessels transit through a given area. The likelihood of a residual effect on ancient murrelet movement is moderate along the shipping route but is not expected to affect the sustainability of regional populations and is determined to be not significant. The confidence in the characterization of this effect is also moderate due to limited information on ancient murrelet movement patterns in the LAA.

Cumulative Effects Assessment
Cumulative loss of ocean areas to support marine infrastructure in the RAA (Table 11-3 of the EIS Addendum) may affect the availability of ancient murrelet foraging habitat. The Project's contribution to cumulative mortality risk is also low and limited to individuals that may move into nearshore waters where they may interact with coastal lighting infrastructure within the RAA. Project effects from alteration of movement will act cumulatively with other vessel traffic along the shipping route. Collectively, cumulative effects are not expected to affect the long-term sustainability of regional ancient murrelet populations and are determined to be not significant.

Band-tailed Pigeon
Baseline Conditions
Band-tailed pigeon is currently blue-listed in BC and is designated as Special Concern on SARA Schedule 1 (BC CDC 2014). In recent years, band-tailed pigeon has declined throughout its range in western North America, in part due to increased hunting pressure (COSEWIC 2008a). This is a low-fecundity species, with females producing only one or two eggs per year which limit overall population recovery rates (COSEWIC 2008a). Since this species is ranked as Special Concern, no recovery plan has been developed nor has critical habitat been identified.

In BC, the breeding range of band-tailed pigeon is generally restricted to the southwest of the province, but may also breed in small numbers in localized areas of the central and north coasts (COSEWIC 2008a). Nests have been found in coniferous and deciduous trees, though more commonly in coniferous trees, in particular Douglas-fir (Campbell et al. 1990b; COSEWIC 2008a). This species will nest across a variety of canopy closures and seral stages, though closed-canopy pole-sapling stands are the primary nesting habitat with higher nest success in forested stands with higher canopy cover (Leonard 1998; Sanders 2012). Mineral sites are also important for band-tailed pigeon in the Pacific Northwest and occurrences are thought to occur within 50 km of a mineral site (COSEWIC 2008a). Although band-tailed pigeon was not detected during baseline surveys for the Project, individuals have been recorded during surveys for the BC Breeding Bird Atlas, the Kwinitsa breeding bird surveys and during surveys for the Fairview Project on Kaien Island (Appendix H of the EIS).

Effects Assessment
Forested and anthropogenic communities within the LAA and RAA have the potential to support nesting and foraging activities for band-tailed pigeon. Project activities (e.g., vegetation clearing for site preparation, onshore construction, site clean-up and reclamation) and decommissioning (e.g., dismantling of the LNG facility and supporting infrastructure) will result in direct removal of 44 ha of old coniferous forest (Table 4).

Seral coniferous and deciduous forests, and anthropogenic footprints, are located outside of the PDA and will not be affected by the Project.

Table 4 Total Area of each Ecological Community used by Band-tailed Pigeon Removed by Clearing within the Project Development Area

Ecological Community	Area Affected in PDA (ha)
Anthropogenic	0
Forest – Old Coniferous	44
Forest – Seral Coniferous	0
Forest – Seral Deciduous	0

Measures to mitigate change in habitat include: locating the Project adjacent to existing infrastructure where feasible to reduce habitat fragmentation and edge effects, limiting clearing and temporary work spaces to within the PDA to reduce the final overall footprint, maintaining a 30 m riparian buffer around the PDA, and instituting measures to reduce noise effects and disturbance of individuals using habitat adjacent to the PDA. Change in availability of terrestrial ecological communities that potentially support band-tailed pigeon will be moderate in magnitude (i.e., 44 ha affected). Direct habitat removal will occur once during vegetation clearing for the PDA and will persist unless the PDA is reclaimed following decommissioning of the Project. Indirect effects of habitat avoidance caused by noise during the construction phase may extend to adjacent habitats in the LAA. Because band-tailed pigeon is a low-fecundity species that would recover slowly from potential effects, it is expected that regional populations would demonstrate moderate resilience to changes in habitat availability caused by the Project. The likelihood of a residual effect occurring is high as vegetation clearing for the PDA will alter the availability of habitat for band-tailed pigeon. With mitigation measures applied, the residual effects from the change in habitat availability are not expected to affect the sustainability of regional populations of this species. Consequently, change in habitat availability from the Project is predicted to be not significant. The confidence in this prediction is moderate based on the current understanding of band-tailed pigeon population dynamics on the north coast and the relative importance of old coniferous forest in the LAA compared to seral forest communities as preferred nesting habitat for this species.

Construction and operations of the Project may also result in a change in mortality risk to band-tailed pigeon. Vegetation clearing for construction of the PDA could result in incidental destruction of nests, eggs, and young if conducted during the breeding season. To prevent this, the Project will implement a restricted activity period to avoid clearing and construction of the PDA during the spring and summer when birds are breeding in the LAA (Environment Canada 2014a). Potential for light-induced mortality from the LNG facility during operations is expected to be negligible for this species and is described in detail in the technical memo *Potential Effects of Project Lighting on Songbirds, Marine Birds, and Bats*. Overall, mortality risk for band-tailed pigeon as a result of the Project is expected to be low in magnitude (i.e., limited to a small number of individuals) since clearing will be completed outside the period when birds are expected to be nesting in the LAA. Clearing will be a single event occurring during initial site preparation within the PDA, and potential effects of mortality from clearing will be short-term during construction. Effects from mortality are reversible through recruitment from reproduction and immigration. However, as with change in habitat, band-tailed pigeon is expect to demonstrate moderate resilience to changes in mortality risk because it is a low fecundity species. With mitigation measures applied, residual effects from the change in mortality risk are not expected to affect the sustainability of regional band-tailed pigeon populations and are predicted to be not significant. The confidence in this prediction is high based on the current understanding of the species' presence and distribution in the LAA and the effectiveness of mitigation options.

Because band-tailed pigeons are highly mobile and occurrence records indicate it is not reliant on ecological communities on Lelu Island, it is anticipated that their movements will not be impeded by project infrastructure. Thus, the Project will not result in residual effects on local and regional movement patterns of band-tailed pigeon and will not contribute to cumulative effects to regional populations.

Cumulative Effects
The Project is likely to contribute to cumulative changes in habitat for band-tailed pigeon. Cumulative loss or alteration will result in the greatest change to availability of seral coniferous forest within the RAA (Table 11-3 of the EIS Addendum). However, given its relative availability, it is not expected that the habitat change will affect long-term sustainability of regional band-tailed pigeon populations and is considered to be not significant. Through adherence to the Migratory Birds Convention Act and the BC Wildlife Act, cumulative risk of mortality from past, present, and reasonably foreseeable future activities are not expected to result in a significant effect for mortality risk to this species.

Common Nighthawk
Baseline Conditions
Common nighthawk is a medium-sized bird that forages nocturnally in open landscapes (COSEWIC 2007c). This species breeds throughout British Columbia (BC), nesting in habitats devoid of vegetation, including beaches, harvested cut-blocks and burns, rocky outcroppings, agricultural areas, marshes, peatbogs, and anthropogenic features (e.g., roads and railways). Baseline surveys detected a flight call from a single nighthawk on acoustic recording units deployed on Lelu Island; this record constitutes the first observation of nighthawk across regional datasets compiled from the Prince Rupert region (Appendix H of the EIS).

Common nighthawk is yellow-listed in BC and designated as Threatened on Schedule 1 of SARA (BC CDC 2014). Recent declines in nighthawk populations are attributed to corresponding declines in insect populations combined with the loss of open habitats due to reforestation initiatives (COSEWIC 2007c). Currently, there is no recovery strategy in place for common nighthawk, and critical habitat for this species has not been identified.

Effects Assessment
Potential for interaction with project related activities is limited to change in habitat availability. Ecological communities in the LAA, including those on Lelu Island are generally forested or shrub-dominated communities that are unsuitable for nesting. Accordingly, suitable habitat on or near Lelu Island is limited to open landscapes (e.g., aquatic wetlands and tidal mudflats) that may support foraging opportunities (Table 5).

Given that regional occurrence records for common nighthawk are rare, and vegetation clearing will not remove ecological communities with potential to support breeding sites for common nighthawk, there is negligible potential for risk of mortality. Similarly, construction, operations, and decommissioning of the Project are not expected to alter nighthawk movement patterns.

Table 5 Total Area of each Ecological Community used by Common Nighthawk Removed by Clearing within the Project Development Area

Ecological Community	Area Affected in PDA (ha)
Anthropogenic	0
Wetland – Aquatic	1
Wetland – Estuarine Marsh	0
Wetland – Estuarine Meadow	0
Wetland – Estuarine Tidal Flat	3

The Wetland Habitat Compensation Plan will be implemented to offset the net loss of wetland habitat removed during clearing. Priority for compensation opportunities will be given to creating or restoring wetlands that replace wetland functions (including habitat functions insectivorous birds) removed by construction of the Project. Wetland compensation activities that replace open aquatic and marsh wetland habitats will mitigate for nighthawk foraging habitat removed during construction of the PDA. Other measures that will be implemented to mitigate change in habitat include: locating the Project adjacent to existing infrastructure where feasible to reduce habitat fragmentation and edge effects, limiting clearing and temporary work spaces to within the PDA to reduce the final overall footprint, and instituting measures to reduce noise effects and disturbance of individuals using habitat adjacent to the PDA.

Change in habitat for common nighthawk occurs in a stable ecosystem with moderate resilience to changing conditions. Change in habitat will occur once during vegetation clearing for construction and is restricted to the PDA. Removal of ecological communities potentially used by nighthawk is low in magnitude (Table 5). Effects of change in habitat will persist for the lifetime of the Project and are reversible following reclamation activities. The likelihood of a residual effect occurring is moderate as vegetation clearing for construction of project components will change habitat availability, but there is limited regional data to support use of habitats in the LAA by nighthawk. With mitigation measures applied, the residual effects from the change in habitat availability are not expected to affect the sustainability of regional populations of this species. Consequently, change in habitat availability from the Project is predicted to be not significant. The confidence in this prediction is high based on the current understanding of common nighthawk habitat requirements and occurrence in the LAA combined with the effectiveness of mitigation options.

Vegetation clearing for the PDA will not remove ecological communities with potential to support breeding sites for common nighthawk; there is negligible potential for risk of mortality. Similarly, because common nighthawks forage in open landscapes, it is anticipated that their movements will not be impeded by Project infrastructure. Thus, the Project will not result in residual effects on local and regional movement patterns of this species and will not contribute to cumulative effects to regional populations.

Cumulative Effects Assessment
The Project is moderately likely to contribute to cumulative changes in habitat for common nighthawk. Loss or alteration of aquatic, marsh, and estuarine meadow wetland communities bog wetlands within the LAA will act cumulatively with loss of similar habitats available in the RAA (Table 11-3 of the EIS Addendum). The Project's contribution to change in habitat for common nighthawk is limited to 4 ha (Table 1) and it is not expected that the Project's contribution to habitat change will affect long-term sustainability of common nighthawk populations. Accordingly, the Project's contribution to cumulative effects on habitat for common nighthawk is determined to be not significant.

Great Blue Heron, *fannini* subspecies
Baseline Conditions
The great blue heron (*fannini* subspecies) is a large wading bird that resides on the BC coast year-round (COSEWIC 2008b). This subspecies is slightly smaller, darker, and breeds earlier than the continental *herodias* subspecies. The subspecies is currently listed as Special Concern under Schedule 1 of the SARA, and is on the BC provincial blue list (BC CDC 2014). No recovery strategy has been drafted for the subspecies, though COSEWIC (2008b) identifies human disturbance of nesting colonies as the greatest threat to this subspecies

Foraging habitat for great blue herons along the coast typically includes intertidal and shallow coastal waters, as well as wetlands, lakes and rivers away from the coast (Campbell et al. 1990a). This species forms breeding pairs or small colonies along the coast, typically nesting in mature riparian or wet forest stands, preferably in areas undisturbed by humans (Campbell et al. 1990a; COSEWIC 2008b; BC CDC 2014). Heron colonies or breeding pairs were not detected in forested or wetland habitats on Lelu Island during baseline

surveys; however individual herons were regularly detected in shoreline habitats in the LAA during stationary count and vessel-based surveys for marine birds. These records are consistent with regional detections of great blue heron throughout the RAA (Appendix H of the EIS).

Effects Assessment

Within the LAA, six ecological communities have the potential to support great blue heron (Table 6). Project activities during construction, operations, and decommissioning will affect four of these six communities.

Table 6 Total Area of each Ecological Community used by Great Blue Heron Removed by Clearing within the Project Development Area

Ecological Community	Area Affected in PDA (ha)
Forest – Old Coniferous	44
Forest – Seral Coniferous	0
Wetland - Aquatic	1
Wetland – Estuarine Marsh	0
Wetland – Estuarine Tidal Flat	3
Marine – Ocean	5

Changes in the marine terminal and trestle design have greatly reduced potential project effects on marine and estuarine tidal flat habitat from what was reported in the EIS (Section 11 of the EIS Addendum). Accordingly, potential effects from change in the habitat from project activities are generally limited to forest and wetland communities on Lelu Island. Mitigation measures will reduce potential adverse effects to great blue heron habitat by: limiting clearing and temporary work spaces to the PDA, locating the Project adjacent to existing infrastructure, maintaining a 30 m riparian buffer, following BC OGC standards for noise buffering (BC OGC 2009), implementing a Fish Habitat Offsetting strategy to replace lost intertidal foraging habitat and implementing a Blasting Management Plan to limit disturbance from construction noise. A Wetland Habitat Compensation Plan will also be implemented to offset the net loss of wetland habitat removed during clearing. Priority for compensation opportunities will be given to creating or restoring wetlands that replace wetland functions (including habitat for great blue heron) removed by construction of the Project. Change in availability of habitat for great blue heron will be moderate in magnitude. Direct habitat removal will occur once during construction within the PDA, persist for the lifetime of the Project, but will be reversible following decommissioning of project infrastructure. Indirect effects of habitat avoidance caused by noise during the construction and operations phase may extend into suitable habitat within the LAA. Great blue heron is expected to have high resilience to changes in habitat availability caused by the Project given the absence of heron colonies in LAA and mitigation measures that will offset for lost terrestrial and marine ecological communities. The likelihood of a residual effect occurring is high as construction for the Project will change habitat for great blue heron. Residual effects from the change in habitat availability are not expected to affect the sustainability of regional populations of this species, and this effect is predicted to be not significant. The confidence in this predication is high, based on the small size of the area affected and the effectiveness of mitigation options.

The Project is not expected to result in a change in mortality to great blue herons. No nests or colonies were detected on Lelu Island during baseline studies, and both the conspicuous nature of great blue heron nests combined with mitigations to apply a restricting activity during the breeding bird season (Environment Canada 2014a) will avoid potential mortality should herons establish nests on the island prior to construction. Light-induced mortality from the LNG facility during operations is expected to be negligible for

herons and is described in detail in the technical memo *Potential Effects of Project Lighting on Songbirds, Marine Birds, and Bats*.

Facility construction and blasting have the potential to alter great blue heron movements during project construction. Operational activities may cause disturbance if they occur along shoreline habitats that are most frequently used by herons. Mitigation measures to reduce noise effects, implementation of a Blasting Management Plan, and having vessels adhere to posted speed limits as vessels approach the marine terminal will reduce potential effects to heron movement patterns. The magnitude of this effect is expected to be low and limited to the LAA. Changes to movement will be a multiple, irregularly occurring event throughout the life of the Project, as a result of ongoing facility and terminal operations. However, effects on heron movement are expected to be reversible upon decommissioning of the Project. Heron individuals can be quite tolerant of human disturbance when not nesting, and thus herons are expected to demonstrate high resilience to this effect. Residual effects from alteration of movement are not expected to affect the sustainability of regional great blue heron populations and are predicted to be not significant. Likelihood of this effect occurring is high, and confidence in the characterization is high, given the small area affected, the effectiveness of mitigation measures, and occurrence records of great blue heron in the LAA.

Cumulative Effects Assessment
Changes in habitat and movement for great blue heron from the Project are expected to act cumulatively with effects from past, present, and reasonably foreseeable future activities in the RAA. However, given the extent of available habitat in the RAA (Table 11-3 of the EIS Addendum), herons will have access to other suitable habitat in the region. As the majority of past, present, and reasonably foreseeable future projects occur in interior terrestrial landscapes or offshore marine waters, cumulative effects to heron movement is expected to be not significant.

Horned Grebe
Baseline Conditions
The horned grebe is a water bird; the subspecies *Podiceps auritus cornutus* breeds in North America (COSEWIC 2009b). Two breeding populations are known to occur in Canada. The western population breeds from BC to Ontario while the Magdalen Islands population breeds sporadically in Quebec as well as on the Magdalen Islands archipelago (COSEWIC 2009b). The western population is yellow-listed provincially and designated as Special Concern by COSEWIC (BC CDC 2014). The western population is not listed on Schedule 1 of SARA, and thus does not have a recovery strategy developed for it, nor has critical habitat been defined or protected.

In BC, the horned grebe occurs along the coast from fall through spring migration (Stedman 2000; COSEWIC 2009b). Suitable marine habitats includes sheltered waters in estuaries, bays, harbours, inlets and coves (Campbell et al. 1990b). Regional occurrence records for horned grebe in the Prince Rupert region, including the LAA, are limited to four observations of horned grebes (Appendix H of the EIS), indicating this species is highly uncommon in the area.

Effects Assessment
Table 1 identifies two ecological communities within the LAA with the potential to support horned grebes. Ocean and estuarine tidal flats provide potential foraging and overwintering habitat for horned grebes using nearshore waters around Lelu Island. Although there is potential for limited use of the LAA by horned grebes, none were observed during baseline studies conducted for the Project (see Appendix H of the EIS). Project activities during construction (e.g., marine construction, operational testing and commissioning, site clean-up), operations (e.g., marine terminal use, shipping and fish habitat offsetting) and reclamation (e.g., dismantling the facility and supporting infrastructure, dismantling the marine trestle) will affect overwintering habitat for this species. Due to changes in the marine terminal and trestle design, project effects to overwintering habitat have been greatly reduced from what was reported in the EIS to 5 ha of ocean habitat and 3 ha of estuarine tidal flat (Section 11 of the EIS Addendum). Mitigation measures will be

implemented to further reduce potential adverse effects to horned grebe. These mitigation measures include: limiting clearing and temporary work spaces to the PDA, locating the Project adjacent to existing infrastructure, maintaining a 30 m riparian buffer, following BC OGC standards for noise buffering (BC OGC 2009), implementing a Fish Habitat Offsetting strategy to replace lost foraging habitat and implementing a Blasting Management Plan to limit disturbance from construction noise.

Change in availability of overwintering habitat for horned grebe will be low in magnitude (8 ha of marine overwintering habitat removed). Direct habitat removal will occur once during the construction of the marine terminal and trestle and will persist until the marine infrastructure is dismantled and removed. Indirect effects of habitat avoidance caused by noise during the construction and operation phase may extend into suitable overwintering habitat within the LAA. Horned grebes are expected to have high resilience to changes in habitat availability caused by the Project, as a lack of grebes observed during baseline studies combined with few historical records suggest that the project area is does not support many individuals. The likelihood of a residual effect occurring is high as marine construction for the Project will change habitat for horned grebe. With mitigation measures applied, the residual effects from the change in habitat availability are not expected to affect the sustainability of regional populations of this species. Change in habitat availability from the Project is predicted to be not significant. The confidence in this predication is high, based on current understanding of horned grebe overwintering habitat requirements, occurrence in the LAA and the effectiveness of mitigation options.

Construction and operations phases of the Project have negligible potential to result in a change in mortality risk to horned grebe. Light-induced mortality could occur as a result of facility operations and is described in detail in the technical memo Potential Effects of Project Lighting on Songbirds, Marine Birds, and Bats, and is expected to have the greatest effect on taxonomic orders of Procellariiformes (fulmars, petrels, storm-petrels, and shearwaters) and Charadriiformes (auks, murres, and puffins) .

Construction activities (e.g., marine construction and vessel traffic), operations activities (e.g., operation of the marine terminal and shipping), and decommissioning (e.g., dismantling of the marine terminal) have the potential to change horned grebe movements from noise or physical disturbance in the vicinity of those activities. Mitigation measures to reduce noise effects, implementation of a Blasting Management Plan and having vessels adhere to posted speed limits vessel transportation routes will reduce potential effects to horned grebe movement patterns. The magnitude of this effect is expected to be low and limited to the LAA, as few individuals have been observed in the project area and mitigation measures will limit the effect to individuals. The potential for effects of change in movement will occur regularly throughout the life of the Project, as a result of ongoing operations of the marine terminal and continued vessel movements. However, effects of displacement are expected to be temporary, individuals in the LAA are expected to demonstrate high resilience to effects. Changes to movements are expected to be reversible and will return to baseline conditions following project decommissioning. Given the mitigation measures to be implemented, residual effects from the change in movement are not expected to affect the sustainability of regional horned grebe populations and are predicted to be not significant. Likelihood of this effect occurring is low, and confidence in the characterization is high, given the low numbers of horned grebes observed in the region and thus limited potential for this interaction to occur.

Cumulative Effects Assessment

Cumulative loss of ocean and estuarine tidal flat will result in change of overwintering habitat availability within the RAA. In addition, cumulative changes to movement patterns from other marine activities within the RAA are expected to interact with project effects. However given the limited use of the RAA by horned grebe, and the effectiveness of mitigation measures, cumulative effects from change in habitat and alteration of movement are not expected to affect the sustainability of regional populations of this species.

Marbled Murrelet

Baseline Conditions

The marbled murrelet is the most widely-distributed alcid in BC, inhabiting coastal waters within 2 km of land throughout the year and traveling up to 80 km inland during the breeding season (Campbell et al. 1990b). In BC the species is blue-listed (i.e., special concern) and is an Identified Wildlife species (BC CDC 2014; BC MWLAP 2004). Federally, the species is designated Threatened on Schedule 1 of the SARA (BC CDC 2014). The recovery strategy for marbled murrelet was finalized in 2014, and identifies critical habitat as well as recovery objectives and strategies (Environment Canada 2014b).

Marbled murrelets spend much of their life in the open ocean within 2 km of land, where they forage on fish and marine crustaceans (Blood 1998). During the breeding season, adult murrelets fly inland to old-growth coniferous forests, where they typically nest on large mossy platforms up in old coniferous forest stands (BC MWLAP 2004; Environment Canada 2014b). Under SARA, critical habitat for marbled murrelet is described as "a state where greater than 70% of the 2002 suitable nesting habitat coast-wide remains" (Environment Canada 2014b).

Effects Assessment

Table 1 identifies four ecological communities in the LAA with the potential to support marbled murrelets. Ocean and estuarine tidal flat habitat provide year-round foraging habitat for murrelets, while old coniferous forest and treed swamp or bog habitat provide potential nesting opportunities during the breeding season. Murrelets were observed using ocean habitats adjacent to Lelu Island during Project baseline studies which is consistent with regional occurrence records (Appendix H of the EIS). No murrelets were found nesting on Lelu Island or the adjacent mainland, but suitability modelling identified 306 ha of moderate or high suitability nesting habitat in the LAA.

Project activities (e.g., vegetation clearing for site preparation, onshore construction, site clean-up and reclamation) and decommissioning (e.g., dismantling of the LNG facility and supporting infrastructure) will affect both nesting and marine foraging habitat for the species. As described in the EIS, the Project will result in the direct loss of 85 ha and indirect alteration to 6 ha of moderate suitability nesting habitat (see the technical memo *Marbled Murrelet Effects Assessment* for more information). Due to changes in the marine terminal and trestle design, project effects to foraging habitat have been greatly reduced from what was reported within the EIS, to 5 ha ocean habitat and 3 ha estuarine tidal flat. In addition to the design mitigation, the technical memo *Marbled Murrelet Effects Assessment* describes additional ways in which effects to marbled murrelet habitat will be mitigated, including: maintaining a 30 m buffer around the periphery of Lelu Island to reduce disturbance to individuals using marine habitat around the island, locating the Project adjacent to existing infrastructure where feasible to reduce habitat fragmentation and edge effects, limiting clearing and temporary work spaces to within the PDA to reduce the final overall footprint, instituting measures to reduce noise effects and disturbance of individuals using habitat adjacent to the PDA, compensating for lost treed swamp or bog habitat through Wetland Habitat Compensation, and implementing a Fish Habitat Offsetting Strategy to replace lost foraging habitat. Change in availability of preferred nesting and foraging habitat for marbled murrelet will be moderate in magnitude. Direct habitat removal will occur once during clearing for the PDA and will persist unless the PDA is reclaimed following decommissioning of the Project. Indirect effects of habitat avoidance caused by noise during the construction phases may extend to adjacent habitats in the LAA. It is expected that marbled murrelet will demonstrate moderate resilience to changes in habitat availability caused by the Project, as none of the preferred habitat being affected is rated as high suitability (see the EIS and the technical memo *Marbled Murrelet Effects Assessment*), and because no nesting was observed in the LAA during baseline studies. The likelihood of a residual effect occurring is high as vegetation clearing and marine construction for the Project will change habitat for marbled murrelet. With mitigation measures applied, the residual effects from the change in habitat availability are not expected to affect the sustainability of the regional populations. Consequently, change in habitat availability from the Project is predicted to be not significant.

The confidence in this prediction is moderate based on the current understanding of marbled murrelet habitat requirements and occurrence in the LAA and the effectiveness of mitigation options.

Construction and operations of the Project may also result in a change in mortality risk to marbled murrelet. Vegetation clearing during site preparation could potentially result in the incidental destruction of active nest sites. Poor waste management practices in the PDA can also increase the abundance of murrelet nest predators. However, the Project will implement a restricted activity period to avoid clearing and construction of the PDA while birds are expected to be nesting (Environment Canada 2014a). Waste materials will be stored in wildlife-proof containers and disposed of at an approved facility. Light-induced mortality could occur as a result of LNG facility operations and is described in detail in the technical memo *Potential Effects of Project Lighting on Songbirds, Marine Birds, and Bats*, but lighting mitigation will reduce the change in mortality from lighting. Mortality to marbled murrelet is expected to be low in magnitude (i.e., limited to a small number of individuals) since clearing will be completed outside the period when birds are expected to be nesting in the LAA, and mitigation will reduce potential light-induced mortality. Light-induced mortality will be multiple irregular events during the life of the Project, and the effects on mortality are expected to be long-term but reversible upon decommissioning of the Project. Murrelets are expected to have moderate resilience to changes in mortality from the Project. Likelihood of this effect occurring is moderate. With mitigation measures applied, residual effects from the change in mortality risk are not expected to affect the sustainability of regional marbled murrelet populations and are predicted to be not significant. The confidence in this prediction is moderate based on the effectiveness of mitigation options.

Onshore and offshore construction and decommissioning activities could result in marbled murrelets avoiding portions of the LAA during these phases of the Project. Murrelets may also be temporarily displaced from portions of the LAA due to project related marine traffic during all phases. Mitigation to reduce noise effects, implementation of a Blasting Management Plan, and having vessels adhere to posted speed limits will reduce these potential effects to murrelet movement. Magnitude of this effect is expected to be moderate and generally restricted to a small number of individuals in the marine portion of the LAA. Murrelet populations will be moderately resilient to this effect. Effects of movement will be short-term as murrelets may be temporarily displaced from marine habitats due to ongoing regularly occurring vessel traffic. Changes to movements are expected to be reversible and return to baseline conditions following Project decommissioning. With mitigation measures applied, residual effects from the change in movement are not expected to affect the sustainability of regional marbled murrelet populations and are predicted to be not significant. Likelihood of this effect occurring is moderate, and confidence in the characterization of this effect is also moderate, because of the limited available information on marbled murrelet movement patterns in the LAA.

Cumulative Effects Assessment

The Project is likely to contribute to cumulative changes in habitat for marbled murrelet. Cumulative loss of old coniferous forest and mature treed swamp or bog habitats in the RAA (Table 11-3 of the EIS Addendum) will affect marbled murrelet nesting habitat availability. It is not expected that the Project's contribution to habitat change will affect long-term sustainability of regional marbled murrelet populations. Based on the estimated current and future loss of old coniferous forest in the RAA (Table 11-3 of the EIS Addendum), cumulative effects on habitat for marbled murrelet are determined to be not significant. The Project is also likely to contribute to cumulative changes to mortality risk and alteration of movement for the species. However after the application of appropriate mitigation, the Project's contribution to cumulative effects is expected to be not significant. Acting cumulatively with potential mortality or movement effects from past, present, or future activities is not expected to affect the sustainability of regional populations and is predicted to be not significant. There is a moderate degree of confidence with this prediction due to the uncertainty around the extent of current effects of mortality and movement from other activities.

Northern Goshawk, *laingi* subspecies

Baseline Conditions

The Northern Goshawk (*laingi* subspecies) is an accipiter that occurs in coastal sections of BC from the Alaskan border to the Fraser Valley, including Haida Gwaii and Vancouver Island (NGRT 2008). Northern goshawk is currently red-listed in BC because the population is sparsely distributed and restricted to mature-to-old coastal forest (BC CDC 2014). The *laingi* subspecies is also designated as Threatened on Schedule 1 of SARA (BC CDC 2014). The province has developed a recovery strategy for the *laingi* subspecies but a federal recovery strategy has not yet been developed and critical habitat is not identified (NGRT 2008).

The northern goshawk (*laingi* subspecies) selects breeding habitat based on forest stand structure rather than stand age or species composition. Nesting primarily occurs in mature to old-growth forest stands but they will breed in younger, even-aged stands if the canopy is relatively closed and multi-layered with large trees and snags (NGRT 2008). Larger, intact forest patches are preferable breeding habitat over smaller, isolated patches (COSEWIC 2013d). No goshawks were observed during project baseline studies, although several detections have been recorded across regional datasets (Appendix H of the EIS).

Effects Assessment

Table 1 identifies three ecological communities in the LAA with the potential to support breeding for goshawk: old coniferous forest, seral coniferous forest and seral deciduous forest. Suitability modelling conducted for the Project identified 276 ha of moderate suitability habitat in the LAA (Appendix H of the EIS). Construction and decommissioning of the Project will result in the direct loss of 54 ha and indirectly affect 31 ha of moderately suitable nesting habitat for northern goshawk. Measures presented to mitigate the effect of this change in habitat will include: locating the project adjacent to existing infrastructure where feasible to reduce habitat fragmentation and edge effects, limiting clearing of the temporary workspace to the PDA, establishment of a 30 m riparian buffer on Lelu Island, and following BC OGC standards for noise buffering. Mitigations to reduce changes to goshawk habitat are consistent with the recovery objective outlined in the recovery strategy for northern goshawk to manage and conserve habitat that meets the needs of the species (NGRT 2008). Change in availability of preferred habitat for northern goshawk will be moderate in magnitude. Direct habitat removal will occur once during vegetation clearing for the PDA and will persist for the lifetime of the Project but is reversible following decommissioning of the Project. Indirect effects of habitat avoidance caused by noise during the construction phase may extend to adjacent habitats in the LAA and have been described in Section 11.5.2 of the EIS. It is expected that northern goshawk will exhibit moderate resilience to changes in habitat caused by the Project, as none of the preferred habitat being affected is rated as high-suitability for the species (see the EIS), and no goshawks were observed in the LAA during baseline studies. The likelihood of a residual effect occurring is high as vegetation clearing will change habitat for goshawk. With mitigation measures applied, the Project is not expected to affect the long-term sustainability of the regional population, and effects from change in habitat availability are predicted to be not significant. The confidence in this prediction is moderate based on the current understanding of the species' presence and distribution in the LAA and the effectiveness of mitigation options.

Vegetation clearing during construction of the Project could potentially result in a change in mortality risk to northern goshawk through destruction of active nests containing unfledged juveniles. However, no goshawk nests were detected on Lelu Island during baseline surveys. Further, the Project will implement a restricted activity period to avoid clearing and construction of the PDA while birds are expected to be breeding (Environment Canada 2014a), which will reduce the mortality risk to goshawks. With the implementation of mitigation measures, the change in mortality will be low in magnitude. Potential mortality will occur once during vegetation clearing for construction and is restricted to the PDA. The effect of change in mortality is expected to last for a moderate-term, but is anticipated to be reversible given that the population would recover from the loss of one or a few juvenile birds from a single nest within a couple of generations. Goshawks are expected to have moderate resilience to any change in mortality that does occur. The likelihood of a residual effect from mortality is low because no goshawks were observed using Lelu Island

during baseline studies, and the restricted activity period will restrict vegetation clearing to outside the general breeding bird season. With mitigation measures applied, residual effects from the change in mortality associated with construction, operations and decommissioning are predicted to be not significant. The confidence in this prediction is high based on the absence of goshawk nests in on Lelu Island and the overall current understanding of the species' presence and distribution in the LAA considered in context with the effectiveness of mitigation options.

Northern goshawks are sensitive to disturbance and may alter their movement patterns due to noise, blasting, and other activities during construction, operations and decommissioning (Stuart-Smith et al. 2012). Mitigation to reduce effects on movement from disturbance will include noise buffering in compliance with BC OGC standards and implementation of a Blasting Management Plan. Goshawks are expected to be moderately resilient to changes in movement, and after the implementation of mitigation measures, this effect is predicted to be negligible or low in magnitude. Potential effects on alteration of movement will occur continuously throughout the life of the Project, but reversible upon decommissioning. The likelihood of a residual effect to goshawk movements is moderate because although no goshawks were observed within the LAA during baseline surveys, individuals can forage within territories spanning several thousand hectares and regional occurrence records indicate they occur in low numbers in the RAA (Mahon et al. 2008; Appendix H of the EIS). Residual effects are not expected to affect the sustainability of the regional northern goshawk populations and are predicted to be not significant. The confidence in this prediction is high based on the current understanding of the species' presence and distribution in the LAA.

Cumulative Effect Assessment
The Project is likely to contribute to cumulative changes in habitat for northern goshawk. Cumulative loss or alteration of old coniferous forest, seral coniferous forest and seral deciduous forest potentially used for nesting will 3% of the extent of these communities within the RAA (Table 11-3 of the EIS Addendum). Cumulative change in habitat is not expected to impact the long-term sustainability of regional northern goshawk populations and is determined to be not significant. The Project is also likely to contribute to cumulative changes to mortality risk and change in movement for the species. However cumulative changes in mortality and movement are not expected to impact the long-term sustainability of regional goshawk populations. The cumulative effects from change in mortality and change in movement are both determined to be not significant.

Olive-Sided Flycatcher
Baseline Conditions
Olive-sided flycatcher is a medium-sized songbird that is common throughout coastal forests of BC (COSEWIC 2007d). This species is currently blue-listed in BC and designated as Threatened on Schedule 1 of SARA (BC CDC 2014; COSEWIC 2007d). This species is often considered an indicator species of coniferous forest health and is experiencing population decline across its distribution, generally attributed to habitat loss and alteration in their winter ranges in Central and South America (COSEWIC 2007d). Although it is listed as Threatened on SARA, a recovery strategy has not yet been developed for the species, nor has designated critical habitat been established.

The olive-sided flycatcher is predominantly associated with forest stands with natural forest openings in the canopy due to deadfall, or has natural edges along wetlands, but may secondarily use open to semi-open forest stands (COSEWIC 2007d). Flycatchers also use man-made openings in the forest canopy and early successional forest, as long as tall perching stands remain (COSEWIC 2007d). The species uses these prominent snags to survey and then forage for flying insects before returning to the same perch throughout the year, making these habitat features critical. The reasons behind olive-sided flycatcher population decreases are perceived to be complex as they prefer foraging in edge habitats, which are increasingly abundant through ongoing forestry development, but their numbers continue to decline across their global range (COSEWIC 2007d).

Effects Assessment

Table 1 identifies two ecological communities within the LAA with the potential to support olive-sided flycatcher, including old coniferous forest and treed swamp or bog habitats. Olive-sided flycatchers were not observed during the project baseline studies and regional occurrences are limited. Suitability modelling identified 394 ha of moderate or high suitability breeding habitat in the LAA (Appendix H of the EIS). Project activities (e.g., vegetation clearing for site preparation, onshore construction, site clean-up and reclamation) and decommissioning (e.g., dismantling of the LNG facility and supporting infrastructure) will result in the direct removal of 104 ha and indirectly affect 29 ha of suitable habitat for olive-sided flycatcher. The Wetland Habitat Compensation Plan will be implemented to offset the net loss of wetland habitat removed during clearing. Priority for compensation opportunities will be given to creating or restoring wetlands that replace wetland functions (including foraging habitat for olive-sided flycatcher) removed by construction of the Project. Wetland compensation activities that replace treed swamp or bog communities will mitigate for the loss of olive-sided flycatcher habitat lost during construction of the PDA. Measures that will be implemented to mitigate change in the rest of the affected habitat include: locating the Project adjacent to existing infrastructure where feasible to reduce habitat fragmentation and edge effects, limiting clearing and temporary work spaces to within the PDA to reduce the final overall footprint, maintenance of a 30 m riparian buffer, and instituting measures to reduce noise effects and disturbance of individuals using habitat adjacent to the PDA. Change in availability of preferred habitat that supports olive-sided flycatcher will be moderate in magnitude. Change in habitat will occur once, during vegetation clearing activities as part of construction. Effects will extend into the LAA and persist for the duration of the Project, but is reversible following decommissioning and site reclamation. With mitigation measures applied, the residual effects from the change in habitat availability are not expected to affect the sustainability of regional populations of this species. Consequently, change in habitat availability from the Project is predicted to be not significant. Olive-sided flycatchers are predicted to be highly resilient to changes in movement in the LAA, given that habitats for the species are fairly common across the region (i.e., edge habitats), no individuals were observed during baseline studies, and regional occurrence records are limited. The likelihood of a residual effect occurring is high as vegetation clearing for construction of project components will change habitat for olive-sided flycatcher. The confidence in this prediction is moderate based on the current understanding of olive-sided flycatcher habitat requirements and occurrence in the LAA and the effectiveness of mitigation options.

Vegetation clearing during construction of the Project could potentially result in a change in mortality risk to olive-sided flycatcher through destruction of active nests containing eggs or young. The Project will implement a restricted activity period to avoid clearing and construction of the PDA while birds are expected to be breeding (Environment Canada 2014a), which will reduce the mortality risk to this species. With the implementation of mitigation measures, the change in mortality will be low in magnitude, and olive-sided flycatcher is expected to be moderately resilient to this effect. Potential mortality will occur once during vegetation clearing for construction and will be restricted to the PDA. The effect of change in mortality is expected to last for a moderate-term, but is expected to be reversible given that recruitment would replace potential loss of one or a few juvenile birds within a couple of generations. The likelihood of a residual effect from mortality is low given that no olive-sided flycatchers were observed on Lelu Island during baseline studies and regional occurrence records are low. The restricted activity period will further limit vegetation clearing to outside the general breeding bird season. Accordingly, residual effects from the change in mortality associated with construction, operations and decommissioning of the Project are predicted to be not significant. The confidence in this prediction is high based on the lack of detections of olive-sided flycatcher in the LAA and the overall current understanding of the species' presence and distribution in the region.

Noise, blasting, and other activities during construction, operations and decommissioning have the potential to alter the movements of olive-sided flycatchers. Mitigation to reduce effects on movement from disturbance will include noise buffering in compliance with BC OGC standards (BC OGC 2009) and implementation of a Blasting Management Plan. Olive-sided flycatchers are predicted to be highly resilient

to changes in movement in the LAA given their mobility and likelihood of occurrence in the LAA. Following mitigation, this effect is predicted to be low in magnitude. Potential effects on alteration of movement will occur continuously throughout the lifetime of the Project, but reversible upon decommissioning. The likelihood of a residual effect to olive-sided flycatcher movements is moderate because although no flycatchers were observed during baseline studies, the do have potential to occur in the LAA. Residual effects are not expected to affect the sustainability of the regional olive-sided flycatcher population and are predicted to be not significant. The confidence in this prediction is high based on the current understanding of the species' presence and distribution in the LAA.

Cumulative Effects Assessment
The Project will contribute to cumulative changes in habitat for olive-sided flycatcher. Cumulative loss or alteration of habitat from past, present, and future activities will result in a reduction of old-growth coniferous forest and treed swamp or bog habitat preferred by olive-sided flycatcher for nesting. Given the change in habitat, relative to its availability in the RAA (Table 11-3 of the EIS Addendum), this change is not expected to affect the long-term sustainability of regional populations. Accordingly, the cumulative effects on habitat for olive-sided flycatcher are determined to be not significant. The Project will also contribute to cumulative changes to mortality risk and movement for olive-sided flycatcher. However, through adherence to applicable regulations (e.g., the *Migratory Birds Convention Act*), cumulative changes in mortality risk and movement are not expected to affect the long-term sustainability of regional olive-sided flycatcher populations and are also expected to be not significant.

Western Grebe
Baseline Conditions
Western grebe is a gregarious waterbird endemic to North America that breeds in southwestern Canada through to northern Baja California (COSEWIC 2014). In the Canadian portion of its range, western grebe winters along the BC coast with largest numbers in the southern Strait of Georgia and Gulf Islands (COSEWIC 2014). Currently red-listed in BC, western grebe was ranked Special Concern in 2014 by COSEWIC (BC CDC 2014; COSEWIC 2014). Western grebe is not listed under the SARA and no federal recovery strategy has been developed, nor has any critical habitat been identified (BC CDC 2014). The conservation status of western grebe is associated with its dependency on a few nesting locations in the interior of the province, most of which are subject to human disturbances (Blood and Backhouse 1999).

Western grebe nesting colonies typically occur at sites with stable water levels that are protected from wind, and have sufficient depth to allow diving (COSEWIC 2014). Sites must have sufficient prey fish, be free of ice during the nesting period and have low levels of human disturbance (COSEWIC 2014). In wintering areas, western grebes tend to occur on salt or brackish bays, estuaries, inlets or open water within 2 or 3 km of shore (Campbell et al. 1990a).

Effects Assessment
Within the LAA, two ecological communities have the potential to support wintering western grebes, including ocean and estuarine tidal flats. Western grebes were observed during stationary point count surveys, fixed-width vessel transects in nearshore waters surrounding Lelu Island, and incidentally during other baseline surveys in the LAA (see Appendix H of the EIS).

Project activities during construction (e.g., marine construction, operational testing and commissioning, site clean-up), operations (e.g., marine terminal use and shipping) and reclamation (e.g., dismantling the facility and supporting infrastructure, dismantling the marine trestle) will affect overwintering habitat for this species. Changes in the marine terminal and trestle design greatly reduced project effects on overwintering habitat from what was reported in the EIS to 5 ha of ocean habitat and 3 ha of estuarine tidal flat (Section 11 of the EIS Addendum). Mitigation measures will further reduce potential adverse effects to western grebe. Mitigation measures include: limiting clearing and temporary work spaces to the PDA, locating the Project adjacent to existing infrastructure, following BC OGC standards for noise buffering (BC OGC 2009),

implementing a Blasting Management Plan to limit disturbance from construction noise, and implementing a Fish Habitat Offsetting strategy to replace lost foraging habitat. Change in availability of overwintering habitat for western grebe will be low in magnitude (8 ha of marine overwintering habitat removed). Direct habitat removal will occur once during the construction of the marine terminal and trestle and will persist until the marine infrastructure is dismantled and removed. Indirect effects of habitat avoidance caused by noise during the construction and operation phase may extend into suitable overwintering habitat within the LAA. Western grebes are expected to have high resilience to changes in habitat availability caused by the Project given the small size of the affected area relative to the availability of surrounding habitat. The likelihood of a residual effect occurring is high as marine construction for the Project will change habitat availability for western grebe. With mitigation measures applied, the residual effects from the change in habitat availability are not expected to affect the sustainability of regional populations of this species and are predicted to be not significant. The confidence in this predication is high, based on the small size of the area affected and the effectiveness of mitigation options.

Construction and operations phases of the Project have negligible potential to result in a change in mortality risk to western grebe. Potential for light-induced mortality as a result of facility operations and is expected to be negligible for western grebe and is described in detail in the technical memo *Potential Effects of Project Lighting on Songbirds, Marine Birds, and Bats*.

Marine construction, operations, and decommissioning activities have the potential to change western grebe movements from noise or physical disturbance in the vicinity of those activities. Mitigation measures to reduce noise effects, implementation of a Blasting Management Plan and having vessels adhere to posted speed limits along vessel transportation routes will reduce potential effects to western grebe movement patterns. The magnitude of this effect is expected to be low and limited to the LAA. The potential for effects on change in movement will be a multiple, regularly occurring event throughout the life of the Project, as a result of ongoing operations of the marine terminal and continued vessel movements. However, effects of displacement are expected to be short-term, as individuals in the LAA will be temporarily displaced as vessel transit through a given region. Accordingly, western grebe is expected to demonstrate high resilience to effects. Changes to movements are expected to be reversible and will return to baseline conditions following project decommissioning. Likelihood of this effect occurring is high given the occurrence of western grebe in the LAA and potential to interact with activities at the marine terminal and along the shipping route. However, given mitigation measures, residual effects from the change in movement are not expected to affect the sustainability of regional western grebe populations and are not predicted to be significant. Confidence in the characterization is high, given that effects will be short-term and localized.

Cumulative Effects Assessment

Cumulative loss of ocean and estuarine tidal flat will result in change of overwintering habitat availability, but is small relative to the availability of those communities within the RAA (Table 11-3 of the EIS Addendum). Cumulative changes to movement patterns from other marine activities within the RAA are also expected to interact with project effects. However given the effectiveness of mitigation measures, cumulative effects from change in habitat and alteration of movement are not expected to affect the sustainability of regional populations of this species and are predicted to be not significant.

Western Screech-owl, *kennicottii* subspecies

Baseline Conditions

Between 2000 and 2009, western screech-owl populations declined sharply along the south and central coast of BC (COSEWIC 2012). While no data has been collected to assess the population status on the north coast, these populations are presumed to have declined as well (COSEWIC 2012; BC MOE 2013). Currently blue-listed in BC, western screech-owl was added to Schedule 1 of SARA as a species of Special Concern in 2005. COSEWIC reassessed the status of western screech-owl in 2012 and changed the COSEWIC designation to Threatened, although their status remains unchanged on SARA (BC CDC 2014). Species declines are attributed to habitat loss, and competition and predation by barred owls (Kissling and Lewis

2009; COSEWIC 2012). As western screech-owl is ranked as Special Concern under SARA, no recovery strategy has been drafted and critical habitat has not been designated for this species.

The *kennicottii* subspecies of western screech-owl is most common in southwestern BC, with fewer occurrences on the north coast (BC MOE 2013). This owl occurs at low elevation in a variety of coastal forest types, though riparian communities and deciduous forest stands are preferred nesting habitat (Campbell et al. 1990b; Kissling and Lewis 2009; BC CDC 2014). Western screech-owl is a secondary cavity nester; owls select deciduous trees with diameter greater than 25 cm at breast-height for nesting (COSEWIC 2012). Vocalizations of western screech-owl, *kennicottii* were recorded on acoustic recording units deployed on Lelu Island during baseline studies; there is only one other occurrence record for western-screech owl in Prince Rupert region (Appendix H of the EIS).

Effects Assessment

Old coniferous forests and treed swamp or bog communities within the LAA and RAA have potential to support breeding habitat for western screech-owl. Clearing for the PDA will result in the direct loss of 44 ha of old coniferous forest and 43 ha of treed swamp or bog. The Wetland Habitat Compensation Plan will be implemented to offset the net loss of wetland habitat removed during clearing. Priority for compensation opportunities will be given to creating or restoring wetlands that replace wetland functions (including habitat functions for birds) removed by construction of the Project. Other measures that will be implemented to mitigate change in habitat include: locating the Project adjacent to existing infrastructure where feasible to reduce habitat fragmentation and edge effects, limiting clearing and temporary work spaces to within the PDA to reduce the final overall footprint, maintaining a 30 m riparian buffer around the PDA, and instituting measures to reduce noise effects and disturbance of individuals using habitat adjacent to the PDA. Change in availability of terrestrial ecological communities that potentially support western screech-owl will be moderate in magnitude. Direct habitat removal will occur once during vegetation clearing for the PDA and will persist unless the PDA is reclaimed following decommissioning of the Project. Indirect effects of habitat avoidance caused by noise during the construction phase may extend to adjacent habitats in the LAA. It is expected that western screech-owl, *kennicottii* populations will demonstrate moderate resilience to changes in habitat availability caused by the Project based on the availability of suitable habitats in the LAA relative to the RAA (Table 11-3 of the EIS Addendum). The likelihood of a residual effect occurring is high as vegetation clearing for construction of the PDA will change habitat for western screech-owl. With mitigation measures applied, the residual effects from the change in habitat availability are not expected to affect the sustainability of regional populations of this species. Consequently, change in habitat availability from the Project is predicted to be not significant.
The confidence in this prediction is moderate based on the current understanding of western screech-owl population dynamics on the north coast.

Construction and operation of the Project may also result in a change in mortality risk to western screech-owl. Vegetation clearing during site preparation and decommissioning could result in incidental destruction of nests. To prevent this, the Project will implement a restricted activity period to avoid clearing and construction of the PDA during the spring and summer when birds are breeding in the LAA (Environment Canada 2014a). Risk of western screech-owl mortality as a result of the Project is expected to be low in magnitude since clearing will be completed outside the period when birds are expected to be nesting in the LAA. Clearing will be a single event occurring during initial site preparation within the PDA. The effect of change in mortality is expected to last for a moderate-term, but is anticipated to be reversible given that the population would recover within a couple of generations. With mitigation measures applied, western screech-owl populations are expected to show moderate resilience to change in mortality. Based on the frequency of screech-owl detections, the likelihood of a residual change in mortality is low. Change in mortality rate is not expected to affect the sustainability of regional western screech-owl populations and is not predicted to be significant. The confidence in this prediction is moderate because screech-owls were detected in the LAA during baseline studies.

Noise produced during construction, operations and decommissioning has the potential to alter movement patterns of western screech-owl. Mitigation to reduce effects on movement from disturbance will include noise buffering in compliance with BC OGC standards (BC OGC 2009) and implementation of a Blasting Management Plan. Based on their varied habitat use, screech-owls are expected to be moderately resilient to changes in movement. After the implementation of mitigation measures, this effect is predicted to be low in magnitude. Potential effects on alteration of movement will occur continuously throughout the life of the Project due to noise produced by the LNG facility during operations, but is reversible upon decommissioning. The likelihood of a residual effect to screech-owl movements is moderate because screech-owls were observed within the LAA during baseline surveys (Appendix H of the EIS). Residual effects are not expected to affect the sustainability of the regional screech-owl populations and are predicted to be not significant. The confidence in this prediction is moderate based on the current understanding of the species' presence and distribution in the LAA.

Cumulative Effects

The Project is likely to contribute to cumulative changes in habitat for western screech-owl. Cumulative loss or alteration of old coniferous forest in the RAA will be 1% of the extent of this community, and for treed swamp or bog habitat it will be 3% (Table 11-3 of the EIS Addendum). Cumulative change in habitat is not expected to impact the long-term sustainability of regional western screech-owl populations and is determined to be not significant. The Project is also likely to contribute to cumulative changes to mortality risk and change in movement for the species. However cumulative changes in mortality and movement are not expected to impact the long-term sustainability of regional screech-owl populations. The cumulative effects from change in mortality and change in movement are both determined to be not significant.

Table 7 Summary of Residual Effects Characterizations for Terrestrial Wildlife and Marine Birds

Species	Effect	Residual Effects Characterization								
		Context	Magnitude	Extent	Duration	Reversibility	Frequency	Likelihood	Significance	Confidence
Little Brown Myotis	Change in Wildlife Habitat Availability	M	M	LAA	LT	R	S	H	N	M
	Change in Mortality Risk	M	L	PDA	LT	R	MI	M	N	M
	Alteration of Movement Patterns	-	-	-	-	-	-	-	-	-
Keen's Myotis	Change in Wildlife Habitat Availability	L	M	LAA	LT	R	S	H	N	M
	Change in Mortality Risk	L	L	PDA	LT	R	MI	M	N	M
	Alteration of Movement Patterns	-	-	-	-	-	-	-	-	-
Ancient Murrelet	Change in Wildlife Habitat Availability	H	L	LAA	LT	R	S	H	N	H
	Change in Mortality Risk	H	L	LAA	LT	R	MI	M	N	M
	Alteration of Movement Patterns	M	M	LAA	ST	R	MR	M	N	M
Band-tailed Pigeon	Change in Wildlife Habitat Availability	M	M	LAA	LT	R	S	H	N	M
	Change in Mortality Risk	M	L	LAA	LT	R	S	L	N	H
	Alteration of Movement Patterns	-	-	-	-	-	-	-	-	-
Common Nighthawk	Change in Wildlife Habitat Availability	M	L	PDA	LT	R	S	M	N	H
	Change in Mortality Risk	-	-	-	-	-	-	-	-	-
	Alteration of Movement Patterns	-	-	-	-	-	-	-	-	-
Great Blue Heron *fannini* subspecies	Change in Wildlife Habitat Availability	H	M	LAA	LT	R	S	H	N	H
	Change in Mortality Risk	-	-	-	-	-	-	-	-	-
	Alteration of Movement Patterns	H	L	LAA	LT	R	MI	H	N	H

Species	Effect	Residual Effects Characterization								
		Context	Magnitude	Extent	Duration	Reversibility	Frequency	Likelihood	Significance	Confidence
Horned Grebe	Change in Wildlife Habitat Availability	H	L	LAA	LT	R	S	H	N	H
	Change in Mortality Risk	-	-	-	-	-	-	-	-	-
Marbled Murrelet	Alteration of Movement Patterns	H	L	LAA	LT	R	MR	L	N	H
	Change in Wildlife Habitat Availability	M	M	LAA	LT	R	S	H	N	M
	Change in Mortality Risk	M	L	LAA	LT	R	MI	M	N	M
	Alteration of Movement Patterns	M	M	LAA	ST	R	MR	M	N	M
Northern Goshawk *laingi* subspecies	Change in Wildlife Habitat Availability	M	M	LAA	LT	R	S	H	N	M
	Change in Mortality Risk	M	L	PDA	MT	R	S	L	N	H
	Alteration of Movement Patterns	M	L	LAA	LT	R	C	M	N	H
Olive-sided Flycatcher	Change in Wildlife Habitat Availability	H	M	LAA	LT	R	S	H	N	M
	Change in Mortality Risk	M	L	PDA	MT	R	S	L	N	H
	Alteration of Movement Patterns	H	L	LAA	LT	R	C	M	N	H
Western Grebe	Change in Wildlife Habitat Availability	H	L	LAA	LT	R	S	H	N	H
	Change in Mortality Risk	-	-	-	-	-	-	-	-	-
	Alteration of Movement Patterns	H	L	LAA	LT	R	C	L	N	H
Western Screech-owl *kennicotti* subspecies	Change in Wildlife Habitat Availability	M	M	LAA	LT	R	S	H	N	M
	Change in Mortality Risk	M	L	PDA	MT	R	S	M	N	M
	Alteration of Movement Patterns	M	L	LAA	LT	R	C	M	N	M

Marine Resources Species-at-Risk

There are potential residual effects as a result of project activities on marine fish and marine mammals, including species-at-risk. The potential residual effects include change in sediment or water quality, change in habitat, direct mortality/physical injury to marine fish or marine mammals and change in behaviour of marine fish or marine mammals. Table 8 provides a summary of the potential interactions with project activities on a species-by-species basis, and is determined from the ranking of potential effects in Table 13-7 in the EIS. The potential for effects from project activities on a species is identified based on baseline information providing information on species distribution, abundance and habitat use (see Appendix M and Appendix L of the EIS).

For potential effects to marine resources, project activities could result in changes in sediment or water quality through changes in contaminant concentrations or TSS concentrations. Change in fish habitat can result from project activities that permanently alter or destroy area. Change in behaviour was measured through timing (seasonal), duration (hr.), sound level (dB) and extent (km from sound source) of underwater noise potentially affecting marine mammals, and timing (seasonal) and duration (hr) of underwater noise potentially affecting fish. Direct mortality or physical injury to fish or marine mammals was assessed using the qualitative likelihood of injuring or killing marine mammals or fish from blasting, crushing or burial, increased TSS and underwater noise. Marine mammal vessel strikes were assessed in Accidents and Malfunctions, Section 22.8.1.3. Marine mammal vessel strikes are not considered as a potential residual effect from routine project activities as it would be an unexpected occurrence or unintended action. Accordingly, this effect is not included in the assessment provided below.

Table 8 Screening of Potential Project Effects for Marine Resources Species-at-Risk Potentially Occurring the Local and Regional Assessment Area. ✓ = Potential interaction; NI = No interaction predicted.

Species Name	Scientific Name	BC Status	SARA Status	Schedule	Habitat Present in the LAA or RAA?	Habitat Requirements in the LAA and RAA	Potential Project Effects			
							Change in Fish Habitat	Direct Mortality or Physical Injury	Change in Behaviour	Change in Sediment or Water Quality
Fish										
Bluntnose sixgill shark	*Hexanchus griseus*	No status	Special Concern	1	LAA RAA	Predicted distribution based on preferred depth range (20 – 2,000 m) suggests habitat is available in LAA/RAA (COSEWIC 2007a). Widely distributed deep water species found in outer continental and insular shelf waters, typically below 91 m depth (COSEWIC 2007a). Preferred depth range is assumed to be 20 – 2,000 m (COSEWIC 2007a). Newborn pups and juveniles may stray into shallow nearshore waters, and are occasionally found in bays and harbours (COSEWIC 2007a). Historical records indicate presence in the Prince Rupert area; however, commercial hook and line and trawl fisheries reported no incidental catch for PMFC area 5D between 1996 and 2005 (COSEWIC 2007a).	NI	✓	✓	✓
Bocaccio	*Sebastes paucispinis*	No status	Endangered (COSEWIC)	–	LAA RAA	Juvenile and adult habitat available in LAA/RAA, juvenile habitat available in PDA, and limited adult habitat available at Brown Passage. Adults typically associated with rocky substrates at depths of 12 to 478 m (Love et al. 2002). Juveniles recruit to shallow nearshore habitats, including rocks covered with various types of algae, kelp beds and eelgrass meadows (Love et al. 2002).	✓	✓	✓	✓
Canary rockfish	*Sebastes pinniger*	No status	Threatened (COSEWIC)	–	LAA RAA	Juvenile and adult habitat available in LAA/RAA, juvenile habitat available in PDA, and limited adult habitat available at Brown Passage. Adults typically aggregate around pinnacles and other high-relief rock at depths of 80 – 200 m, but may also be found over mixed mud-boulder habitat (Love et al. 2002). Juveniles recruit to shallow nearshore habitats, often at the interface of sand and rock outcrops (Love et al. 2002).	✓	✓	✓	✓
Darkblotched rockfish	*Sebastes crameri*	No status	Special Concern (COSEWIC)	–	LAA RAA	Limited juvenile and adult habitat available in LAA/RAA, no juvenile or adult habitat available in PDA, and limited adult habitat available at Brown Passage. Adults typically found on mud bottoms adjacent to cobble or boulders at depths of 25 – 904 m, with most fish found at depths of 140 – 210 m (Love et al. 2002). Juveniles settle on benthic habitats at depths of 55 – 200 m (Love et al. 2002).	NI	✓	✓	✓
Eulachon (Nass/Skeena Rivers Population)	*Thaleichthys pacificus*	Blue	Special Concern (COSEWIC)	–	LAA RAA	Larval/juvenile and adult habitat available in LAA/RAA, larval/juvenile habitat available in PDA, and adult habitat not available in PDA, except for migratory fish bound for spawning habitat in the Skeena River. Adult habitat available at Brown Passage. Adults lay eggs in coarse sand or gravel in the lower Skeena River, where the eggs hatch after two to three weeks (Stoffels 2001). Larvae are carried downstream to estuaries where they may rear for several months, using increasingly deeper and offshore waters as they grow. McCarter and Hay (1999) maps of eulachon density indicate eulachon larvae are present in three areas within the northern portion of the LAA between the Lucy Islands and Melville Island. More recent field studies by Kelson (2011) and Rolston (2010) indicate that eulachon larvae are found within lower Skeena estuary or further offshore, with specific areas of high density identified by Rolston (2010) outside the LAA, south of Smith Island. The LAA falls within a DFO "Important Area" for eulachon (DFO 2005). Adult eulachon are found on shelf waters in close association with the bottom, typically between 50 m and 200 m depth (COSEWIC 2013b).	✓	✓	✓	✓
Green sturgeon	*Acipenser medirostris*	Red	Special Concern	1	LAA RAA	Adult habitat available in LAA/RAA and adult habitat available in PDA and at Brown Passage. Adult green sturgeon are found in marine and estuarine environments from shallow nearshore waters to depths up to 610 m (COSEWIC 2005). Green sturgeon are highly migratory, and it is thought that all green sturgeon in Canadian marine waters originate from spawning rivers in the United States (COSEWIC 2005). There are no known reports of green sturgeon being captured (or observed) in the Prince Rupert area.	NI	✓	✓	✓

Species Name	Scientific Name	BC Status	SARA Status	Schedule	Habitat Present in the LAA or RAA?	Habitat Requirements in the LAA and RAA	Potential Project Effects			
							Change in Fish Habitat	Direct Mortality or Physical Injury	Change in Behaviour	Change in Sediment or Water Quality
North Pacific spiny dogfish	*Squalus suckleyi*	No status	Special Concern (COSEWIC)	–	LAA RAA	Habitat available in LAA/RAA and habitat available in PDA and at Brown Passage. Widely distributed in Canadian waters, occurring from intertidal habitats to deep offshore habitats at depths ranging from the intertidal to 730 m (COSEWIC 2011a). Adults are epibenthic, typically found in large schools just above the seabed (COSEWIC 2011a). Occur in various habitat types and do not show a strong association with any particular substrate type (COSEWIC 2011a).	NI	✓	✓	✓
Northern abalone	*Haliotis kamtschatkana*	Red	Endangered	1	LAA RAA	Habitat available in LAA/RAA and no habitat available in PDA or at Brown Passage. Attributes of critical habitat for northern abalone include the following (DFO 2012a): • Depth: ≤ 10 m (datum) • Primary substrate: bedrock or boulders with adequate rugosity for attachment • Salinity: > 30 ppt • Exposure: moderate to high water exchange (tidal exchange or wave action present) • Biological: presence of encrusting coralline algae (e.g., Lithothaminum spp.) and kelps (e.g., Nereocystis, Macrocystis, Pterygophora, Laminaria spp.)	NI	NI	NI	✓
Quillback rockfish	*Sebastes maliger*	No status	Threatened (COSEWIC)	–	LAA RAA	Juvenile and adult habitat available in LAA/RAA, juvenile and adult habitat available in PDA, and limited adult habitat available at Brown Passage. Adults typically found in high-relief rocky habitats from the shallow subtidal to depths up to 274 m (Love et al. 2002). Juveniles recruit to shallow nearshore habitats, particularly kelp beds and areas of cobble or boulder with abundant algae (Love et al. 2002). Juveniles also found in eelgrass meadows (Love et al. 2002).	✓	✓	✓	✓
Rougheye rockfish	*Sebastes aleutianus*	No status	Special Concern	1	LAA RAA	Limited juvenile and adult habitat available in LAA/RAA, no juvenile or adult habitat available in PDA, and limited juvenile and adult habitat available at Brown Passage. Adults typically found on steeply sloping boulder fields at depths of 25 – 732 m, with most fish occurring at depths of 150 – 450 m (Love et al. 2002). Limited information is available on juvenile habitat, although it is assumed that habitat requirements are similar to other Sebastes species (Love et al. 2002).	NI	✓	✓	✓
Yelloweye rockfish (Pacific Ocean outside waters population)	*Sebastes ruberrimus*	No status	Special Concern	1	LAA RAA	Juvenile and adult habitat available in LAA/RAA, no juvenile or adult habitat available in PDA, and limited juvenile and adult habitat available at Brown Passage. Adults typically found in high-relief rocky habitats, including steep fjord walls, rocky overhangs, caves, crevices and boulder piles at depths of 15 – 549 m, with most fish occurring at depths of 91 – 180 m (Love et al. 2002). Juveniles settle in high-relief rocky habitats at depths greater than 15 m (Love et al. 2002).	NI	✓	✓	✓
Mammals										
Fin whale	*Balaenoptera physlaus*	Red	Threatened	1	LAA RAA	Fin whales occur in BC waters year round (Heise et al. 2007). Thought to move towards coastal areas of BC in the summer to capitalise on the consistent, dense aggregations of euphausiids (Mizroch et al. 2009; Flinn et al. 2002), including the northern portion of Hecate Strait. LAA is not predicted to include critical habitat (Gregr and Trites 2001). Historic data suggests fin whales frequented the southern edge of the Queen Charlotte shelf and the Vancouver Island shelf, with additional records in Dixon Entrance and Hecate Strait (Gregr and Trites 2001). These areas continue to be frequented by fin whales (Williams and Thomas 2007; Gregr et al. 2006; COSEWIC 2005). More recent sighting have been recorded near the LAA in northern Hecate Strait, west of Dundas and Melville Islands (Williams and Thomas 2007; COSEWIC 2005). Ship conducted by DFO's Cetacean Research Program (from 2002-2008) commonly recorded sightings of fin whales along the west coast of Haida Gwaii and between Cape St. James and Cape Scott; no observations occurred within the LAA (Ford et al. 2010).	NI	✓	✓	NI

Species Name	Scientific Name	BC Status	SARA Status	Schedule	Habitat Present in the LAA or RAA?	Habitat Requirements in the LAA and RAA	Potential Project Effects			
							Change in Fish Habitat	Direct Mortality or Physical Injury	Change in Behaviour	Change in Sediment or Water Quality
Humpback whale	*Megaptera novaeangliae*	Blue	Threatened	1	LAA RAA	Tend to feed in higher latitudes from the spring through to the fall (Calambokidis et al. 2001). Sighted year round in BC waters, in a variety of habitats, including fjords and offshore areas (Ford et al. 2010; Williams and Thomas 2007). Sightings within the LAA (BC Cetacean Sightings Network 2013) with higher concentrations to the west in Dixon Entrance and Hecate Strait (Best and Halpin 2011; Ford et al. 2010). Predictions of important areas for humpback whales along the BC coast, suggest that the LAA and environs likely support higher whale densities in spring than in summer; however, the most important areas for humpbacks are southern Dixon Entrance, northwestern Haida Gwaii, middle and southwestern Hecate Strait, and off the entrance of Juan de Fuca Strait (Dalla Rosa et al. 2012). The LAA falls into one of the 'Important Areas' for humpbacks identified by DFO (Clarke and Jamieson 2006). Four critical habitat areas have been identified in BC, none of which overlap with the LAA (Nichol et al. 2010).	NI	✓	✓	NI
Gray whale	*Eschrichtius robustus*	Blue	Special Concern	1	LAA RAA	They migrate through BC waters from approximately mid-March to mid-April, with most individuals passing through the deep eastern waters of Hecate Strait (Ford et al. 2012). Very few gray whales have been reported within the LAA (BC Cetacean Sightings Network 2013).	NI	✓	✓	NI
Northern resident killer whale	*Orcinus orca*	Red	Threatened	1	LAA RAA	Found year round in BC waters. Chatham Sound and adjoining waters are important areas for this species. The whales frequent this area from May to mid-July to feed on chinook salmon migrating to the Skeena and Nass river systems (Ford 2006; Ford and Ellis 2006). "Important areas", defined by DFO, for this species include the LAA (Clarke and Jamieson 2006). This area is 'moderate' in importance and selected based on use for socialization and migration aggregations. Northern resident killer whales have been observed in the inland waters surrounding the LAA and in Hecate Strait by Ford et al. (2010). The BC Cetacean Sightings Network (2013) report multiple sighting of killer whales (not distinguished by ecotype) within the LAA.	NI	✓	✓	NI
Bigg's killer whale (previously 'transient' killer whale)	*Orcinus orca*	Red	Threatened	1	LAA RAA	Sighted in BC waters year round. They tend to move through areas quickly but may have preferential areas or 'home ranges' where they prefer to hunt (Ford and Ellis 1999). They have been sighted in waters around the LAA on recent DFO surveys (Ford et al. 2010). Killer whale sightings have been reported in the LAA by BC Cetacean Sightings Network (2013), but not separated by ecotype.	NI	✓	✓	NI
Harbour porpoise	*Phocoena phocoena*	Blue	Special Concern	1	LAA RAA	They are found in the Northern Hemisphere in cold temperate and sub-polar waters and are seen year round in BC waters. This species does not appear to migrate, but they are not very well studied along the northern coast (COSEWIC 2003b). Harbour porpoise are often found in shallow waters (< 200 m deep) and within 20 km of shore, although sightings have been recorded in deeper, offshore waters (Ford et al. 2010; Heise et al. 2007). Seasonal changes in abundance have been noted with possible movement to deeper offshore waters in winter, but this is poorly understood (Carretta et al. 2009). They have been frequently sighted within the LAA with numerous sightings in the waters east and south east of Digby Island (BC Cetacean Sightings Network 2013; Best and Halpin 2011; Ford et al. 2010). Harbour porpoise were observed, throughout Porpoise Channel and Porpoise Harbour, during all Project related field surveys. They were typically alone or in groups of 2 to 3.	NI	✓	✓	NI
Sea otter	*Enhydra lutris*	Blue	Special Concern	1	LAA RAA	Suitable sea otter habitat likely occurs within the LAA (Gregr et al. 2008); however, this area is currently beyond their northern range.	NI	✓	✓	NI
Loughlin's northern sea lion (previously Steller sea lion)	*Eumetopias jubatus monteriensis*	Blue	Special Concern	1	LAA RAA	Are sighted in BC waters year round. They have four breeding sites (rookeries) along the BC coast and several haulouts that are occupied in winter or year round (DFO 2010a). There are no rookeries in the LAA; the closest known year round haulout site is on Warrior Rocks (outside the LAA to the southwest of Stephens Island) and the closest known major winter haulout is west of Baron and Dunira islands, just north of the LAA (DFO 2010a).	NI	✓	✓	NI

Individual marine fish and marine mammal species for which an interaction with the Project is expected have been discussed in more detail below. A summary of all residual effects characterizations for marine fish is located in Table 9, and for marine mammals in Table 10.

Bluntnose Sixgill Shark

Baseline conditions

Bluntnose sixgill shark is the one of the largest predatory sharks encountered in Canadian Pacific waters with a reported maximum length of 4.8 m and an estimated longevity of up to 80 years (COSEWIC 2007a). This benthic shark species is one of the most wide ranging shark species in the world and is distributed in both temperate and tropic waters along insular and continental shelves. The bluntnose sixgill shark currently has no BC status listing and is designated as Special Concern by both the COSEWIC and on Schedule 1 of the SARA (BC CDC 2014). Its designation of Special Concern is based on the absence of information regarding population sizes and trends, and its principal known threat of historical fishing in Canadian waters (most recently ending in the late 1980s and early 1990s) (COSEWIC 2007a). Because of these unknown trends and previous fishing pressure, a decline in the population is suspected (COSEWIC 2007a).

Available habitat for this widely distributed deep water species is expected to occur in the LAA/RAA based on their preferred depth of 20 - 2,000 m, though they are typically found below 91 m (COSEWIC 2007a). Although this species usually inhabits deep water characteristic of outer continental and insular shelves, newborn pups and juveniles are thought to occasionally inhabit shallower coastal waters in bays and inlets until reaching adolescence based on anecdotal diving records and video footage taken in the Strait of Georgia (COSEWIC 2007a). Although historical records have indicated presence of bluntnose sixgill shark in the Prince Rupert area, there are no records of incidental catch by commercial fisheries in Pacific Marine Fisheries Commission area 5D, which includes the LAA/RAA, between 1996 to 2005 (COSEWIC 2007a). Seasonal abundance of juvenile bluntnose sixgill sharks on the BC coast within the Strait of Georgia has been documented through a single observational study to be highest between May and October with a peak between mid-June to mid-July (Dunbrack and Zielinski 2003).

There is currently no recovery strategy or action plan in the draft or finalized stage for the bluntnose sixgill shark.

Effects Assessment

Potential effects of the Project on bluntnose sixgill shark include:

- Direct mortality or physical injury
- Change in behaviour
- Change in sediment or water quality

The potential effect of Change in Fish Habitat was not included because project activities are not predicted to interact with the deep water habitats typically used by bluntnose sixgill shark. Based on the new project design, construction and operations expected to affect a change in fish habitat will all occur at depths of -25 chart datum (CD) or shallower (Section 13 of the EIS addendum). Given that the preferred habitat of this species is waters deeper than 91 meters and there are no recent coastal records of the species in the Prince Rupert area, project activities are expected to have no effect on bluntnose sixgill shark habitat availability.

Construction and operations of the Project have the potential to result in direct mortality or physical injury to bluntnose sixgill shark throughout the extent of the LAA. This effect, if it occurs, will be long-term and continuous throughout the life of the Project. The magnitude of direct mortality or physical injury to bluntnose sixgill shark is considered low as the measureable change from this effect will be within the range of natural variability and therefore not pose a risk to population viability. Blasting, pile installation, and

increased TSS from vessel manoeuvring at the berth during construction and operations could result in incidental mortality or injury to bluntnose sixgill sharks if they are present in the area at the time of construction or operations. Through mitigation measures implemented by the Project such as a Marine Pile Installation Management Plan, Department of Fisheries and Oceans (DFO) Blasting Guidelines and a Blasting Management Plan, and conducting in water construction activities within DFO least-risk timeline windows where applicable, the potential for mortality or physical injury to bluntnose sixgill shark will be reduced to the extent possible (Section 13 of the EIS addendum). The likelihood of direct mortality or physical injury to bluntnose sixgill shark is expected to be low for project activities after implementation of mitigation measures. Although individual bluntnose sixgill shark could be affected, residual effects of project related direct mortality or injury are expected to be reversible as the sustainability of the population will not be affected. Therefore, the effects of direct mortality or physical injury on bluntnose sixgill shark as a result of the Project are considered not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Construction and operations of the Project have the potential to effect a change in behaviour of marine fish occurring within the extent of the LAA and are likely to result in a residual effect for marine fish in general. However, as bluntnose sixgill sharks are not expected to frequently occur in the LAA, the potential for residual effects on this species are minimal. If present in the LAA, the magnitude of change in behaviour of bluntnose sixgill shark is moderate as the effect will have a measureable change above natural behaviour of the species but will not pose a risk to population viability. Mitigation measures that will be implemented to reduce the risk of change in behaviour of marine fish include limiting the speed of LNG carriers, tugs, and barges to 16 knots within the LAA and 6 knots on approach to the boarding station, use of low noise piling techniques paired with bubble curtains, and adhering to DFO's least-risk timing windows (Section 13 of the EIS). Because bluntnose sixgill sharks are highly mobile, it is expected that if they are present in the area, change in behaviours will be limited to a short-term residual effect from project activities. This residual effect has the potential to occur continuously throughout the project life, but any effects to bluntnose sixgill shark are expected to be reversible to baseline conditions and are not expected to affect population viability. The likelihood of a residual effect in the change in behaviour of bluntnose sixgill shark as a result of project activities is high; however it is expected to be limited to temporary startle responses and therefore is determined as not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Change in sediment or water quality due to dredging during the construction phase is expected to occur and result in a residual effect on marine fish occurring within the extent of the LAA and continuously (construction, operations, decommissioning) throughout the life of the Project. As previously noted, bluntnose sixgill shark are not expected to frequently occur in the LAA; therefore, the likelihood that localized change in sediment or water quality will result in residual effects on this species is medium. The magnitude of the change in sediment or water quality from project activities is moderate because the effect will have a measureable change above background levels, (Section 13 and Appendix G of the EIS) but it is not expected to pose a risk to population viability of bluntnose sixgill sharks. Additionally, this effect is expected to be long-term since it will persist through all project phases. Total suspended solids (TSS) and inferred turbidity monitoring during in-water construction will occur and adjustment of the rate of dredging activity (e.g., slowing) or addition of further mitigation measures (e.g., silt curtains) will be implemented if needed to minimize the spatial extent of elevated TSS. Additional mitigation measures to be implemented include a 30 m vegetation buffer retained around the perimeter of Lelu Island (except at access points) to minimize the potential introduction of sediment to the marine environment, dredging operations conducted at low tide (where possible) and using methods that reduce sediment spill, consideration of the re-use of sediment and rock for construction of fish habitat offset, disposal of any unused sediment within the previously used disposal area at or near the center point of the disposal at sea site, and the use of tugs with less sediment scour-inducing propulsion systems. The effect of change in sediment and water quality as it

relates to bluntnose sixgill shark is expected to be reversible to baseline conditions, especially when considering that the LAA experiences extended periods of elevated TSS during the Skeena River spring freshet annually (Section 13 and Appendix G of the EIS). With the implementation of these mitigation measures, residual effects on the bluntnose sixgill shark from change in sediment or water quality are expected to be not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Based on the unknown trends in populations, historical fishing pressure, and the longevity of bluntnose sixgill shark, they exhibit a context rating of moderate resilience to the residual effects described above.

Cumulative Effects Assessment

Residual, and therefore, cumulative effects from project activities are not expected to affect the population viability of the bluntnose sixgill shark. Although little is known on the population trends of this species, low numbers are expected to occur within the LAA/RAA. Cumulative effects on sediment and water quality are not expected because of the effects of dredging and disposal activities of all projects occurring in the RAA are not predicted to overlap in time or space based on current project construction schedules. Residual effects of change in fish habitat are expected to be negligible given that habitat offsetting features will be designed to ensure that the productivity of CRA fisheries is maintained or improved. Therefore the Project is not expected to contribute to cumulative effects of change in fish habitat in the RAA. The Project is unlikely to contribute to a cumulative effect of direct mortality or physical injury that affects the population viability for bluntnose sixgill sharks. With mitigation measures in place, it is not expected that the Project's contribution to change in fish habitat, direct mortality or physical injury, change in behaviour or change in sediment or water quality will affect long-term viability of the bluntnose sixgill shark population. Accordingly, the Projects contribution to cumulative effects on bluntnose sixgill shark is determined to be not significant.

Bocaccio

Baseline conditions

Bocaccio is a species of rockfish found in marine waters off coastal BC. They are a medium sized rockfish that reach up to 90 cm in length, reach maturity in about 7 years, and reach longevity of at least 57 years (COSEWIC 2013a). This semi-pelagic fish species is wide ranging and is found in coastal waters in preferred depths between 60 - 340 m. There are currently only two clusters of bocaccio recognized, one centered on the west coast of BC and the other centered on the central/southern California coast. Bocaccio currently has no BC status listing and is designated as *Endangered* by the COSEWIC (BC CDC 2014). In 2011 the Government in Council decided not to add bocaccio to the list of wildlife species at risk (Schedule 1) under the *Species at Rick Act* (SARA) (Department of Justice Canada 2011). Its designation of *Endangered* is based on its continuous decline as described through available population information and stock assessments. The longevity and life history of bocaccio makes it extremely susceptible to overfishing. Over the past 60 years, the population biomass of bocaccio has declined by more than 90%. Furthermore, since first being assessed as *Threatened* by COSEWIC in 2002, the population has undergone a 28% decline (COSEWIC 2013a).

Available habitat for this widely distributed semi-pelagic species is expected to occur in the LAA based on their preference of high relief rocky substrate habitats, attenuation to sponges and corals, and a typical depth range of 60 - 340 m (COSEWIC 2013a, Love et al. 2002). Although this species usually inhabits waters near the edge of the continental shelf, and along the edge of troughs and underwater canyons, juveniles are known to recruit to shallower nearshore habitats (COSEWIC 2013a, Love et al. 2002).

Fisheries bycatch of bocaccio in the groundfish trawl fishery along the BC coast has been documented to occur in the Prince Rupert Area in Pacific Marine Fisheries Commission area 5D from 1998 to 2001, and through survey and commercial observation from 1996 to 2011 (COSEWIC 2013a). No bocaccio were

identified during Remotely Operated Vehicle (ROV) studies at both the marine terminal jetty and trestle alignment, or at the Brown Passage disposal at sea site (Appendix M of the EIS).

There is currently no recovery strategy or action plan in the draft or finalized stage for this species. There is no direct fishery for bocaccio; but since it is caught incidentally in fisheries targeting other groundfish, it is managed under the Department of Fisheries and Oceans (DFO) Integrated Fishery Management Plan (IFMP) for groundfish (DFO 2014). A conservation strategy is in development to protect cold water corals and sponges in BC waters which would overlap significantly with bocaccio habitat once implemented (DFO 2010b). In addition, the groundfish bottom trawl fishery has new mitigation measures in effect as of April 2012 which includes bycatch limits, avoidance protocols, and the closure of a wide area of BC coastal waters to bottom trawl, which includes the project LAA (COSEWIC 2013a). Additionally, Rockfish Conservation Areas (RCAs) have been established in nearshore areas throughout the BC coast since 2002 (COSEWIC 2013a). Considering the widespread distribution of bocaccio over the continental shelf, it is unlikely that this species will benefit from this protection, except for during the juvenile stage where they are expected to be found in shallower nearshore areas.

Effects Assessment
Potential project effects on bocaccio include:

- Change in fish habitat
- Direct mortality or physical injury
- Change in behaviour
- Change in sediment or water quality

Permanent change in fish habitat is expected to occur in a single event during the construction phase of the Project. This change in habitat availability is expected to be reversible through habitat offsetting measures. The extent of change in fish habitat is within the PDA and the likelihood of a residual effect from change in fish habitat occurring is low. During the construction phase, dredging in the intertidal and subtidal habitats within the materials offloading facility (MOF) and pile installation for the Marine Terminal will permanently alter or destroy open water soft substrate and intertidal eelgrass found in the MOF, which may be occasionally used by juvenile bocaccio based on depth and location (Section 13 and Appendix G.10 of the EIS Addendum). Based on new project design, the dredge footprint has been significantly reduced to avoid Flora Bank (an important eelgrass habitat area) (Section 13 of the EIS Addendum). The magnitude of potential change in habitat availability for bocaccio is moderate as the effect is outside the range of natural variability but does not pose a risk to population viability. Through habitat offsetting measures, oroject effects on potential bocaccio habitat availability are expected to be negligible, and as a result, the residual effects on bocaccio are expected to be not significant (Section 13 and Appendix G.10 of the EIS Addendum). Additionally, a marine fish and fish habitat follow-up and monitoring program will be completed to confirm mitigation measure effectiveness in protecting fish habitats within the LAA and the long term effectiveness of habitat offsetting measures. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Construction and operations of the Project have the potential to result in direct mortality or physical injury to bocaccio individuals throughout the extent of the LAA. This effect, if it occurs, will be long-term and continuous throughout the life of the Project. The magnitude of direct mortality or physical injury to bocaccio is considered low as the measureable change from this effect will be within the range of natural variability and therefore not pose a risk to population viability. Blasting, burial, crushing, or effects of underwater noise (underwater noise is relevant to fish species that have swim bladders such as rockfish) from dredging, pile installation and shipping activities during construction could result in incidental mortality or injury to bocaccio if they are present in the area at the time of construction. This however remains

unlikely as bocaccio adults are typically found in greater depths and are associated with hard substrates rather than soft substrates. Direct mortality or injury to bocaccio through shipping activities during the operations phase (e.g., potential for burial or crushing from increased TSS during vessel manoeuvring) is expected to be negligible. Through mitigation measures implemented by the Project such as a Marine Pile Installation Management Plan, Department of Fisheries and Oceans (DFO) Blasting Guidelines and a Blasting Management Plan, and conducting in water construction activities within DFO least-risk timeline windows where applicable, the potential for mortality or physical injury of bocaccio will be reduced to the extent possible (Section 13 of the EIS Addendum). The likelihood of direct mortality or physical injury to bocaccio is expected to be low for project activities after implementation of mitigation measures. Although individual bocaccio could be affected, residual effects of project related direct mortality or injury are expected to be reversible as the sustainability of the population will not be affected. Therefore, the effects of direct mortality or physical injury on bocaccio as a result of the Project are considered not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Construction and operations of the Project have the potential to effect a change in behaviour of marine fish occurring within the extent of the LAA and are likely to result in a residual effect for marine fish in general. The magnitude of change in behaviour of bocaccio is moderate as the effect will have a measureable change above natural behaviour of the species but will not pose a risk to population viability. Mitigation measures that will be implemented to reduce the risk of change in behaviour of marine fish include limiting the speed of LNG carriers, tugs, and barges to 16 knots within the LAA and 6 knots on approach to the pilot boarding station, use of low noise piling techniques paired with bubble curtains, and adhering to DFO's least risk-timing windows where applicable (Section 13 of the EIS). Because bocaccio have relatively short migrations with movements of less than 1 km to a maximum of 50 km (less with age) (COSEWIC 2013a), it is expected that if they are present in the area, project activities may have a short-term effect on their behaviour. This residual effect has the potential to occur continuously throughout the project life, but effects to population viability of bocaccio is expected to be reversible to baseline conditions. The likelihood of a residual effect in the change in behaviour of bocaccio as a result of project activities is high, although is expected to be limited to temporary startle responses and therefore is determined as not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the Project design and operational details.

Change in sediment or water quality is expected to occur and result in a residual effect on marine fish occurring within the extent of the LAA and continuously (construction, operations, decommissioning) throughout the life of the Project. The magnitude of the change in sediment or water quality from project activity is moderate because the effect will have a measureable change above background levels, (Section 13 and Appendix G.10 of the EIS Addendum) but it is not expected to pose a risk to population viability of bocaccio. Additionally, this effect is expected to be long-term since it will persist through all project phases. To curtail the effect of change in sediment or water quality, mitigation measures will be implemented. Total suspended solids (TSS) and inferred turbidity monitoring during in-water construction will occur and adjustment of the rate of dredging activity (e.g., slowing) or addition of further mitigation measures (e.g., silt curtains) will be implemented if necessary to minimize the spatial extent of elevated TSS. Additional mitigation measures to be implemented include a 30 m vegetation buffer retained around the perimeter of Lelu Island (except at access points) to minimize the potential introduction of sediment to the marine environment, dredging operations conducted at low tide (where possible) and using methods that reduce sediment spill, consideration of the re-use of sediment and rock for construction of fish habitat offset, disposal of any unused sediment within the previously used disposal area at or near the center point of the disposal at sea site, and the use of tugs with less sediment scour-inducing propulsion systems (Section 13 of the EIS Addendum). The long-term effect of change in sediment and water quality as it relates to bocaccio is expected to be reversible to baseline conditions, especially when considering that the LAA experiences

extended periods of elevated TSS during the Skeena River spring freshet annually (Section 13 and Appendix G of the EIS). Although the likelihood of this residual effect is high, with the implementation of these mitigation measures, change in sediment and water quality is expected to be not significant as it will not result in an increased toxicological risk for marine fish including bocaccio. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Bocaccio is currently exposed to existing anthropogenic pressures and threats such as those described in the baseline conditions section. Because of their sensitive life history and longevity, bocaccio exhibit a context rating of moderate resilience to the effects described above.

Cumulative Effects Assessment

Residual effects from project activities are not expected to affect the population viability of bocaccio. Cumulative effects on sediment and water quality are not expected because of the effects of dredging and disposal activities of all projects occurring in the LAA are not predicted to overlap in time or space based on current project construction schedules. Residual effects of change in fish habitat are expected to be negligible given that habitat offsetting features will be designed to ensure that the productivity of CRA fisheries is maintained or improved. Therefore the Project is not expected to contribute to cumulative effects of change in fish habitat in the LAA. The Project is unlikely to contribute to a cumulative effect of direct mortality or physical injury that affects the population viability for bocaccio. With mitigation and offsetting measures in place, it is not expected that the Project's contribution to change in fish habitat, direct mortality or physical injury, change in behaviour or change in sediment or water quality will affect long-term viability of the bocaccio population. Accordingly, the Projects contribution to cumulative effects on bocaccio is determined to be not significant.

Canary Rockfish

Baseline conditions

Canary rockfish is a species of rockfish found in marine waters off coastal BC. They are considered a medium sized rockfish that reach up to 68 cm in length, reaching maturity at about 13 years and a maximum longevity of 84 years (COSEWIC 2007b). This semi-pelagic fish species is wide ranging and is found in coastal waters in depths between 78 - 268 m (COSEWIC 2007b). Although two populations (northern and southern populations) of canary rockfish in BC waters are noted based on evidence for a biogeographical boundary; this assessment follows the COSEWIC status report and treats canary rockfish as a single designatable unit in BC waters (COSEWIC 2007b). The canary rockfish currently has no BC status listing and is designated as *Threatened* by the COSEWIC (BC CDC 2014). Its status assessment is based its continuous decline of 78% and 96% over 30 and 17 years respectively observed through surveys in the Southern extent of the canary rockfishes extent. The Northern extent reports no consistent trends. The status designation takes the population decline previously noted and the species wide distribution into account to determine it as *Threatened* (COSEWIC 2007b).

Available habitat for this widely distributed semi-pelagic species is expected to occur in the LAA based on their preferred depth range of 80 - 200 m and possible occurrences over mixed mud-boulder habitats (COSEWIC 200b7, Love et al. 2002). Although this species usually inhabits coastal shelf waters, juveniles are known to recruit to shallower nearshore habitats, from depths of 15 – 20 m, often at the interface of sand and rock outcrops (COSEWIC 2007b, Love et al. 2002).

The commercial groundfish trawl fishery along the BC coast has documented catch of canary rockfish in the Prince Rupert Area in Pacific Marine Fisheries Commission (PMFC) area 5D, from the 1960s - 2004 (COSEWIC 2007b). Recreational fisheries are not directed towards canary rockfish as adults typically inhabit waters too deep for this fishery. No canary rockfish were identified during remotely operated vehicle (ROV) studies at either the marine terminal jetty and trestle alignment, or at the Brown Passage disposal at sea site (Appendix M of the EIS).

There is currently no formal recovery strategy or action plan in the draft or finalized stage for canary rockfish. Canary rockfish are caught within set quotas in the groundfish trawl fishery and are managed under the Department of Fisheries and Oceans (DFO) 2013 Integrated Fishery Management Plan (IFMP) (DFO 2014). Harvest has allocated additional quota into little-exploited areas such as the Prince Rupert area since the mid-1990s. A Conservation strategy is in development to protect cold water corals and sponges in BC waters which overlaps with canary rockfish habitat (DFO 2010b). In addition, the groundfish bottom trawl fishery has new mitigation measures in effect as of April 2012 which includes bycatch limits, avoidance protocols, and the closure of a wide area of BC coastal waters to bottom trawl (COSEWIC 2007b), which includes the project LAA. Additionally, Rockfish Conservation Areas (RCAs) have been established in nearshore areas throughout the BC coast since 2002 (COSEIWC 2007). Considering the distribution of canary rockfish over the continental shelf, it is unlikely that this species will benefit from this protection, except for during the juvenile stage where they are expected to be found in shallower nearshore areas. The mitigation measures described in the 'residual effects assessment' section below will help to reduce the potential of project effects on canary rockfish.

Effects Assessment
Potential project effects on canary rockfish include:

- Change in fish habitat
- Direct mortality or physical injury
- Change in behaviour
- Change in sediment or water quality

Permanent change in fish habitat for juvenile canary rockfish is expected to occur in a single event within the extent of the PDA during the construction phase of the Project. This change in habitat availability is expected to be reversible through habitat offsetting measures. Specifically, dredging in the intertidal and subtidal environments within the materials offloading facility (MOF) and pile installation for the Marine Terminal will permanently alter or destroy open water soft substrate, intertidal soft substrate, eelgrass (in the MOF only) and intertidal rocky substrate habitat which may occasionally be used by juvenile canary rockfish based on depth and location (Section 13 and Appendix G.10 of the EIS Addendum). The magnitude of the change in canary rockfish habitat is considered moderate because the change is outside the range of natural variability but is not expected to not pose a risk to canary rockfish population viability. The likelihood of a residual effect from change in fish habitat is low. Through habitat offsetting measures, the residual effect on potential canary rockfish habitat availability is expected to be negligible. As a result, the residual effect on canary rockfish is expected to be not significant (Appendix G.10 of the EIS Addendum). Additionally, a marine fish and fish habitat follow-up and monitoring program will be completed to confirm mitigation measure effectiveness in protecting fish habitats within the LAA and the long term effectiveness of habitat offsetting measures. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Construction and operations of the Project have the potential to result in direct mortality or physical injury to canary rockfish individuals throughout the extent of the LAA. This effect is expected to be long-term in duration and continuous throughout the life of the Project. The magnitude of direct mortality or physical injury to canary rockfish is considered low as this effect will have a measureable change within the range of natural variability and therefore, will not pose a risk to population viability. Blasting, burial, crushing, or effects of underwater noise (which affect fish that possess a swim bladder such as rockfish) from dredging, pile installation and shipping activities during construction could result in the incidental mortality or injury of canary rockfish if they are present in the area at the time of construction. This however remains unlikely as canary rockfish adults are typically found in greater depths and are associated with mixed mud-boulder habitats rather than soft substrates. Direct mortality or injury to canary rockfish through shipping activities

during the operations phase (e.g., potential for burial or crushing from increased TSS during vessel manoeuvring) is expected to be negligible. Through mitigation measures implemented by the Project such as a Marine Pile Installation Management Plan, Department of Fisheries and Oceans (DFO) Blasting Guidelines and a Blasting Management Plan, and conducting in water construction activities within DFO least-risk timeline windows where applicable (Section 13 of the EIS), the potential for mortality or physical injury of canary rockfish will be reduced to the extent possible. The likelihood of direct mortality or physical injury to canary rockfish is expected to be low for project activities after implementation of mitigation measures. Although individual canary rockfish could be affected, residual effects of Project related direct mortality or injury are expected to be reversible as the sustainability of the population will not be affected. Therefore, the effects of direct mortality or physical injury on canary rockfish as a result of the Project are considered not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Construction and operations of the Project have the potential to effect a change in behaviour of canary rockfish occurring within the extent of the LAA and are likely to result in a residual effect for marine fish in general. The magnitude of change in behaviour of canary rockfish is considered moderate as the effect will have a measureable change above natural behaviour of the species but will not pose a risk to population viability. This residual effect of the Project has the potential to occur at a continuous frequency throughout the project life, but effects to population viability of canary rockfish is expected to be reversible to baseline conditions. Mitigation measures that will be implemented to reduce the risk of change in behaviour of marine fish include limiting the speed of LNG carriers, tugs, and barges to f 16 knots within the LAA and 6 knots on approach to the pilot boarding station, use of low noise piling techniques paired with bubble curtains, and adhering to DFO's least-risk timing windows (Section 13 of the EIS). Because canary rockfish have migrations with movements documented to a max of 236 km, typically greater than 100 km (COSEWIC 2007b), it is expected that if they are present in the area, project activities may have a short-term effect on their behaviour. The likelihood of a residual effect in the change in behaviour of canary rockfish as a result of project activities is high, although it is expected to be limited to temporary startle responses and will not affect population viability. Therefore, the residual effect is considered not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Change in sediment or water quality is expected to occur and result in a residual effect on canary rockfish within the extent of the LAA and continuously (construction, operations, decommissioning) throughout the life of the Project (long-term in duration). The magnitude of the change in sediment or water quality from project activity is considered moderate because the effect will have a measureable change above background levels, (Section 13 and Appendix G.10 of the EIS Addendum) but it is not expected to pose a risk to population viability of canary rockfish. Additionally, this effect is expected to be long-term since it will persist through all project phases. To curtail the effect of change in sediment or water quality, mitigation measures will be implemented. Total suspended solids (TSS) and inferred turbidity monitoring during in-water construction will occur and adjustment of the rate of activity (e.g., slowing) or addition of further mitigation measures (e.g., silt curtains) will be implemented if necessary to minimize the spatial extent of elevated TSS. Additional mitigation measures to be implemented include a 30 m vegetation buffer retained around the perimeter of Lelu Island (except at access points) to minimize the potential introduction of sediment to the marine environment, dredging operations conducted at low tide (where possible) using methods that reduce sediment spill, consideration of the re-use of sediment and rock for construction of fish habitat offset, disposal of any unused sediment within the previously used disposal area at or near the center point of the disposal at sea site, and the use of tugs with less sediment scour-inducing propulsion systems (Section 13 of the EIS Addendum). The effect of change in sediment and water quality as it relates to canary rockfish is expected to be reversible to baseline conditions, especially when considering that the LAA experiences extended periods of elevated TSS during the Skeena River spring freshet (Section 13 and Appendix G.10 of the EIS Addendum). Although the likelihood of this residual effect is high, with the

implementation of these mitigation measures, change in sediment and water quality are expected to be not significant as they will not result in an increased toxicological risk for marine fish including canary rockfish. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Canary rockfish are currently exposed to existing anthropogenic pressures and threats such as those described in the baseline conditions section. Because of their sensitive life history and longevity, canary rockfish would exhibit a context rating of moderate resilience to the effects described above.

Cumulative Effects Assessment

Residual effects from project activities are not expected to affect the population viability of canary rockfish. Cumulative effects on change in sediment or water quality are not expected because of the effects of dredging and disposal activities of all projects occurring in the RAA are not predicted to overlap in time or space based on current project construction schedules. Residual effects of change in fish habitat are expected to be negligible given that habitat offsetting features will be designed to ensure that the productivity of CRA fisheries is maintained or improved. Therefore the Project is not expected to contribute to cumulative effects of change in fish habitat in the RAA. The Project is unlikely to contribute to a cumulative effect of direct mortality or physical injury that affects the population viability for canary rockfish. With mitigation and offsetting measures in place, it is not expected that the Project's contribution to change in fish habitat, direct mortality or physical injury, change in behaviour or change in sediment or water quality will affect long-term viability of the canary rockfish population. Accordingly, the Projects contribution to cumulative effects on canary rockfish is determined to be not significant.

Darkblotched Rockfish

Baseline conditions

Darkblotched rockfish is a species of rockfish found in marine waters off coastal BC. They are a long lived rockfish that reach up to 58 cm in length, reaching maturity at about 8 or 9 years and a maximum longevity of 100 years (COSEWIC 2009a). This semi-pelagic fish species is wide ranging and is found in coastal waters in preferred depths between 140 - 210 m (COSEWIC 2009a). Although studies have shown that genetic structures exist and restrict gene flow between neighbouring populations along the coast of the United States, this assessment follows the COSEWIC status report and treats darkblotched rockfish as a single unit in BC waters. The darkblotched rockfish currently has no BC status listing and is designated as *Special Concern* by COSEWIC (BC CDC 2014). The status designation takes into account the episodic recruitment events and wide distribution of this species with no consistent indications of decline in population to determine darkblotched rockfish as *Special Concern* (COSEWIC 2009a).

Available habitat for this widely distributed bottom-dwelling species is expected to occur in the LAA based on their maximum depth range of 25 - 904 m and typical occurrences over mud bottom habitat adjacent to cobbles or boulders (COSEWIC 2009a, Love et al. 2002). Although this species usually inhabits continental shelf and slope waters, pelagic juveniles are known to settle on benthic habitat from depths of 55 - 200 m as they reach maturity (COSEWIC 2009a, Love et al. 2002).

The commercial Pacific Ocean perch trawl fishery along the BC coast has documented bycatch of darkblotched rockfish in the Prince Rupert Area in Pacific Marine Fisheries Commission (PMFC) area 5D (COSEWIC 2009a). There has been a historical decline in the population as a result of a large-scale harvesting event by foreign fleets in the 1960s and increased domestic catches in the 1980s and 1990s (COSEWIC 2009a). No darkblotched rockfish were identified during remotely operated vehicle (ROV) studies at either the marine terminal jetty and trestle alignment, or at the Brown Passage disposal at sea site (Appendix M of the EIS).

There is currently no formal recovery strategy or action plan in the draft or finalized stage for darkblotched rockfish. Although not a target of commercial fisheries, darkblotched rockfish are occasionally caught as bycatch within the Pacific Ocean perch trawl fishery and are managed under the Department of Fisheries and Oceans (DFO) 2013 Integrated Fishery Management Plan (FMP) (DFO 2014). A Conservation strategy is in development to protect cold water corals and sponges in BC waters which may overlap with darkblotched rockfish habitat (DFO 2010b). In addition, the groundfish bottom trawl fishery has new mitigation measures in effect as of April 2012 which includes bycatch limits, avoidance protocols, and the closure of a wide area of BC coastal waters to bottom trawl, which includes the project LAA (COSEWIC 2009a). Additionally, Rockfish Conservation Areas (RCAs) have been established in nearshore areas throughout the BC coast since 2002 (COSEWIC 2009a). The mitigation measures described in the 'residual effects assessment' section below will help to reduce the potential of project effects on darkblotched rockfish.

Effects Assessment
Potential project effects on darkblotched rockfish include:

- Direct mortality or physical injury
- Change in behaviour
- Change in sediment or water quality.

The potential effect of Change in fish habitat was not included because project activities are not predicted to interact with the habitats typically used by darkblotched rockfish. Based on the new project design, construction and operations expected to affect a change in fish habitat will occur at depths of -25 chart datum (CD) or shallower (Section 13 and Appendix G.10 of the EIS Addendum). Given that the preferred adult habitat of this species is waters from 140 – 210 m, the presence of a pelagic juvenile stage that settles typically in depths greater than 55 m, and little catch data observed in the Prince Rupert area, project activities are expected to have no residual effects on darkblotched rockfish habitat availability.

Construction and operations of the Project have the potential to result in direct mortality or physical injury to darkblotched rockfish individuals throughout the extent of the LAA. This effect is expected to be long-term in duration and continuous throughout the life of the Project. The magnitude of direct mortality or physical injury to darkblotched rockfish is considered low as this effect will have a measureable change within the range of natural variability and therefore, will not pose a risk to population viability. Blasting, burial, crushing, or effects of underwater noise (which affect fish that possess a swim bladder such as rockfish) from dredging, pile installation and shipping activities during construction could result in the incidental direct mortality or physical injury of darkblotched rockfish if they are present in the area at the time of construction. This however remains unlikely as darkblotched rockfish adults are typically found in greater depths and are associated with mud-bottomed cobble and boulder habitats rather than soft substrates typical of the areas where project activity will occur. Direct mortality or physical injury to darkblotched rockfish through shipping activities during the operations phase (e.g., potential for burial or crushing from increased TSS during vessel manoeuvring) is expected to be negligible. Through mitigation measures implemented by the Project such as a Marine Pile implementation Management Plan, Department of Fisheries and Oceans (DFO) Blasting Guidelines and a Blasting Management Plan, and conducting in water construction activities within DFO least-risk timeline windows where applicable, the potential for mortality or physical injury of darkblotched rockfish will be reduced to the extent possible (Section 13 of the EIS). The likelihood of direct mortality or physical injury to darkblotched rockfish is expected to be low for project activities after implementation of mitigation measures. Although individual darkblotched rockfish could be affected, residual effects of project related direct mortality or injury are expected to be reversible as the sustainability of the population will not be affected. Therefore, the effects of direct mortality or physical injury on darkblotched rockfish as a result of the Project are considered not significant. The overall confidence level in this significance rating is moderate based on the current

understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Construction and operations of the Project have the potential to effect a change in behaviour of darkblotched rockfish occurring within the extent of the LAA and are likely to result in a residual effect for marine fish in general. The magnitude of change in behaviour of darkblotched rockfish is considered moderate as the effect will have a measureable change above natural behaviour of the species but will not pose a risk to population viability. This residual effect of the Project has the potential to occur at a continuous frequency throughout the project life, but effects to population viability of darkblotched rockfish is expected to be reversible to baseline conditions. Mitigation measures that will be implemented to reduce the risk of change in behaviour of marine fish include limiting the speed of LNG carriers, tugs, and barges to 16 knots within the LAA and 6 knots on approach to the pilot boarding station, use of low noise piling techniques paired with bubble curtains, and adhering to DFO's least-risk timing windows where applicable (Appendix M of the EIS). Because darkblotched rockfish have dispersal with movements documented to a distance of 100 km (COSEWIC 2009a), it is expected that if they are present in the area, project activities may have a short-term effect on their behaviour. The likelihood of a residual effect in the change in behaviour of darkblotched rockfish as a result of project activities is high, although it is expected to be limited to temporary startle responses and will not affect population viability. Therefore, the residual effect is considered not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Change in sediment or water quality is expected to occur and result in a residual effect on darkblotched rockfish within the extent of the LAA and continuously (construction, operation, decommissioning) throughout the life of the Project. The magnitude of the change in sediment or water quality from Project activity is considered moderate because the effect will have a measureable change above background levels, (Section 13 and Appendix G of the EIS) but it is not expected to pose a risk to population viability of darkblotched rockfish. Additionally, this effect is expected to be long-term since it will persist through all project phases. To curtail the effect of change in sediment or water quality, mitigation measures will be implemented. Total suspended solids (TSS) and inferred turbidity monitoring during in-water construction will occur and adjustment of the rate of activity (e.g., slowing) or addition of further mitigation measures (e.g., silt curtains) will be implemented if necessary to minimize the spatial extent of elevated TSS. Additional mitigation measures to be implemented include a 30 m vegetation buffer retained around the perimeter of Lelu Island (except at access points) to minimize the potential introduction of sediment to the marine environment, dredging operations conducted at low tide (where possible) using methods that reduce sediment spill, consideration of the re-use of sediment and rock for construction of fish habitat offset, disposal of any unused sediment within the previously used disposal area at or near the center point of the disposal at sea site, and the use of tugs with less sediment scour-inducing propulsion systems (Section 13 of the EIS Addendum). The effect of change in sediment and water quality as it relates to darkblotched rockfish is expected to be reversible to baseline conditions, especially when considering that the LAA experiences extended periods of elevated TSS during the Skeena River spring freshet (Section 13 and Appendix G of the EIS). Although the likelihood of this residual effect is high, with the implementation of these mitigation measures, change in sediment and water quality are expected to be not significant as they will not result in an increased toxicological risk for marine fish including darkblotched rockfish. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Darkblotched rockfish is currently exposed to existing anthropogenic pressures and threats such as those described in the baseline conditions section. Because of their sensitive life history and longevity, darkblotched rockfish would exhibit a context rating of moderate resilience to the effects described above.

Cumulative Effects Assessment

Residual effects from project activities are not expected to affect the population viability of darkblotched rockfish. Cumulative effects on change in sediment or water quality are not expected because dredging and disposal activities of all projects occurring in the LAA are not predicted to overlap in time or space based on current project construction schedules. Residual effects of change in fish habitat are expected to be negligible given that habitat offsetting features will be designed to ensure that the productivity of CRA fisheries is maintained or improved. Therefore the Project is not expected to contribute to cumulative effects of change in fish habitat in the LAA. The Project is unlikely to contribute to a cumulative effect of direct mortality or physical injury that affects the population viability for darkblotched rockfish. With mitigation measures in place, it is not expected that the Project's contribution to change in fish habitat, direct mortality or physical injury, change in behaviour or change in sediment or water quality will affect long-term viability of the darkblotched rockfish population. Accordingly, the Projects contribution to cumulative effects on darkblotched rockfish is determined to be not significant.

Eulachon (Nass/Skeena Rivers Population)

Baseline conditions

Eulachon is an anadromous, semelparous species of smelt that spends 95% of their lives in the ocean and the other 5% in low reaches of freshwater systems to spawn and subsequently die. Eulachon is a short lived fish that reaches up to 20 cm in length, reaching maturity and longevity at about 3 years (COSEWIC 2013b). In the freshwater environment, Eulachon spawn on coarse sand and gravel river bottoms in low reaches (up to 24 km up the Nass River, and up to 17.5 km up the main stem of the Skeena River) of coastal rivers associated with glaciers or snowpack which contribute to strong spring freshet (COSEWIC 2013b). In the marine environment, this semi-pelagic fish species has been found in coastal waters in depths between 10 - 500 m (COSEWIC 201b3). Although three designatable units are described in Canada; the Central Pacific Coast unit, the Fraser River unit and the Nass/Skeena unit, this assessment is focused on the Nass/Skeena River population. Eulachon are currently blue listed through the BC status listing and is designated as *Special Concern* by the COSEWIC for the Nass/Skeena Rivers Population (BC CDC 2014). The status designation for the Nass/Skeena River population was re-assessed and changed from *Threatened* (2011) to *Special Concern* (2013). The populations of Eulachon are currently being considered for listing under the *Species at Rick Act* (SARA). Although current run sizes in the Nass/Skeena Rivers population are estimated to be less than 10% of what they were in the 1800s (Moody 2008), this change reflects recent information from this area indicating the stability of the population and the threats in the freshwater environment are considered to be small (COSEWIC 2013b). COSEWIC acknowledges that this population could become threatened in a relatively short period of time if marine survival declines or threats in the freshwater spawning environment increase.

Available habitat for eulachon is expected to occur in the LAA based on larval and juvenile stages occurring within sheltered inlet habitats and the depth preference of adults between 50 – 200 m and migratory route to the Nass and Skeena River mouths (COSEWIC 2013b). Although this species usually inhabits continental shelf and slope waters, pelagic larvae are known to remain in low saline estuarine waters and occur in deep inlets and fjords typical of the BC coast (COSEWIC 2013b).

Eulachon were identified during remotely operated vehicle (ROV) studies south of the Brown Passage disposal at sea site but not along the marine terminal jetty and trestle alignment (Appendix M of the EIS).

There is currently no formal recovery strategy or action plan in the draft or finalized stage for eulachon. Although not a target of commercial fisheries, eulachon are occasionally caught as bycatch within the shrimp trawl fishery. The Department of Fisheries and Oceans Canada (DFO) has undertaken multiple initiatives for the protection of Eulachon since 1995, some of which affect the Nass/Skeena Rivers population, including: adoption of 'Eulachon action levels' by DFO management that warn of possible shrimp closures when the allowed cumulative Eulachon bycatch level is reached, the requirement of mandatory Bycatch Reduction Devices (BRDs) installed in shrimp trawls to reduce Eulachon bycatch, and the

closure of the shrimp trawl fishery from February 1 to March 31 to avoid interaction with schooling Eulachon retuning to the Nass River. In-river fisheries also constitute a threat to eulachon populations. The Nass River Eulachon fishery remains managed under traditional Nisga'a' First Nation laws that govern resource uses.

Effects Assessment
Potential project effects on eulachon include:

- Change in fish habitat
- Direct mortality or physical injury
- Change in behaviour
- Change in sediment or water quality

Permanent change in fish habitat for eulachon is expected to occur in a single event during the construction phase of the Project. This change in habitat availability is expected to be reversible through habitat offsetting measures. The extent of change in fish habitat is within the PDA and the likelihood of a residual effect from change in fish habitat occurring is low. During the construction phase, dredging in the intertidal and subtidal habitats within the materials offloading facility (MOF) and pile installation for the Marine Terminal will permanently alter or destroy open water soft substrate and intertidal soft substrate eelgrass habitat (in the MOF only) which may be used by larval and juvenile eulachon for holding and foraging (Section 13 of the EIS Addendum). Based on new project design, the dredge footprint has been significantly reduced to avoid Flora Bank (an important eelgrass habitat area occasionally used by larval and juvenile eulachon) (Hart, 1988, Section 13 and Appendix G.10 of the EIS Addendum). The magnitude of potential change in habitat availability for eulachon is moderate as the effect is outside the natural change in variability but through habitat offsetting, does not pose a risk to population viability. Through habitat offsetting measures, project effects on potential eulachon habitat availability are expected to be negligible, and as a result, the residual effects on eulachon are expected to be not significant (Section 13 and Appendix G.10 of the EIS Addendum). Additionally, a marine fish and fish habitat follow-up and monitoring program will be completed to confirm mitigation measure effectiveness in protecting fish habitats within the LAA and the long term effectiveness of habitat offsetting measures. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Construction and operations of the Project have the potential to result in direct mortality or physical injury to eulachon individuals throughout the extent of the LAA. This effect, if it occurs, will be long-term and continuous throughout the life of the Project. The magnitude of direct mortality or physical injury to eulachon is considered low as the measurable change from this effect will be within the range of natural variability and therefore, not pose a risk to population viability. As eulachon do not have a swim bladder, underwater noise is not expected to cause direct mortality or physical injury. Blasting, burial, or crushing from dredging, pile installation and shipping activities during construction could result in the incidental direct mortality or physical injury of eulachon larvae or juveniles if they are present in the area at the time of construction. This is unlikely to affect adult eulachon as they are typically found in greater depths than the areas where project activity will occur (except during migration in the spring). Direct mortality or physical injury to eulachon through shipping activities during the operations phase (e.g., potential for burial or crushing from increased TSS during vessel manoeuvring) is expected to be negligible. Through mitigation measures implemented by the Project such as a Marine Pile Implementation Management Plan, Department of Fisheries and Oceans (DFO) Blasting Guidelines and a Blasting Management Plan, and conducting in water construction activities within DFO least-risk timeline windows where applicable, the potential for mortality or physical injury of eulachon will be reduced to the extent possible (Section 13 of the EIS Addendum). The likelihood of direct mortality or physical injury to eulachon is expected to be low for project activities after implementation of mitigation measures. Although individual eulachon could be

affected, residual effects of project related direct mortality or injury are expected to be reversible as the sustainability of the population will not be affected. Therefore, the effects of direct mortality or physical injury on eulachon as a result of the Project are considered not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Construction and operations of the Project have the potential to effect a change in behaviour of marine fish occurring within the extent of the LAA and are likely to result in a residual effect for marine fish in general. The magnitude of change in behaviour of eulachon is moderate as the effect will have a measureable change above the natural behaviour of the species but will not pose a risk to population viability. Mitigation measures that will be implemented to reduce the risk of change in behaviour of marine fish include limiting the speed of LNG carriers, tugs, and barges to 16 knots within the LAA and 6 knots on approach to the boarding station, use of low noise piling techniques paired with bubble curtains, and adhering to DFO's least-risk timing windows where applicable (Section 13 of the EIS). Because adult eulachon migrate from coastal shelf habitat inland to the mouths of the Nass and Skeena Rivers in the spring, it is expected that project activities may have a short term effect on their behaviour. This residual effect has the potential to occur continuously throughout the project life, but effects to population viability of eulachon is expected to be reversible to baseline conditions. The likelihood of a residual effect in the change in behaviour of eulachon as a result of project activities is high, although is expected to be limited to temporary startle responses and therefore is determined as not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Change in sediment or water quality due to dredging during the construction phase is expected to occur and result in a residual effect on marine fish occurring within the extent of the LAA and continuously (construction, operations, decommissioning) throughout the life of the Project. The magnitude of the change in sediment or water quality from project activity is moderate because the effect will have a measureable change above background levels, (Section 13 and Appendix G.10 of the EIS Addendum) but it is not expected to pose a risk to population viability of eulachon. Additionally, this effect is expected to be long-term since it will persist through all project phases. To curtail the effect of change in sediment or water quality, mitigation measures will be implemented. Total suspended solids (TSS) and inferred turbidity monitoring during in-water construction will occur and adjustment of the rate of activity (e.g., slowing) or addition of further mitigation measures (e.g., silt curtains) will be implemented if necessary to minimize the spatial extent of elevated TSS. Additional mitigation measures to be implemented include a 30 m vegetation buffer retained around the perimeter of Lelu Island (except at access points) to minimize the potential introduction of sediment to the marine environment, dredging operations conducted at low tide (where possible) using methods that reduce sediment spill, consideration of the re-use of sediment and rock for construction of fish habitat offset, disposal of any unused sediment within the previously used disposal area at or near the center point of the disposal at sea site, and the use of tugs with less sediment scour-inducing propulsion systems (Section 13 of the EIS Addendum). The effect of change in sediment and water quality as it relates to eulachon is expected to be reversible to baseline conditions, especially when considering that the LAA experiences extended periods of elevated TSS during the Skeena River spring freshet annually (Section 13 and Appendix G of the EIS). With the implementation of these mitigation measures, residual effects from change in sediment and water quality are expected to be not significant as they will not result in an increased toxicological risk for marine fish including eulachon. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Eulachon is currently exposed to existing anthropogenic pressures and threats such as those described in the baseline conditions section. Because of their habitat usage in the PDA, and the potential for eulachon to

become threatened if marine survival declines or threats in the freshwater environment increase, a context rating of moderate resilience to the effects described above.

Cumulative Effects Assessment

Residual effects from project activities are not expected to affect the population viability of eulachon. Cumulative effects on change in sediment or water quality are not expected because of the effects of dredging and disposal activities of all projects occurring in the LAA are not predicted to overlap in time or space based on current project construction schedules. Residual effects of change in fish habitat are expected to be negligible given that habitat offsetting features will be designed to ensure that the productivity of CRA fisheries is maintained or improved. Therefore the Project is not expected to contribute to cumulative effects of change in fish habitat in the LAA. The Project is unlikely to contribute to a cumulative effect of direct mortality or physical injury that affects the population viability for eulachon. With mitigation measures in place, it is not expected that the Project's contribution to change in fish habitat, direct mortality or physical injury, change in behaviour or change in sediment or water quality will affect long-term viability of the eulachon population. Accordingly, the Projects contribution to cumulative effects on eulachon is determined to be not significant.

Green Sturgeon

Baseline conditions

Green Sturgeon is an anadromous species of fish spending most of its life in the marine environment (COSEWIC 2004b). Green sturgeon is a long lived fish species that reach a reported maximum length of 2.3 m, an estimated maturity of 15 – 25 years, and an estimated longevity of up to 70 years (COSEWIC 2004b). This benthic fish species is a wide ranging species distributed in both temperate and tropic waters. There are currently no known spawning populations located in Canada, thus the green sturgeon is found completely in the estuarine and marine environment in coastal BC waters, with the exception of rare reported captures in the lower Fraser, Nass, Stikine, Skeena and Taku Rivers. Although speculation and genetic studies suggest there are two separate populations in North America, this assessment follows the COSEWIC status report and treats green sturgeon as one population due to their large northern migrations (COSEWIC 2004b). Green sturgeon are currently red listed through the BC status listing and are designated as *Special Concern* by both the COSEWIC and on Schedule 1 of the SARA (BC CDC 2014). Its designation of *Special Concern* is based on the absence of information regarding population trends and individuals in Canadian waters and its global risk from exploitation and habitat loss due to the damming of rivers (COSEWIC 2004b).

Available habitat for this widely distributed species is expected to occur in the LAA based on their presence both offshore and in the estuarine environments and its depth range from shallow nearshore water to a maximum of 610 m, though they are typically found around the 80 m depth range based on the mean depth of catches reported (COSEWIC 2004b). There are currently no records of green sturgeon being captured or observed in the Prince Rupert area, but incidental bycatch of green sturgeon in the bottom trawl fishery has been reported along the mid and northern BC coast since 1992 (COSEWIC 2004b). In recent reporting through 100% observer coverage, catches of green sturgeon are rare and single catches are the most commonly reported (COSEWIC 2004b). Seasonal abundance of green sturgeon in shallower nearshore estuarine waters is expected to be highest in the late summer and fall (COSEWIC 2004b).

No green sturgeon were not observed during remotely operated vehicle (ROV) studies at Brown Passage disposal at sea site or along the marine terminal jetty and trestle alignment (Appendix M of the EIS).

There is currently no recovery strategy or action plan in the draft or finalized stage for green sturgeon. It is currently illegal to retain green sturgeon while sport fishing in both marine and freshwater in BC (DFO fishing regulations 2003).

Effects Assessment
Potential effects of the Project on green sturgeon include:

- Change in fish habitat
- Direct mortality or physical injury
- Change in behaviour
- Change in sediment or water quality.

Permanent change in fish habitat is expected to occur in a single event during the construction phase of the Project. This change in habitat availability is expected to be reversible through habitat offsetting measures. The extent of change in fish habitat is within the PDA and the likelihood of a residual effect from change in fish habitat occurring is low. During the construction phase, pile installation for the Marine Terminal will permanently alter or destroy open water soft substrate which may be occasionally used by migrating adult green sturgeon (Section 13 of the EIS Addendum). Dredging of intertidal and subtidal habitat in the materials offloading facility (MOF) area will also occur, which may be occasionally used by green sturgeon based on the knowledge of their time spent in estuarine waters and documented rare cases of this species in the Nass and Skeena river mouths (Section 13 of the EIS Addendum and COSEWIC 2004b). The magnitude of potential change in habitat availability for green sturgeon is low as the effect is not outside the natural change in variability and through habitat offsetting, does not pose a risk to population viability. Through habitat offsetting measures, project effects on potential green sturgeon habitat availability are expected to be negligible, and as a result, the residual effects on green sturgeon are expected to be not significant (Section 13 and Appendix G.10 of the EIS Addendum). Additionally, a marine fish and fish habitat follow-up and monitoring program will be completed to confirm mitigation measure effectiveness in protecting fish habitats within the LAA and the long term effectiveness of habitat offsetting measures. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Construction and operations of the Project have the potential to result in direct mortality or physical injury to green sturgeon throughout the extent of the LAA. This effect, if it occurs, will be long-term and continuous throughout the life of the Project. The magnitude of direct mortality or physical injury to green sturgeon is considered low as the measureable change from this effect will be within the range of natural variability and therefore not pose a risk to population viability. Blasting, pile installation and shipping activities during construction and operations could result in incidental mortality or injury to green sturgeon if they are present in the area at the time of construction or operations. Through mitigation measures implemented by the Project such as a Marine Pile Installation Management Plan, Department of Fisheries and Oceans (DFO) Blasting Guidelines and a Blasting Management Plan, and conducting in water construction activities within DFO least-risk timeline windows where applicable, the potential for mortality or physical injury to green sturgeon will be reduced to the extent possible (Section 13 of the EIS Addendum). The likelihood of direct mortality or physical injury to green sturgeon is expected to be low for project activities after implementation of mitigation measures. Although individual green sturgeon could be affected, residual effects of project related direct mortality or injury are expected to be reversible as the sustainability of the population will not be affected. Therefore, the effects of direct mortality or physical injury on green sturgeon as a result of the Project are considered not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Construction and operations of the Project have the potential to effect a change in behaviour of marine fish occurring within the extent of the LAA and are likely to result in a residual effect for marine fish in general. If present in the LAA, the magnitude of change in behaviour of green sturgeon is moderate as the effect will have a measureable change above natural behaviour of the species but will not pose a risk to population

viability. Mitigation measures that will be implemented to reduce the risk of change in behaviour of marine fish include limiting the speed of LNG carriers, tugs, and barges to 16 knots within the LAA and 6 knots on approach to the pilot boarding station, use of low noise piling techniques paired with bubble curtains, and adhering to DFO's least-risk timing windows (Section 13 of the EIS). Because green sturgeon in Canada are thought to originate from spawning populations in the United States and undergo large migrations, it is expected that if they are present in the area, their behaviours will be limited to a short-term residual effect from project activities. This residual effect has the potential to occur continuously throughout the project life, but any effects green sturgeon is expected to be reversible to baseline conditions as it is not expected to affect population viability. The likelihood of a residual effect in the change in behaviour of green sturgeon as a result of project activities is high, although is expected to be limited to temporary startle responses and therefore is determined as not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Change in sediment or water quality due to dredging during the construction phase is expected to occur and result in a residual effect on marine fish occurring within the extent of the LAA and continuous (construction, operations, decommissioning) throughout the life of the Project. The magnitude of the change in sediment or water quality from project activity is moderate because the effect will have a measureable change above background levels, (Section 13 and Appendix G.10 of the EIS Addendum) but it is not expected to pose a risk to population viability of green sturgeon. As previously noted, green sturgeon are not expected to frequently occur in the LAA; therefore, the likelihood that localized change in sediment or water quality will result in residual effects on this species is low. Additionally, this effect is expected to be long-term since it will persist through all project phases. To curtail the effect of change in sediment or water quality, mitigation measures will be implemented. Total suspended solids (TSS) and inferred turbidity monitoring during in-water construction will occur and adjustment of the rate of dredging activity (e.g., slowing) or addition of further mitigation measures (e.g., silt curtains) will be implemented if needed to minimize the spatial extent of elevated TSS from vessel manoeuvring at the berth. Additional mitigation measures to be implemented include a 30 m vegetation buffer retained around the perimeter of Lelu Island (except at access points) to minimize the potential introduction of sediment to the marine environment, dredging operations conducted at low tide (where possible) and using methods that reduce sediment spill, consideration of the re-use of sediment and rock for construction of fish habitat offset, disposal of any unused sediment within the previously used disposal area at or near the center point of the disposal at sea site, and the use of tugs with less sediment scour-inducing propulsion systems (Section 13 of the EIS Addendum). The effect of change in sediment and water quality as it relates to green sturgeon is expected to be reversible to baseline conditions, especially when considering that the LAA experiences extended periods of elevated TSS during the Skeena River spring freshet annually (Section 13 and Appendix G.10 of the EIS Addendum).With the implementation of these mitigation measures, residual effects on green sturgeon from change in sediment or water quality are expected to be not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Based on the unknown trends in populations and the longevity of green sturgeon, they exhibit a context rating of moderate resilience to the effects described above.

Cumulative Effects Assessment

Residual effects from project activities are not expected to affect the population viability of the green sturgeon. Although little is known on the population trends of this species, low numbers are expected to occur within the LAA. Cumulative effects on sediment and water quality are not expected because dredging and disposal activities of all projects occurring in the LAA are not predicted to overlap in time or space based on current project construction schedules. Residual effects of change in fish habitat are expected to be negligible given that habitat offsetting features will be designed to ensure that the productivity of CRA

fisheries is maintained or improved. Therefore the Project is not expected to contribute to cumulative effects of change in fish habitat in the LAA. The Project is unlikely to contribute to a cumulative effect of direct mortality or physical injury that affects the population viability for green sturgeon. With mitigation measures in place, it is not expected that the Project's contribution to change in fish habitat, direct mortality or physical injury, change in behaviour or change in sediment or water quality will affect long-term viability of the green sturgeon population. The Projects contributions to cumulative effects on the green sturgeon are determined to be not significant.

North Pacific Spiny Dogfish

Baseline conditions

North Pacific spiny dogfish is the one of the smallest predatory sharks encountered in Canadian Pacific waters with an estimated longevity of up to 51 years (COSEWIC 2011a). This epi-benthic shark species is one of the most wide ranging shark species in the world and is distributed in both temperate and tropic waters along continental shelves, showing no particular association with substrate types (COSEWIC 2011a). The spiny dogfish currently has no BC status listing and is designated as *Special Concern* by the COSEWIC (BC CDC 2014). Its designation of *Special Concern* is based on its relative abundance in Canadian waters but low fecundity, long generation time, reduction in composition size, and demonstrated vulnerability to overfishing (COEWIC 2011a).

Available habitat for this widely distributed species is expected to occur in the LAA based on their wide spatial range from the intertidal to offshore habitats in surface waters to 730 m depth (COSEWIC 2011a). Although commercial fishing records have indicated presence of spiny dogfish in the LAA, there are no records of catch by commercial fisheries the Project PDA (COSEWIC 2011a). Seasonal distribution of spiny dogfish has been documented in both juveniles and adults to occur in deeper warmer waters during the winter and spring in aggregates off the edge of the continental shelf, and shallower shelf waters in the summer and fall (COSEWIC 2011a). No spiny dogfish were identified during remotely operated vehicle (ROV) studies at either the marine terminal jetty and trestle alignment, or at the Brown Passage disposal at sea site (Appendix M of the EIS).

There is currently no recovery strategy or action plan in the draft or finalized stage for the North Pacific spiny dogfish. Currently, the spiny dogfish fishery is managed by Fisheries and Oceans Canada through catch quotas.

Effects Assessment

Potential effects of the Project on North Pacific spiny dogfish include:

- Change in fish habitat
- Direct mortality or physical injury
- Change in behaviour
- Change in sediment or water quality.

Permanent change in fish habitat is expected to occur in a single event during the construction phase of the Project. This change in habitat availability is expected to be reversible through habitat offsetting measures. The extent of change in fish habitat is within the PDA and the likelihood of a residual effect from change in fish habitat occurring is low. During the construction phase, pile installation for the Marine Terminal will permanently alter or destroy open water soft substrate which may be occasionally used by migrating adult spiny dogfish (Section 13 of the EIS Addendum). Dredging of intertidal and subtidal habitat in the materials offloading facility (MOF) area will also occur, which may be occasionally used by wide ranging spiny dogfish based their low affinity to a particular substrate type or depth (Section 13 of the EIS Addendum and COSEWIC 2011a). The magnitude of potential change in habitat availability for spiny dogfish is low as the effect is not outside the natural change in variability and through habitat offsetting, does not pose a risk to

population viability. Through habitat offsetting measures, project effects on potential spiny dogfish habitat availability are expected to be negligible, and as a result, the residual effects on spiny dogfish are expected to be not significant (Section 13 and Appendix G.10 of the EIS Addendum). Additionally, a marine fish and fish habitat follow-up and monitoring program will be completed to confirm mitigation measure effectiveness in protecting fish habitats within the LAA and the long term effectiveness of habitat offsetting measures. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Construction and operations of the Project have the potential to result in direct mortality or physical injury to spiny dogfish throughout the extent of the LAA. This effect, if it occurs, will be long-term and continuous throughout the life of the Project. The magnitude of direct mortality or physical injury to spiny dogfish is considered low as the measureable change from this effect will be within the range of natural variability and therefore not pose a risk to population viability Blasting, pile installation, and shipping activities during construction and operations could result in incidental mortality or injury to spiny dogfish if they are present in the area at the time of construction or operations. Through mitigation measures implemented by the Project such as a Marine Pile Installation Management Plan, Department of Fisheries and Oceans (DFO) Blasting Guidelines and a Blasting Management Plan, and conducting in water construction activities within DFO least-risk timeline windows where applicable, the potential for mortality or physical injury to spiny dogfish will be reduced to the extent possible (Section 13 of the EIS Addendum). The likelihood of direct mortality or physical injury to spiny dogfish is expected to be low for project activities after implementation of mitigation measures. Although individual spiny dogfish could be affected, residual effects of project related direct mortality or injury are expected to be reversible as the sustainability of the population will not be affected. Therefore, the effects of direct mortality or physical injury on spiny dogfish as a result of the Project are considered not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Construction and operations of the Project have the potential to effect a change in behaviour of marine fish occurring within the extent of the LAA and are likely to result in a residual effect for marine fish in general. If present in the LAA, the magnitude of change in behaviour of spiny dogfish is moderate as the effect will have a measureable change above natural behaviour of the species, but will not pose a risk to population viability. Mitigation measures that will be implemented to reduce the risk of change in behaviour of marine fish include limiting the speed of LNG carriers, tugs, and barges to 16 knots within the LAA and 6 knots on approach to the boarding station, use of low noise piling techniques paired with bubble curtains, and adhering to DFO's least-risk timing windows (Section 13 of the EIS). Because spiny dogfish are highly mobile, and have been documented to migrate up to 7,000 km, it is expected that if they are present in the area, their behaviour will be limited to a short-term residual effect from project activities. This residual effect has the potential to occur continuously throughout the project life, but any effects spiny dogfish is expected to be reversible to baseline conditions as it is not expected to affect population viability. The likelihood of a residual effect in the change in behaviour of spiny dogfish as a result of project activities is high, although is expected to be limited to temporary startle responses and therefore is determined as not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Change in sediment or water quality due to dredging during the construction phase is expected to occur and result in a residual effect on marine fish occurring within the extent of the LAA and continuous (construction, operations, decommissioning) throughout the life of the Project. The magnitude of the change in sediment or water quality from project activity is moderate because the effect will have a measureable change above background levels, (Section 13 and Appendix G of the EIS) but it is not expected to pose a risk to population viability of spiny dogfish. As previously noted, spiny dogfish are not expected to

frequently occur in the LAA; therefore, it is the likelihood that localized change in sediment or water quality will result in residual effects on this species is low. Additionally, this effect is expected to be long-term since it will persist through all project phases. To curtail the effect of change in sediment or water quality, mitigation measures will be implemented. Total suspended solids (TSS) and inferred turbidity monitoring during in-water construction will occur and adjustment of the rate of dredging activity (e.g., slowing) or addition of further mitigation measures (e.g., silt curtains) will be implemented if needed to minimize the spatial extent of elevated TSS from vessel manoeuvring at the berth. Additional mitigation measures to be implemented include a 30 m vegetation buffer retained around the perimeter of Lelu Island (except at access points) to minimize the potential introduction of sediment to the marine environment, dredging operations conducted at low tide (where possible) and using methods that reduce sediment spill, consideration of the re-use of sediment and rock for construction of fish habitat offset, disposal of any unused sediment within the previously used disposal area at or near the center point of the disposal at sea site, and the use of tugs with less sediment scour-inducing propulsion systems (Section 13 of the EIS). The long-term effect of change in sediment and water quality as it relates to spiny dogfish is expected to be reversible to baseline conditions, especially when considering that the LAA experiences extended periods of elevated TSS during the Skeena River spring freshet annually (Section 13 and Appendix G of the EIS). With the implementation of these mitigation measures, residual effects on the spiny dogfish shark from change in sediment or water quality are expected to be not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Based on the low fecundity, longevity and demonstrated vulnerability to overfishing of the spiny dogfish, they exhibit a context rating of moderate resilience to the effects described above.

Cumulative Effects Assessment

Residual effects from project activities are not expected to affect the population viability of the spiny dogfish. Although little is known on the population trends of this species, low numbers are expected to occur within the LAA. Cumulative effects on sediment and water quality are not expected because dredging and disposal activities of all projects occurring in the LAA are not predicted to overlap in time or space based on current project construction schedules. Residual effects of change in fish habitat are expected to be negligible given that habitat offsetting features will be designed to ensure that the productivity of CRA fisheries is maintained or improved. Therefore the Project is not expected to contribute to cumulative effects of change in fish habitat in the LAA. The Project is unlikely to contribute to a cumulative effect of direct mortality or physical injury that affects the population viability for spiny dogfish. With mitigation measures in place, it is not expected that the Project's contribution to change in fish habitat, direct mortality or physical injury, change in behaviour or change in sediment or water quality will affect long-term viability of the spiny dogfish population. Accordingly, the Projects contribution to cumulative effects on the spiny dogfish is determined to be not significant.

Northern Abalone

Baseline conditions

Northern abalone is a relatively slow growing, long lived species of marine mollusc that is distributed along the pacific coast from Alaska to Baja California (Mexico) (DFO, 2012). In its northern range limit, it is found from the lower intertidal to at least one hundred meters depth. However, within BC it is typically found in the sub tidal zone at depths below 10 m, in water with greater than 30 ppt salinity (not near river run off) (DFO, 2012). The abalone selects firm substrate such as rock and boulders in marine environments receiving moderate water exchange, such as exposed or semi-exposed coasts (DFO, 2012). Within their habitat they are patchily distributed (COSEWIC 2009c).

Northern abalone habitat was identified within the LAA based on available rocky habitat below 10 m and with moderate water exchange. However, habitat was not observed within the PDA or at Brown Passage.

Northern abalone were not identified during remotely operated vehicle (ROV) studies at either the marine terminal jetty and trestle alignment, or at the Brown Passage disposal at sea site (Appendix M of the EIS).

The mollusc is highly prized for its meat but a moratorium on its harvest in Canada has been in place since 1990 to try and help curb its declining populations. Even with the complete ban on the northern abalone fishery, the species is still in decline; the main reason for this decline is illegal harvesting (DFO, 2012). Presently, the species is federally classified as *Endangered* under Schedule 1 of the SARA and is *Red* listed in BC (BC CDC 2014).

Effects Assessment
Potential effects of the Project on northern abalone include:

- Change in sediment or water quality.

The potential effects for Change in Fish Habitat, Direct Mortality or Physical injury and Change in Behaviour were not considered to interact with northern abalone because project activities that may lead to these effects will not occur in their habitat. In particular, during the construction phase, dredging in the intertidal and subtidal environments within the materials offloading facility (MOF) and pile installation for the Marine Terminal will occur in open water soft substrate, intertidal eelgrass soft substrate (in the MOF only) and intertidal rocky substrate habitat. As a result, except for changes in sediment or water quality, it is not anticipated that rocky substrate greater than 10 m depth (northern abalone habitat) will be affected.

Change in sediment or water quality is expected to occur and result in a residual effect on northern abalone within the extent of the LAA and continuously (construction, operations, decommissioning) throughout the life of the Project (long-term in duration). The magnitude of the change in sediment or water quality from project activity is considered moderate because the effect will have a measureable change above background levels, (Section 13 and Appendix G of the EIS) but it is not expected to pose a risk to population viability of the northern abalone. Additionally, this effect is expected to be long-term since it will persist through all project phases. To curtail the effect of change in sediment or water quality, mitigation measures will be implemented. Total suspended solids (TSS) and inferred turbidity monitoring during in-water construction will occur and adjustment of the rate of dredging activity (e.g., slowing) or addition of further mitigation measures (e.g., silt curtains) will be implemented if necessary to minimize the spatial extent of elevated TSS from vessel manoeuvring at the berth. Additional mitigation measures to be implemented include a 30 m vegetation buffer retained around the perimeter of Lelu Island (except at access points) to minimize the potential introduction of sediment to the marine environment, dredging operations conducted at low tide (where possible) and using methods that reduce sediment spill, consideration of the re-use of sediment and rock for construction of fish habitat offset, disposal of any unused sediment within the previously used disposal area at or near the center point of the disposal at sea site, and the use of tugs with less sediment scour-inducing propulsion systems (Section 13 of the EIS Addendum). With the implementation of these mitigation measures, residual effects on quillback rockfish from change in sediment and water quality are expected to be not significant as they will not result in an increased toxicological risk for marine fish and invertebrates including abalone.

The effect of change in sediment and water quality as it relates to northern abalone is expected to be reversible to baseline conditions, especially when considering that the LAA experiences extended periods of elevated TSS during the Skeena River spring freshet (Section 13 and Appendix G of the EIS). Although the likelihood of this residual effect is high, with the implementation of mitigation measures, change in sediment and water quality is expected to be not significant as it will not result in an increased toxicological risk to marine biota including northern abalone. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Northern abalone is currently exposed to existing anthropogenic pressures and threats such as those described in the baseline conditions section. Because of their sensitive life history and longevity, northern abalone would exhibit a context rating of moderate resilience to the effects described above.

Cumulative Effects Assessments

With the mitigation measures in place, it is not expected that the Project's contribution to change in sediment or water quality will affect long-term viability of the northern abalone population. Changes in sediment and water quality as a result of project activities are predicted to be not significant for northern abalone and no interactions are anticipated with all other potential effects. Therefore, the Project's contribution to cumulative effects is considered not significant.

Quillback Rockfish

Baseline conditions

Quillback rockfish is a species of North Pacific rockfish with a distribution range from the Gulf of Alaska to Anacapa Passage in southern California (United States). This rockfish is associated with hard, complex substrates with some vertical relief such as rock reefs, ridges, broken rock and crevices (COSEWIC, 2013). Adult quillback rockfish have been observed at depths ranging from 16 to 182 m (COSEWIC, 2013). In contrast, juvenile quillback rockfish recruit to shallow, rocky near-shore habitats and only move into deeper water as they age (COSEWIC, 2013). Juveniles have also been observed in eelgrass meadows (Love et al. 2002). Quillback rockfish habitat is expected to occur in the LAA based on their preference for rocky substrate habitats with some vertical relief as adults and shallow rocky or shallow eelgrass meadows as juveniles. No quillback rockfish were identified during remotely operated vehicle (ROV) studies at either the marine terminal jetty and trestle alignment, or at the Brown Passage disposal at sea site (Appendix M of the EIS).

Quillback rockfish experience fishing pressure from commercial, recreational and Aboriginal (CRA) fisheries due to the high quality of its meat and commercial value. Fish harvesting is considered the main acting force on declining stocks (COSEWIC, 2013). Presently, quillback rockfish is not a species listed under the SARA and it is has no conservation designation in BC (BC CDC 2014). In 2009, it was designated as *Threatened* by the COSEWIC (COSEWIC, 2013).

Effects Assessment

Potential project effects on quillback rockfish include:

- Change in fish habitat
- Direct mortality or physical injury
- Change in behaviour
- Change in sediment or water quality.

Permanent change in fish habitat for quillback rockfish is expected to occur in a single event within the extent of the PDA during the construction phase of the Project. This change in habitat availability is expected to be reversible through habitat offsetting measures. Specifically, dredging in the intertidal and subtidal environments within the materials offloading facility (MOF) and pile installation for the Marine Terminal will permanently alter or destroy open water soft substrate, intertidal soft substrate, eelgrass (in the MOF only) and intertidal rocky substrate habitat which may occasionally be used by juvenile quillback rockfish based on depth and location. The magnitude of the change in quillback habitat is considered moderate because the change is outside the range of natural variability but is not expected to pose a risk to quillback rockfish population viability. The likelihood of a residual effect in change in fish habitat occurring is low and through habitat offsetting measures, the project effects on potential quillback rockfish habitat availability is expected to be negligible (Section 13 and Appendix G of the EIS). As a result, the residual effect on quillback rockfish is expected to be not significant. Additionally, a marine fish and fish habitat follow-up

and monitoring program will be completed to confirm mitigation measure effectiveness in protecting fish habitats within the LAA and the long term effectiveness of habitat offsetting measures. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Construction and operations of the Project have the potential to result in direct mortality or physical injury to quillback rockfish individuals throughout the extent of the LAA. This effect is expected to be long-term in duration and continuous throughout the life of the Project. The magnitude of direct mortality or physical injury to quillback rockfish is considered low as this effect will have a measureable change within the range of natural variability and therefore, will not pose a risk to population viability. Blasting, burial, crushing, or effects of underwater noise (underwater noise is relevant to fish species that have swim bladders such as rockfish) from dredging, pile installation and shipping activities during construction could result in incidental mortality or injury to quillback if they are present in the area at the time of construction. Direct mortality or injury to quillback rockfish through shipping activities during the operations phase (e.g., potential for burial or crushing from increased TSS during vessel manoeuvring) is expected to be negligible. Through mitigation measures implemented by the Project such as a Marine Pile Installation Management Plan, Department of Fisheries and Oceans (DFO) Blasting Guidelines and a Blasting Management Plan, and conducting in water construction activities within DFO least-risk timeline windows where applicable, the potential for mortality or physical injury of quillback rockfish will be reduced to the extent possible (Section 13 of the EIS Addendum). The likelihood of direct mortality or physical injury to quillback rockfish is expected to be low for project activities after implementation of mitigation measures. Although individual quillback rockfish could be affected, residual effects of project related direct mortality or injury are expected to be reversible as the sustainability of the population will not be affected. Therefore, the effects of direct mortality or physical injury on quillback rockfish as a result of the Project are considered not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the Project design and operational details.

Construction and operation of the Project have the potential to effect a change in behaviour of quillback rockfish occurring within the extent of the LAA and are likely to result in a residual effect for marine fish in general. The magnitude of change in behaviour of quillback rockfish is considered moderate as the effect will have a measureable change above natural behaviour of the species but will not pose a risk to population viability. This residual effect of the Project has the potential to occur at a continuous frequency throughout the project life, but effects to population viability of quillback rockfish is expected to be reversible to baseline conditions. Mitigation measures that will be implemented to reduce the risk of change in behaviour of marine fish include limiting the speed of LNG carriers, tugs, and barges to 16 knots within the LAA and 6 knots on approach to the pilot boarding station, use of low noise piling techniques paired with bubble curtains, and adhering to DFO's least risk-timing windows where applicable (Section 13 of the EIS). Because quillback rockfish show considerable site fidelity (COSEWIC 2013b), it is expected that if they are present in the area, project activities may have a short-term effect on their behaviour. The likelihood of a residual effect in the change in behaviour of quillback rockfish as a result of project activities is high, although it is expected to be limited to temporary startle responses and will not affect population viability. Therefore, the residual effect is considered not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Change in sediment or water quality is expected to occur and result in a residual effect on quillback rockfish within the extent of the LAA and continuously (construction, operations, decommissioning) throughout the life of the Project. The magnitude of the change in sediment or water quality from project activity is considered moderate because the effect will have a measureable change above background levels, (Section 13 and Appendix G.10 of the EIS Addendum) but it is not expected to pose a risk to population viability of

quillback rockfish. To curtail the effect of change in sediment or water quality, mitigation measures will be implemented. Total suspended solids (TSS) and inferred turbidity monitoring during in-water construction will occur and adjustment of the rate of dredging activity (e.g., slowing) or addition of further mitigation measures (e.g., silt curtains) will be implemented if necessary to minimize the spatial extent of elevated TSS. Additional mitigation measures to be implemented include a 30 m vegetation buffer retained around the perimeter of Lelu Island (except at access points) to minimize the potential introduction of sediment to the marine environment, dredging operations conducted at low tide (where possible) and using methods that reduce sediment spill, consideration of the re-use of sediment and rock for construction of fish habitat offset, disposal of any unused sediment within the previously used disposal area at or near the center point of the disposal at sea site, and the use of tugs with less sediment scour-inducing propulsion systems (Section 13 of the EIS Addendum).

The long-term effect of change in sediment and water quality as it relates to quillback rockfish is expected to be reversible to baseline conditions, especially when considering that the LAA experiences extended periods of elevated TSS during the Skeena River spring freshet (Section 13 and Appendix G.10 of the EIS Addendum). Although the likelihood of this residual effect is high, with the implementation of these mitigation measures, change in sediment and water quality are expected to be not significant as they will not result in an increased toxicological risk for marine fish including quillback rockfish. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Quillback rockfish are currently exposed to existing anthropogenic pressures and threats such as those described in the baseline conditions section. Because of their sensitive life history and longevity, quillback rockfish would exhibit a context rating of moderate resilience to the effects described above.

Cumulative Effects Assessment

Residual effects from project activities are not expected to affect the population viability of quillback rockfish. Cumulative effects on sediment and water quality are not expected because dredging and disposal activities of all projects occurring in the LAA are not predicted to overlap in time or space based on current project construction schedules. Residual effects of change in fish habitat are expected to be negligible given that habitat offsetting features will be designed to ensure that the productivity of CRA fisheries is maintained or improved. Therefore the Project is not expected to contribute to cumulative effects of change in fish habitat in the LAA. The Project is unlikely to contribute to a cumulative effect of direct mortality or physical injury that affects the population viability for quillback rockfish. With mitigation and offsetting measures in place, it is not expected that the Project's contribution to change in fish habitat, direct mortality or physical injury, change in behaviour or change in sediment or water quality will affect long-term viability of the quillback rockfish population. Accordingly, the Projects contribution to cumulative effects on quillback rockfish is determined to be not significant.

Rougheye Rockfish

Baseline conditions

Rougheye rockfish is a marine fish belonging to the family Scorpaenidae (COSEWIC 2007f). In North America, rougheye rockfish range from southern California north to Alaska (COSEWIC 2007f). Rougheye rockfish inhabit the continental slope in BC. They are typically captured at depths ranging from 170 to 660 m (COSEWIC 2007f; Love et al. 2002), and have a preference for soft substrates, areas with frequent boulders, and slopes greater than 20º (COSEWIC 2007f). Their preference for soft substrates stems from their preferred prey items (pandalid shrimp) habitat. Rougheye rockfish are known to live up to 205 years, reaching a maximum length of 90 cm (COSEWIC 200f7), this makes them among the longest lived fish species on earth. Similar to other rockfish species, female rougheye rockfish are viviparous, giving birth to live young. Females reach 50% maturity at 20 years of age (COSEWIC 2007f). As a result of their longevity and complex life history, rougheye rockfish are extremely susceptible to overfishing. This is reflected in the

decline of older age class (50+) individuals from 1996 to 2003, as the total mortality doubled (COSEWIC 2007f).

Rougheye rockfish have recently been identified as two sympatric species (type I and type II); however, the distribution and abundance of these two species in Canadian waters is largely unknown. As such, this assessment will discuss these species as a single unit in BC waters. Rougheye rockfish fish currently has no BC status listing, is designated as *Special concern* by the COSEWIC, and is listed as *Special concern* under Schedule 1 of the SARA (BC CDC 2014). Studies into the population size and trend of rougheye rockfish are limited, and those that exist focus on other species, and thus do not cover a suitable habitat range. However, the population trend of rougheye rockfish is generally without trend, or increasing (COSEWIC 2007f).

Available habitat for this widely distributed benthic species is expected to occur in the LAA based on their preference for steep-slope, soft substrate, and boulder habitats (COSEWIC 2007f). Although adult rougheye rockfish are known to inhabit the continental slope, juveniles and planktonic larvae are thought to have similar habitat requirements as other *Sebastes* spp., occurring in the surface and midwater depths, and recruiting to shallower nearshore habitats (COSEWIC 2007f; Love et al. 2002). No rougheye rockfish were identified during Remotely Operated Vehicle (ROV) studies at both the marine terminal jetty and trestle alignment, or at the Brown Passage disposal at sea site (Appendix M of the EIS).

There is currently no recovery strategy or action plan in the draft or finalized stage for this species. There is no direct fishery for rougheye rockfish; but since it is caught within fisheries targeting other groundfish, it is managed under the Department of Fisheries and Oceans (DFO) Integrated Fishery Management Plan (IFMP) for groundfish (DFO 2014). A Conservation strategy is in development to protect cold water corals and sponges in BC waters which may overlap with rougheye rockfish habitat (DFO 2010b). The groundfish bottom trawl fishery has new mitigation measures in effect as of April 2012 which includes bycatch limits, avoidance protocols, and the closure of a wide area of BC coastal waters to bottom trawl, which includes the project LAA (COSEWIC 2007f). Additionally, Rockfish Conservation Areas (RCAs) have been established in nearshore areas throughout the BC coast since 2002 (COSEWIC 2007f). Considering the widespread distribution of rougheye rockfish over the continental slope, it is unlikely that this species will benefit from this protection, except for during the juvenile stage where they are expected to be found in shallower nearshore areas. The mitigation measures described in the 'residual effects assessment' section below will help to reduce the potential of project effects on rougheye rockfish.

Effects Assessment
Potential project effects on rougheye rockfish include:

- Change in fish habitat
- Direct mortality or physical injury
- Change in behaviour
- Change in sediment or water quality.

Permanent change in fish habitat is expected to occur in a single event during the construction phase of the Project. This change in habitat availability is expected to be reversible through habitat offsetting measures. The extent of change in fish habitat is within the PDA and the likelihood of a residual effect from change in fish habitat occurring is low. During the construction phase, dredging in the intertidal and subtidal habitats within the materials offloading facility (MOF) and pile installation for the Marine Terminal will permanently alter or destroy open water soft substrate, intertidal soft substrate eelgrass (in the MOF only) which may be occasionally used by juvenile rougheye rockfish based on depth and location (Section 13 and Appendix G.10 of the EIS Addendum). Based on new project design, the dredge footprint has been significantly reduced to avoid Flora Bank (an important eelgrass habitat area) (Section 13 of the EIS Addendum). The magnitude of

potential change in habitat availability for rougheye rockfish is moderate as the effect is outside the range of natural variability but does not pose a risk to population viability. Through habitat offsetting measures, project effects on potential rougheye rockfish habitat availability are expected to be negligible, and as a result, the residual effects on rougheye rockfish are expected to be not significant (Section 13 and Appendix G.10 of the EIS Addendum). Additionally, a marine fish and fish habitat follow-up and monitoring program will be completed to confirm mitigation measure effectiveness in protecting fish habitats within the LAA and the long term effectiveness of habitat offsetting measures. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Construction and operations of the Project have the potential to result in direct mortality or physical injury to rougheye rockfish individuals throughout the extent of the LAA. This effect is expected to be long-term in duration and continuous throughout the life of the Project. The magnitude of direct mortality or physical injury to rougheye rockfish is considered low as this effect will have a measureable change within the range of natural variability and therefore, will not pose a risk to population viability. Blasting, burial, crushing, or effects of underwater noise (underwater noise is relevant to fish species that have swim bladders such as rockfish) from dredging, pile installation and shipping activities during construction could result in incidental mortality or injury to rougheye rockfish if they are present in the area at the time of construction. This however remains unlikely as rougheye rockfish adults are typically found in greater depths where they are associated with steep-sloping habitats, with soft substrate and frequent boulders (COSEWIC 2007f). Direct mortality or injury to rougheye rockfish through shipping activities during the operations phase (e.g., potential for burial or crushing from increased TSS during vessel manoeuvring) is expected to be negligible. Through mitigation measures implemented by the Project such as a Marine Pile Installation Management Plan, Department of Fisheries and Oceans (DFO) Blasting Guidelines and a Blasting Management Plan, and conducting in water construction activities within DFO least-risk timeline windows where applicable, the potential for mortality or physical injury of rougheye rockfish will be reduced to the extent possible (Section 13 of the EIS Addendum). The likelihood of direct mortality or physical injury to rougheye rockfish is expected to be low for project activities after implementation of mitigation measures. Although individual rougheye rockfish could be affected, residual effects of project related direct mortality or injury are expected to be reversible as the sustainability of the population will not be affected. Therefore, the effects of direct mortality or physical injury on rougheye rockfish as a result of the Project are considered not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details. Construction and operations of the Project have the potential to effect a change in behaviour of marine fish occurring within the extent of the LAA and are likely to result in a residual effect for marine fish in general. The magnitude of change in behaviour of rougheye rockfish is considered moderate as the effect will have a measureable change above natural behaviour of the species but will not pose a risk to population viability. This residual effect of the Project has the potential to occur at a continuous frequency throughout the project life, but effects to population viability of rougheye rockfish is expected to be reversible to baseline conditions. Mitigation measures that will be implemented to reduce the risk of change in behaviour of marine fish include limiting the speed of LNG carriers, tugs, and barges to 16 knots within the LAA and 6 knots on approach to the pilot boarding station, use of low noise piling techniques paired with bubble curtains, and adhering to DFO's least risk-timing windows where applicable (Section 13 of the EIS). Although little information is available on the dispersal and migrations of rougheye rockfish, they are thought to display limited movement as a result of genetic heterogeneity among various geographic populations (COSEWIC 2007f). Thus, similar to other species of rockfish, it is expected that if they are present in the area, project activities may have a short-term effect on their behaviours. The likelihood of a residual effect in the change in behaviour of rougheye rockfish as a result of project activities is high, although it is expected to be limited to temporary startle responses and will not affect population viability. Therefore, the residual effect is considered not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Change in sediment or water quality is expected to occur and result in a residual effect on rougheye within the extent of the LAA and continuously (construction, operations, decommissioning) throughout the life of the Project (long-term in duration). The magnitude of the change in sediment or water quality from project activity is considered moderate because the effect will have a measureable change above background levels, (Section 13 and Appendix G of the EIS) but it is not expected to pose a risk to population viability of rougheye rockfish. Additionally, this effect is expected to be long-term since it will persist through all project phases. To curtail the effect of change in sediment or water quality, mitigation measures will be implemented. Total suspended solids (TSS) and inferred turbidity monitoring during in-water construction will occur and adjustment of the rate of dredging activity (e.g., slowing) or addition of further mitigation measures (e.g., silt curtains) will be implemented if necessary to minimize the spatial extent of elevated TSS. Additional mitigation measures to be implemented include a 30 m vegetation buffer retained around the perimeter of Lelu Island (except at access points) to minimize the potential introduction of sediment to the marine environment, dredging operations conducted at low tide (where possible) and using methods that reduce sediment spill, consideration of the re-use of sediment and rock for construction of fish habitat offset, disposal of any unused sediment within the previously used disposal area at or near the center point of the disposal at sea site, and the use of tugs with less sediment scour-inducing propulsion systems (Section 13 of the EIS Addendum).

The effect of change in sediment and water quality as it relates to rougheye rockfish is expected to be reversible to baseline conditions, especially when considering that the LAA experiences extended periods of elevated TSS during the Skeena River spring freshet (Section 13 and Appendix G of the EIS). Although the likelihood of this residual effect is high, with the implementation of these mitigation measures, change in sediment and water quality are expected to be not significant as they will not result in an increased toxicological risk to for marine fish including rougheye rockfish. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the project design and operational details.

Rougheye rockfish is currently exposed to existing anthropogenic pressures and threats such as those described in the baseline conditions section. Because of their sensitive life history and longevity, rougheye rockfish would exhibit a context rating of moderate resilience to the effects described above.

Cumulative Effects Assessment

Residual effects from project activities are not expected to affect the population viability of rougheye rockfish. Cumulative effects on sediment and water quality are not expected because dredging and disposal activities of all projects occurring in the LAA are not predicted to overlap in time or space based on current project construction schedules. Residual effects of change in fish habitat are expected to be negligible given that habitat offsetting features will be designed to ensure that the productivity of CRA fisheries is maintained or improved. Therefore the Project is not expected to contribute to cumulative effects of change in fish habitat in the LAA. The Project is unlikely to contribute to a cumulative effect of direct mortality or physical injury that affects the population viability for rougheye rockfish. With mitigation and offsetting measures in place, it is not expected that the Project's contribution to change in fish habitat, direct mortality or physical injury, change in behaviour or change in sediment or water quality will affect long-term viability of the rougheye rockfish population. Accordingly, the Projects contribution to cumulative effects on rougheye rockfish is determined to be not significant.

Yelloweye Rockfish

Baseline conditions

Yelloweye rockfish is a species of rockfish found in marine waters off coastal BC. They are one of the largest rockfish species, reaching up to a maximum recorded length of 91 cm, maturity in about 16 years, and reaching longevity of at least 120 years (COSEWIC 2008d). This demersal fish species is wide ranging and is found in coastal waters in preferred depths between 91 - 180 m (Love et al. 2002). There are currently two designatable units (DUs) of yelloweye rockfish recognized in Canadian waters based on distinguishable

genetic information restricting gene flow between the two; the Pacific Ocean inside waters and the Pacific Ocean outside waters (COSEWIC 2008d). This assessment considers the Pacific Ocean outside waters DU only, as it is the population that potentially occurs in the project LAA. The yelloweye rockfish currently has no BC status listing and is designated as *Special Concern* by the COSEWIC and on Schedule 1 of the SARA (BC CDC 2014). Its designation of *Special Concern* is based on the probable continued removal of individuals by fisheries and the longevity and life history characteristics of yelloweye rockfish that make it susceptible to overfishing. The population of yelloweye rockfish is not believed to be in decline based on a 10 year fishery-independent study and 19 year commercial catch per unit effort (CPUE) reports (COSEWIC 2008d).

Available habitat for this widely distributed demersal species is expected to occur in the LAA based on their preference for high relief rocky substrate habitats, attenuation to high relief areas such as steep fjord walls, rocky overhanging's, caves, crevices, and broken rock piles, and a typical depth range of 15 - 549 m (COSEWIC 2008d, Love et al. 2002). Although this species usually inhabits offshore water near the edge of the continental shelf, juveniles are known to settle in shallower nearshore high relief rocky habitats at depths greater than 15 m (COSEWIC 2008d, Love et al. 2002).

Fisheries landings of yelloweye rockfish in the commercial groundfish trawl fishery and commercial hook and line fishery along the BC coast has been documented to occur in the LAA in Pacific Marine Fisheries Commission area 5D from 1996 to 2004 with the percent of total area occupied by occurrences of yelloweye rockfish being greater than 80% in depths of 51 – 200 m (Yamanaka et al. 2006). No yelloweye rockfish were identified during remotely operated vehicle (ROV) studies at either the marine terminal jetty and trestle alignment, or at the Brown Passage disposal at sea site (Appendix M of the EIS).

There is currently no recovery strategy or action plan in the draft or finalized stage for this species. There is a direct fishery for yelloweye rockfish within the commercial, recreational and aboriginal fisheries. Within the groundfish trawl fishery, yelloweye rockfish are managed under the Department of Fisheries and Oceans (DFO) Integrated Fishery Management Plan (IFMP) for groundfish (DFO 2014). A Conservation strategy is in development to protect cold water corals and sponges in BC waters which may overlap with yelloweye rockfish habitat (DFO 2010b). In addition, the groundfish bottom trawl fishery has new mitigation measures in effect as of April 2012 which includes bycatch limits, avoidance protocols, and the closure of a wide area of BC coastal waters to bottom trawl, which includes the project LAA (COSEWIC 2008d). Additionally, Rockfish Conservation Areas (RCAs) have been established in nearshore areas throughout the BC coast since 2002 (COSEWIC 2008d).

Effects Assessment
Potential project effects on yelloweye rockfish include:

- Direct mortality or physical injury
- Change in behaviour
- Change in sediment or water quality.

Based on the new project design, construction and operations expected to affect a change in fish habitat will occur at depths of -25 chart datum (CD) or shallower, in areas of open water soft-silty substrate or inshore soft-silty eelgrass habitat and hard bottom habitat in the materials offloading facility (MOF) dredge footprint (Section 13 and Appendix G of the EIS). Given that the preferred adult habitat of this species is rocky high-relief substrates in waters from 91 – 180 m, and the presence of juvenile stages typically settle in depths greater than 15 m on rocky high-relief areas (COSEWIC 2008d, Love et al. 2002), project effects on change in fish habitat on yelloweye rockfish is not expected to occur. Therefore, the residual effects of change in fish habitat on yelloweye rockfish as a result of the Project are not included in this assessment.

Construction and operations of the Project have the potential to result in direct mortality or physical injury to yelloweye rockfish individuals throughout the extent of the LAA. This effect is expected to be long-term in duration and continuous throughout the life of the Project. The magnitude of direct mortality or physical injury to yelloweye rockfish is considered low as this effect will have a measureable change within the range of natural variability and therefore, will not pose a risk to population viability. Blasting, burial, crushing, or effects of underwater noise (underwater noise is relevant to fish species that have swim bladders such as rockfish) from dredging, pile installation and shipping activities during construction could result in incidental mortality or injury to yelloweye rockfish if they are present in the area at the time of construction. This however remains unlikely as yelloweye rockfish adults are typically found in greater depths and are associated with hard substrates rather than soft substrates. Direct mortality or injury to yelloweye rockfish through shipping activities during the operations phase (e.g., potential for burial or crushing from increased TSS during vessel manoeuvring) is expected to be negligible. Through mitigation measures implemented by the Project such as a Marine Pile Installation Management Plan, Department of Fisheries and Oceans (DFO) Blasting Guidelines and a Blasting Management Plan, and conducting in water construction activities within DFO least-risk timeline windows where applicable, the potential for mortality or physical injury of yelloweye rockfish will be reduced to the extent possible (Section 13 of the EIS Addendum). The likelihood of direct mortality or physical injury to yelloweye rockfish is expected to be low for project activities after implementation of mitigation measures. Although individual yelloweye rockfish could be affected, residual effects of project related direct mortality or injury are expected to be reversible as the sustainability of the population will not be affected. Therefore, the effects of direct mortality or physical injury on yelloweye rockfish as a result of the Project are considered not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the Project design and operational details.

Construction and operations of the Project have the potential to effect a change in behaviour of marine fish occurring within the extent of the LAA and are likely to result in a residual effect for marine fish in general. The magnitude of change in behaviour of yelloweye rockfish is considered moderate as the effect will have a measureable change above natural behaviour of the species but will not pose a risk to population viability. This residual effect of the Project has the potential to occur at a continuous frequency throughout the Project life, but effects to population viability of yelloweye rockfish is expected to be reversible to baseline conditions. Mitigation measures that will be implemented to reduce the risk of change in behaviour of marine fish include limiting the speed of LNG carriers, tugs, and barges to 16 knots within the LAA and 6 knots on approach to the pilot boarding station, use of low noise piling techniques paired with bubble curtains, and adhering to DFO's least risk-timing windows where applicable (Section 13 of the EIS). Although little information is available on the dispersal and migrations of yelloweye rockfish, they are thought to display limited movement (COSEWIC 2008d). Thus, similar to other species of rockfish, it is expected that if they are present in the area, Project activities may have a short-term effect on their behaviour. The likelihood of a residual effect in the change in behaviour of yelloweye rockfish as a result of Project activities is high, although it is expected to be limited to temporary startle responses and will not affect population viability. Therefore, the residual effect is considered not significant. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the Project design and operational details.

Change in sediment or water quality is expected to occur and result in a residual effect on marine fish within the extent of the LAA and continuously (construction, operations, decommissioning) throughout the life of the Project. The magnitude of the change in sediment or water quality from Project activity is considered moderate because the effect will have a measureable change above background levels, (Section 13 and Appendix G of the EIS) but it is not expected to pose a risk to population viability of yelloweye rockfish. Additionally, this effect is expected to be long-term since it will persist through all project phases. To curtail the effect of change in sediment or water quality, mitigation measures will be implemented. Total suspended solids (TSS) and inferred turbidity monitoring during in-water construction will occur and adjustment of the rate of dredging activity (e.g., slowing) or addition of further mitigation measures (e.g.,

silt curtains) will be implemented if necessary to minimize the spatial extent of elevated TSS. Additional mitigation measures to be implemented include a 30 m vegetation buffer retained around the perimeter of Lelu Island (except at access points) to minimize the potential introduction of sediment to the marine environment, dredging operations conducted at low tide (where possible) using methods that reduce sediment spill, consideration of the re-use of sediment and rock for construction of fish habitat offset, disposal of any unused sediment within the previously used disposal area at or near the center point of the disposal at sea site, and the use of tugs with less sediment scour-inducing propulsion systems (Section 13 of the EIS Addendum). The effect of change in sediment and water quality as it relates to yelloweye rockfish is expected to be reversible to baseline conditions, especially when considering that the LAA experiences extended periods of elevated TSS during the Skeena River spring freshet (Section 13 and Appendix G of the EIS). Although the likelihood of this residual effect is high, with the implementation of these mitigation measures, change in sediment and water quality are expected to be not significant as they will not result in an increased toxicological risk for marine fish including yelloweye rockfish. The overall confidence level in this significance rating is moderate based on the current understanding of the species' presence and distribution in the LAA and the potential for change in the Project design and operational details.

Yelloweye rockfish are currently exposed to existing anthropogenic pressures and threats such as those described in the baseline conditions section. Because of their sensitive life history and longevity, yelloweye rockfish would exhibit a context rating of moderate resilience to the effects described above.

Cumulative Effects Assessment

Residual effects from Project activities are not expected to affect the population viability of yelloweye rockfish. Cumulative effects on sediment and water quality are not expected because dredging and disposal activities of all projects occurring in the LAA are not predicted to overlap in time or space based on current project construction schedules. Residual effects of change in fish habitat are expected to be negligible given that habitat offsetting features will be designed to ensure that the productivity of CRA fisheries is maintained or improved. Therefore the Project is not expected to contribute to cumulative effects of change in fish habitat in the LAA. The Project is unlikely to contribute to a cumulative effect of direct mortality or physical injury that affects the population viability for yelloweye rockfish. With mitigation measures in place, it is not expected that the Project's contribution to change in fish habitat, direct mortality or physical injury, change in behaviour or change in sediment or water quality will affect long-term viability of the yelloweye rockfish population. Accordingly, the Projects contribution to cumulative effects on yelloweye rockfish is determined to be not significant.

Fin Whale

Baseline Conditions

Approximately 250-750 fin whales are estimated to occur in BC waters, with the majority of sightings (averages of 314 to 446, over five survey years) in the Queen Charlotte Basin (Best and Halpin 2011). In contrast, over 40,000 fin whales were estimated to occur in BC waters prior to historic whaling times and regarded as one of the most abundant baleen whale species from the BC coast (COSEWIC 2005). As a result of this considerable population depletion, fin whales are of particular conservation concern. They are listed as *endangered* by the IUCN (IUCN 2012a), red-listed by the Province of BC, and designated as *threatened* under COSEWIC and the SARA (BC CDC 2014; COSEWIC 2005).

Fin whales primarily occur along the continental shelf of BC waters. Whaling data records showed that the majority of fin whale kills occurred along the southern edge of the Queen Charlotte shelf and the Vancouver Island shelf, with additional records in Dixon Entrance and Hecate Strait (Gregr and Trites 2001). These areas continue to be frequented by fin whales (Williams and Thomas 2007; Gregr et al. 2006; COSEWIC 2005). More recent sighting have also been recorded near the LAA, in northern Hecate Strait, west of Dundas and Melville Islands; however, their inshore distribution in and around the LAA remains limited (Williams and Thomas 2007; COSEWIC 2005).

Although fin whales can occur in BC waters year round (Heise et al. 2007), the LAA does not include important areas related to major life history aspects for the species. BC waters are generally used as foraging habitat during periods of migration for large baleen whale species (DFO 2012b). Fin whales are thought to move toward shallower coastal areas of BC in the summer to feed on consistent, dense aggregations of euphausiids (Mizroch et al. 2009; Flinn et al. 2002). These areas include the northern region of Hecate Strait, which lie outside of the Project LAA (Gregr and Trites 2001). Ship based surveys were conducted by DFO's Cetacean Research Program, from 2002-2008 along the BC coast, including the area within the LAA. Fin whales were most commonly sighted along the west coast of Haida Gwaii and between Cape St. James and Cape Scott (Ford et al. 2010). Current data do not show fin whale occurrences within the Project LAA.

Effects Assessment

Project construction activities (e.g., blasting and pile driving) could result in residual effects of direct mortality (blasting only) or physical injury to fin whales; however these species have not been sighted in any previous studies within the LAA. Unmitigated blasting could also result in injury or mortality of a fin whale, if close to the source, and underwater noise from unmitigated blasting and pile driving can cause auditory injury. Mitigation measures will be applied to reduce the potential for direct mortality (blasting only) or physical injury caused by underwater noise.

Mitigation measures for blasting will include using DFO's Blasting Guidelines (Wright and Hopky 1998), and enforcing a safety radius of 500 m (marine mammal exclusion zone) to ensure that fin whales are not present in the safety radius prior to blasting. A marine mammal observation program will be implemented and MMOs will terminate blasting activities if cetaceans or marine mammals listed under SARA enter the 500 m blasting safety radius (detailed below). A Pile Driving Management plan for planning and operating will adhere to the Best Management Practices Policy for Pile Driving and Related Operations developed by the BC Marine and Pile Driving Contractors Association and DFO (BC Marine and Pile Driving Contractors Association 2003) wherever and whenever feasible. Pile installation with a bubble curtain will be used as a mitigation measure to prevent auditory injury from pile driving and reduce areal extents of underwater noise that could result in auditory threshold shifts in marine mammals (based on injury criteria given by NOAA and Southall et al. (2007)). A vibratory hammer (with bubble curtain at the marine terminal) will be used instead of an impact hammer to install piles whenever technically feasible. Bubble curtains with bubble-containment casing will be used with an impact hammer constructed of sound absorbent material, when a vibratory hammer is not technically feasible (e.g., due to unfavourable substrate). During all pile installation activities, a marine mammal observation program will be implemented. Marine mammal observers (MMOs) will monitor a safety (i.e., exclusion) zone around pile installation, including during pile seating, and will halt the activities if cetaceans or other marine mammal species that are listed under SARA enter this zone. Underwater sound levels will also be measured/monitored in situ during the first seven days of underwater blasting and impact pile driving to acquire baseline data on sound pressure levels produced during each activity, and to field-validate the effectiveness of bubble curtains and the size of the safety zone (currently set at 500 m and 1.0 km respectively). If conditions or methodology change, monitoring will be re-started for another seven day period. If monitoring indicates sound levels in excess of 160 dB at the edge of the marine mammal safety (exclusion) zone for any activity, the activity will cease and DFO will be notified. The activity will resume after additional mitigation measures are implemented. Additional measures could include type/configuration of bubble curtain and size of safety radius for marine mammals. If monitoring indicates sound levels at or below 160 dB are being achieved at a distance of 500 m or less, the marine mammal safety (exclusion) zone for that activity may be reduced to 500 m. The duties and responsibilities of the MMOs will include the following protocols:

- Prior to commencement of impact pile installation activities and any time there is a pause in impact pile installation for more than 30 minutes, the safety zone will be surveyed visually by the MMO, and impact pile installation will not commence until (i) any observed cetacean or SARA-listed marine mammal is

seen leaving the safety zone, or (ii) none have been detected in the safety zone for a period of 30 minutes.

- Upon commencement of impact pile installation activities or recommencement after a delay of 30 minutes or more, pile installation will ramp-up by starting with slower, quieter strikes. This is designed to enable any marine mammals in the area time to leave the area prior to attainment of underwater noise levels capable of causing injury.
- During conditions of low visibility (i.e., when the safety zone cannot be monitored, during foggy conditions or darkness), if pile installation activities have ceased for more than 30 minutes, the MMO will delay recommencement of start-up until conditions improve. Once conditions improve, the safety zone will be monitored for cetaceans or other marine mammals listed under SARA for 30 minutes before commencing impact pile installation.

Mitigation measures are consistent with Draft Partial Action Plan for Blue, Fin, Sei and North Pacific Right Whales (Balaenoptera musculus, B. physalus, B. borealis, and Eubalaena japonica) in Pacific Waters (DFO 2013a) and Recovery Strategy for Blue, Fin, and Sei Whales (Balaenoptera musculus, B. physalus, and B. borealis) in Pacific Canadian Waters (Gregr et al. 2006).

The likelihood of direct mortality or physical injury to fin whales is expected to be low for blasting activities, after implementation of blasting mitigation measures during construction activities, and low to moderate for underwater noise after pile installation mitigation measures. Fin whales are not expected to occur within the LAA, which reduces the likelihood of exposure to construction activities. The magnitude of the effects are expected to be moderate for blasting, and underwater noise, with changes outside the range of natural variability that are not expected to affect population viability of fin whales. It is expected that the fin whale population will demonstrate moderate resilience and recovery to individual injury effects. The highest underwater noise effects from blasting or pile driving is anticipated to be short term during construction phases, with highest noise levels localized within the PDA (MOF and marine terminal construction locations) and attenuating into the LAA. With mitigation measures in place, the residual effects from the direct mortality or physical injury to fin whales are not expected to affect the sustainability of the population of fin whales. As fin whales are not expected to be within the LAA, population viability is unlikely to be affected and the residual effect of direct mortality or physical injury is predicted to be not significant. The confidence in the assessment is high for direct mortality or physical injury to fin whales from blasting, due to the implementation of effective mitigation measures (i.e., enforcement of a blasting safety radius). The overall confidence level for injury or mortality to fin whales is moderate based on the current understanding of the species' presence and distribution in the LAA, assumptions made in acoustic modelling of underwater noise from construction activities and the potential from change in Project design and operational details.

Project construction, operations, and decommissioning can create underwater noise likely resulting in residual behavioural effects on fin whales. No fin whales to date have been observed within the LAA, however, they occasionally feed around Triple Island from July to August and could therefore be affected by underwater noise from shipping. Behavioural effects caused by underwater noise are expected to be more prominent during the construction phase compared to operations, as in-water construction activities (e.g., pile installation) are known to produce louder underwater noise levels than operational activities (e.g., vessel movements). Changes in behaviour on fin whales in response to underwater noise have not been well studied.

Several of the mitigation measures recommended for reducing injury from blasting and pile installation will also reduce the potential for behavioural change in fin whales (e.g., MMO enforcement of an exclusion zone). Use of low noise piling techniques (e.g., vibratory hammers) is the key mitigation measure to prevent injury, but is also expected to reduce the extent of behavioural effects. Low noise pile installation techniques will be the primary method of pile installation due to the depths of soft sediment in the area.

Impact pile driving will likely only be used to seat the piles into bedrock. When impact hammers are used, additional mitigations, such as use of a bubble curtain and enforcement of a marine mammal safety zone will be implemented. A bubble curtain will also be used during low noise pile installation, to further reduce the extent over which underwater noise exceeds the behavioural threshold for marine mammals. In addition, if sound levels from blasting or pile installation exceed SPL rms of 160 dB re 1 µPa at the edge of the marine mammal exclusion zone, these activities will cease and potential additional mitigation measures will be considered in consultation with DFO. LNG carrier vessel speeds will be reduced when approaching the Triple Island Pilot Boarding Station. This will reduce the amount of underwater noise for fin whales that are present and potentially feeding in this area. Mitigation measures are consistent with Draft Partial Action Plan for Blue, Fin, Sei and North Pacific Right Whales (Balaenoptera musculus, B. physalus, B. borealis, and Eubalaena japonica) in Pacific Waters (DFO 2013a) and Recovery Strategy for Blue, Fin, and Sei Whales (Balaenoptera musculus, B. physalus, and B. borealis) in Pacific Canadian Waters (Gregr et al. 2006).

Based on implementation of the mitigation measures, it is expected that the residual effects of project related underwater noise on fin whale behaviour during construction and operations will be moderate in magnitude, medium (construction) to long-term (operations) in duration, limited to the LAA, and reversible. Residual effects of project related underwater noise on fin whale behaviour during decommissioning are predicted to be low in magnitude, short-term in duration occurring over multiple regular events, limited to the LAA, and reversible within a context of moderate ecological resilience. The residual, project related effects of this increase in underwater noise could affect localized distributions and communication of the species over the short-term (since potential exposure to a passing vessel will be transient in nature). The likelihood of a residual effect on fin whale behaviour is high. Although behaviour will likely be affected by underwater noise associated with project construction and operations (shipping), this is not expected to affect population viability, therefore residual effects will be not significant. The level of confidence associated with this significance assessment is moderate as there is uncertainty associated with how changes in behaviour from underwater noise can affect fin whale populations. This uncertainty is not unique to the Project as there are a limited number of studies available on behavioural responses of baleen whales (e.g., fin whales) to underwater noise produced during in-water construction activities and noise generated by large vessels such as LNG carriers.

Cumulative Effects Assessment

The Project will result in residual effects that are not significant after applying all mitigation measures, as these effects are not anticipated to affect the overall fin whale population viability. If project construction activities overlap temporally with the Project and the Canpotex Project, it will contribute to the overall cumulative effects.

The cumulative effect could result in a larger area of underwater noise that may result in auditory injury to fin whales. However, the Project is unlikely to contribute to these effects in a way that affects the population viability and sustainability of fin whales. Therefore, the Project's contribution to the cumulative effect of direct mortality or physical injury to the fin whale population is predicted to be not significant.

The Project is likely to contribute to cumulative changes in fin whale behaviour. However, after appropriate mitigation measures are implemented, the contribution to cumulative change in behaviour is predicted to be not significant as changes to behaviour are not expected to affect the sustainability of the North Pacific fin whale population.

Humpback Whale

Baseline Conditions

Humpback whales are sighted year round in BC waters, in a variety of habitats, including fjords and offshore areas (Ford et al. 2010; Williams and Thomas 2007). COSEWIC downgraded its listing of North Pacific humpback whales in May 2011, from threatened to special concern as basin-wide studies have shown increasing population numbers since the last re-assessment (COSEWIC 2011b). The North Pacific population

currently remains listed under Schedule 1 of the federal SARA as threatened, which was designated in 2005. In May 2014, the Minister of Fisheries and Oceans recommended the status of the humpback whale be amended from threatened to special concern (Government of Canada 2014). In the Province of BC, humpback whales are blue-listed, indicating previous vulnerability (BC Conservation Data Centre [BC CDC] 2014).

In the North Pacific, humpback whales breed in the warmer low latitude waters (primarily in Hawaii and Mexico) and migrate to higher latitudes to feed from spring through fall (Calambokidis et al. 2001). Sightings have been recorded within the LAA, however concentrations are closer to Triple Island (BC Cetacean Sightings Network 2013); and higher concentrations noted in Dixon Entrance and Hecate Strait (Best and Halpin 2011; Ford et al. 2010). A large group of adult and juvenile humpback whales were observed during a water monitoring program in support of geotechnical surveys on January 3, 2013, approximately 5 km west-southwest of Lelu Island in Chatham Sound. Predictions of humpback whale distribution and abundance along the BC coast suggest that the LAA likely supports higher whale densities in association with the distribution of important prey species (i.e., euphausiids) during strong spring blooms (Dalla Rosa et al. 2012). This study identified three important regions for humpback whales along the BC coast: southern Dixon Entrance and northwestern Queen Charlotte Islands, middle and southwestern Hecate Strait, and off the entrance of Juan de Fuca Strait (Dalla Rosa et al. 2012). The LAA falls into one of the 'Important Areas' for humpback whales identified by DFO (Clarke and Jamieson 2006a) based on expert opinion, historic whaling data and sightings data (see Figure 8 of Technical Data Report). The area was ranked as having 'high' importance based on 'uniqueness', 'aggregation' and 'fitness consequences'. Of particular note, local ecological knowledge indicates that Work Channel and west of Porcher Island are also areas frequented by humpback whales (DFO and BC Ministry of Sustainable Resource Management 2007). None of the identified four humpback whale critical habitat areas overlap with the LAA (Nichol et al. 2010). The closest identified critical habitat area is Langara Island near the northwest tip of the Queen Charlotte Islands (DFO 2013b). The highest densities of humpback whales are observed during May-October, although observations of adults and juveniles have also been recorded in winter months (Ford et al. 2009).

Several studies have modelled humpback whale abundance in the North Pacific and the North Coast of BC. Approximately 18,000 – 21,000 humpback whales are believed to occur in the North Pacific (Barlow et al. 2011; Ford et al. 2009; Calambokidis et al. 2008). In BC, estimates range from 1,541 (Best and Halpin 2011) to over 3,500 whales (Rambeau 2008), while those for the Queen Charlotte Basin (which includes the LAA), average approximately 995 to 1,431 individuals (Best and Halpin 2011).

Effects Assessment

Project construction activities (e.g., blasting and pile driving) could result in residual effects of direct mortality (blasting only) or physical injury to humpback whales. Unmitigated blasting could also result in injury or mortality of a humpback whale, if close to the source, and underwater noise from unmitigated blasting and pile driving can cause auditory injury. Mitigation measures will be applied to reduce the potential for direct mortality (blasting only) or physical injury caused by underwater noise.

Mitigation measures for blasting will include using DFO's Blasting Guidelines (Wright and Hopky 1998), and enforcing a safety radius of 500 m (marine mammal exclusion zone) to ensure that humpback whales are not present in the safety radius prior to blasting. A marine mammal observation program will be implemented and MMOs will terminate blasting activities if cetaceans or marine mammals listed under SARA enter the 500 m blasting safety radius (detailed below). A Pile Driving Management plan for planning and operating will adhere to the Best Management Practices Policy for Pile Driving and Related Operations developed by the BC Marine and Pile Driving Contractors Association and DFO (BC Marine and Pile Driving Contractors Association 2003) wherever and whenever feasible. Pile installation with a bubble curtain will be used as a mitigation measure to prevent auditory injury from pile driving and reduce areal extents of underwater noise that could result in auditory threshold shifts in marine mammals (based on injury criteria given by NOAA and Southall et al. (2007)). A vibratory hammer (with bubble curtain at the marine terminal)

will be used instead of an impact hammer to install piles whenever technically feasible. Bubble curtains with bubble-containment casing will be used with an impact hammer constructed of sound absorbent material, when a vibratory hammer is not technically feasible (e.g., due to unfavourable substrate). During all pile installation activities, a marine mammal observation program will be implemented. Marine mammal observers (MMOs) will monitor a safety (i.e., exclusion) zone around pile installation, including during pile seating, and will halt the activities if cetaceans or other marine mammal species that are listed under SARA enter this zone. Underwater sound levels will also be measured/monitored in situ during the first seven days of underwater blasting and impact pile driving to acquire baseline data on sound pressure levels produced during each activity, and to field-validate the effectiveness of bubble curtains and the size of the safety zone (currently set at 500 m and 1.0 km respectively). If conditions or methodology change, monitoring will be re-started for another seven day period. If monitoring indicates sound levels in excess of 160 dB at the edge of the marine mammal safety (exclusion) zone for any activity, the activity will cease and DFO will be notified. The activity will resume after additional mitigation measures are implemented. Additional measures could include type/configuration of bubble curtain and size of safety radius for marine mammals. If monitoring indicates sound levels at or below 160 dB are being achieved at a distance of 500 m or less, the marine mammal safety (exclusion) zone for that activity may be reduced to 500 m. The duties and responsibilities of the MMOs will include the following protocols:

- Prior to commencement of impact pile installation activities and any time there is a pause in impact pile installation for more than 30 minutes, the safety zone will be surveyed visually by the MMO, and impact pile installation will not commence until (i) any observed cetacean or SARA-listed marine mammal is seen leaving the safety zone, or (ii) none have been detected in the safety zone for a period of 30 minutes
- Upon commencement of impact pile installation activities or recommencement after a delay of 30 minutes or more, pile installation will ramp-up by starting with slower, quieter strikes. This is designed to enable any marine mammals in the area time to leave the area prior to attainment of underwater noise levels capable of causing injury
- During conditions of low visibility (i.e., when the safety zone cannot be monitored, during foggy conditions or darkness), if pile installation activities have ceased for more than 30 minutes, the MMO will delay recommencement of start-up until conditions improve. Once conditions improve, the safety zone will be monitored for cetaceans or other marine mammals listed under SARA for 30 minutes before commencing impact pile installation.

No Action Plan exists for this species. Mitigation measures are consistent with Recovery Strategy for the North Pacific Humpback Whale (Megaptera novaeanglia) in Canada (DFO 2013b).

The likelihood of direct mortality or physical injury to humpback whales is expected to be low for blasting activities, after implementation of blasting mitigation measures during construction activities, and low to moderate for underwater noise after pile installation mitigation measures. The magnitude of the effects are expected to be moderate for blasting, and underwater noise, with changes outside the range of natural variability that are not expected to affect population viability of humpback whales. It is expected that the North Pacific humpback whale population will demonstrate moderate resilience and recovery to individual injury effects. The highest underwater noise effects from blasting or pile driving is anticipated to be short term during construction phases, with highest noise levels localized within the PDA (MOF and marine terminal construction locations) and attenuating into the LAA. Mitigation is expected to limit the number of humpback whales that may be exposed to underwater noise, population numbers are increasing, and low numbers are expected to be within project construction areas. As a result, humpback whale population viability is unlikely to be affected and the residual effect of direct mortality or physical injury is predicted to be not significant The confidence in the assessment is high for direct mortality or physical injury to humpback whales from blasting, due to the implementation of effective mitigation measures (i.e.,

enforcement of a blasting safety radius). The overall confidence level for injury or mortality to humpback whales is moderate based on the current understanding of the species' presence and distribution in the LAA, assumptions made in acoustic modelling of underwater noise from construction activities and the potential from change in project design and operational details.

The project construction, operations, and decommissioning can create underwater noise likely resulting in residual effects on humpback whale behaviour. Behavioural effects caused by underwater noise are expected to be more prominent during the construction phase compared to operations, as in-water construction activities (e.g., pile installation) are known to produce louder underwater noise levels than operational activities (e.g., vessel movements). Long-term implications of underwater noise are unknown for individual and populations of humpback whales (DFO 2013b).

Several of the mitigation measures recommended for reducing injury from blasting and pile installation will also reduce the potential for behavioural change in humpback whales (e.g., MMO enforcement of an exclusion zone). Use of low noise piling techniques (e.g., vibratory hammers) is the key mitigation measure to prevent injury, but is also expected to reduce the extent of behavioural effects. Low noise pile installation techniques will be the primary method of pile installation due to the depths of soft sediment in the area. Impact pile driving will likely only be used to seat the piles into bedrock. When impact hammers are used, additional mitigations, such as use of a bubble curtain and enforcement of a marine mammal safety zone will be implemented. A bubble curtain will also be used during low noise pile installation, to further reduce the extent over which underwater noise exceeds the behavioural threshold for marine mammals. In addition, if sound levels from blasting or pile installation exceed SPL rms of 160 dB re 1 µPa at the edge of the marine mammal exclusion zone, these activities will cease and potential additional mitigation measures will be considered in consultation with DFO. LNG carrier vessel speeds will be reduced when approaching the Triple Island Pilot Boarding Station. This will reduce the amount of underwater noise for humpback whales that are present and potentially feeding in this area. No Action Plan exists for North Pacific humpback whales. Mitigation measures are consistent with Recovery Strategy for the North Pacific Humpback Whale (Megaptera novaeanglia) in Canada (DFO 2013b).

Based on implementation of the mitigation measures, it is expected that the residual effects of project related underwater noise on humpback whale behaviour during construction and operations will be moderate in magnitude, medium (construction) to long-term (operations) in duration, limited to the LAA, and reversible. Residual effects of project related underwater noise on humpback whale behaviour during decommissioning are predicted to be low in magnitude, short-term in duration occurring over multiple regular events, limited to the LAA, and reversible within a context of moderate ecological resilience. The residual, project related effects of this increase in underwater noise could affect localized distributions and communication of the species over the short-term (since potential exposure to a passing vessel will be transient in nature). The likelihood of a residual effect on humpback whale behaviour is high. Humpback whales are generally concentrated outside the LAA and mitigation for construction activities is expected to reduce the number of humpback whales that may be exposed to underwater noise that could result in changes in behaviour. Reductions in vessel speed when approaching the pilot boarding station is expected to reduce the extent of underwater noise produces and likely reduce the number of humpback whales near Triple Island potentially exposed to underwater noise that could result in change in behaviour. Although humpback whale behaviour can likely be affected by underwater noise associated with project construction and operations (shipping), this is not expected to affect the overall North Pacific Humpback whale population viability, therefore residual effects will be not significant. The level of confidence associated with this significance assessment is moderate as there is uncertainty associated with how changes in behaviour from underwater noise can affect humpback whale populations. This uncertainty is not unique to the Project as there are a limited number of studies available on behavioural responses of baleen whales (i.e., humpback whales) to underwater noise produced during in-water construction activities and noise generated by large vessels such as LNG carriers.

Cumulative Effects Assessment
The Project will result in residual effects that are not significant after applying all mitigation measures, as these effects are not anticipated to affect the overall humpback whale population viability. If project construction activities overlap temporally with the Project and the Canpotex Project, it will contribute to the overall cumulative effects.

The cumulative effect could result in a larger area of underwater noise that may result in auditory injury to humpback whales. However, the Project is unlikely to contribute to these effects in a way that affects the population viability and sustainability of North Pacific humpback whales. Therefore, the Project's contribution to the cumulative effect of direct mortality or physical injury to the North Pacific humpback whale population is predicted to be not significant.

The Project is likely to contribute to cumulative changes in humpback whale behaviour. However, after appropriate mitigation measures are implemented, the contribution to cumulative change in behaviour is predicted to be not significant as changes to behaviour are not expected to affect the sustainability of the North Pacific population.

Gray Whale
Baseline Conditions
Gray whales are a baleen species only found in the North Pacific. Their current populations are gradually growing following declines from historical whaling mortalities. This recovery is reflected in their IUCN listing as least concern (IUCN 2012). Populations within Canadian waters are considered of special concern by COSEWIC and SARA (COSEWIC 2004), and the species has a BC Conservation Rank of 'blue' (i.e., formerly vulnerable) (BC CDC 2014).

Most of the eastern subpopulation is observed migrating from winter breeding grounds in Mexico and southern California to northern feeding grounds in the Bering, Chuckchi and Beaufort Seas. BC waters are used annually as a migration corridor from approximately mid-March to mid-April, with most individuals passing through Hecate Strait (Ford et al. 2012). In BC coastal waters, gray whales are primarily sighted in deeper eastern waters, though some individuals have been recorded along the western side of the Strait (Ford et al. 2012). Very few gray whale individuals have been recorded within the LAA (see Figure 8 of the Technical Data Report). With the exception of one gray whale sighting to the west of Prince Rupert, all records were observed north of Triple Island (BC Cetacean Sightings Network 2013).

Effects Assessment
Project construction activities (e.g., blasting and pile driving) could result in residual effects of direct mortality (blasting only) or physical injury to gray whales, however these species tend to migrate through deeper waters and are infrequently observed in the LAA. Unmitigated blasting could result in injury or mortality of a gray whale, if close to the source, and underwater noise from unmitigated blasting and pile driving can cause auditory injury. Mitigation measures will be applied to reduce the potential for direct mortality (blasting only) or physical injury caused by underwater noise.

Mitigation measures for blasting will include using DFO's Blasting Guidelines (Wright and Hopky 1998), and enforcing a safety radius of 500 m (marine mammal exclusion zone) to ensure that gray whales are not present in the safety radius prior to blasting. A marine mammal observation program will be implemented and MMOs will terminate blasting activities if cetaceans or marine mammals listed under SARA enter the 500 m blasting safety radius (detailed below). A Pile Driving Management plan for planning and operating will adhere to the Best Management Practices Policy for Pile Driving and Related Operations developed by the BC Marine and Pile Driving Contractors Association and DFO (BC Marine and Pile Driving Contractors Association 2003) wherever and whenever feasible. Pile installation with a bubble curtain will be used as a mitigation measure to prevent auditory injury from pile driving and reduce areal extents of underwater noise that could result in auditory threshold shifts in marine mammals (based on injury criteria given by

NOAA and Southall et al. (2007)). A vibratory hammer (with bubble curtain at the marine terminal) will be used instead of an impact hammer to install piles whenever technically feasible. Bubble curtains with bubble-containment casing will be used with an impact hammer constructed of sound absorbent material, when a vibratory hammer is not technically feasible (e.g., due to unfavourable substrate). During all pile installation activities, a marine mammal observation program will be implemented. Marine mammal observers (MMOs) will monitor a safety (i.e., exclusion) zone around pile installation, including during pile seating, and will halt the activities if cetaceans or other marine mammal species that are listed under SARA enter this zone. Underwater sound levels will also be measured/monitored in situ during the first seven days of underwater blasting and impact pile driving to acquire baseline data on sound pressure levels produced during each activity, and to field-validate the effectiveness of bubble curtains and the size of the safety zone (currently set at 500 m and 1.0 km respectively). If conditions or methodology change, monitoring will be re-started for another seven day period. If monitoring indicates sound levels in excess of 160 dB at the edge of the marine mammal safety (exclusion) zone for any activity, the activity will cease and DFO will be notified. The activity will resume after additional mitigation measures are implemented. Additional measures could include type/configuration of bubble curtain and size of safety radius for marine mammals. If monitoring indicates sound levels at or below 160 dB are being achieved at a distance of 500 m or less, the marine mammal safety (exclusion) zone for that activity may be reduced to 500 m. The duties and responsibilities of the MMOs will include the following protocols:

- Prior to commencement of impact pile installation activities and any time there is a pause in impact pile installation for more than 30 minutes, the safety zone will be surveyed visually by the MMO, and impact pile installation will not commence until (i) any observed cetacean or SARA-listed marine mammal is seen leaving the safety zone, or (ii) none have been detected in the safety zone for a period of 30 minutes
- Upon commencement of impact pile installation activities or recommencement after a delay of 30 minutes or more, pile installation will ramp-up by starting with slower, quieter strikes. This is designed to enable any marine mammals in the area time to leave the area prior to attainment of underwater noise levels capable of causing injury
- During conditions of low visibility (i.e., when the safety zone cannot be monitored, during foggy conditions or darkness), if pile installation activities have ceased for more than 30 minutes, the MMO will delay recommencement of start-up until conditions improve. Once conditions improve, the safety zone will be monitored for cetaceans or other marine mammals listed under SARA for 30 minutes before commencing impact pile installation.

There is currently no Recovery Strategy or Action plan in draft stage or finalized for this species. The mitigation measures presented in the Applicable Mitigation Measures column will help to reduce the potential effect from the project.

The likelihood of direct mortality or physical injury to marine mammals is expected to be low for blasting activities and low to moderate for underwater noise from pile installation. If a gray whale were located within the vicinity of project activities, the likelihood would apply, although they are infrequently located within the LAA. Mortality is not be expected from blasting as mitigation measures such as a safety radii and MMO program will be in place. The likelihood for residual effects from pile installation is expected to be moderate due to mitigation and the limited number of gray whales expected to be found in the LAA. It is expected that the gray whale population will demonstrate moderate resilience and recovery to individual injury effects. The magnitude of the effects are expected to be moderate for blasting, and underwater noise, with changes outside the range of natural variability that are not expected to affect population viability of gray whales. The highest underwater noise effects from blasting or pile driving is anticipated to be short term during construction phases, with highest noise levels localized within the PDA (MOF and marine terminal construction locations) and attenuating into the LAA. With mitigation measures in place and infrequent sightings of gray whales in the LAA, the residual effects from the direct mortality or physical injury to gray whales are not expected to affect the sustainability of the population. As a result, the residual

effect of direct mortality or physical injury is predicted to be not significant. The confidence in the assessment is high for direct mortality or physical injury to gray whales from blasting, due to the implementation of effective mitigation measures (i.e., enforcement of a blasting safety radius). The overall confidence level for injury or mortality to gray whales is moderate based on the current understanding of the species' presence and distribution in the LAA, assumptions made in acoustic modelling of underwater noise from construction activities and the potential from change in project design and operational details.

The project construction, operations, and decommissioning can create underwater noise likely resulting in residual effects on gray whale behaviour. Very few gray whales have been observed within the LAA thus changes in behaviour will likely be limited to a few number of individuals. Behavioural effects caused by underwater noise are expected to be more prominent during the construction phase compared to operations, as in-water construction activities (e.g., pile installation) are known to produce louder underwater noise levels than operational activities (e.g., vessel movements).

Several of the mitigation measures recommended for reducing injury from blasting and pile installation will also reduce the potential for behavioural change in gray whales (e.g., MMO enforcement of an exclusion zone). Use of low noise piling techniques (e.g., vibratory hammers) is the key mitigation measure to prevent injury, but is also expected to reduce the extent of behavioural effects. Low noise pile installation techniques will be the primary method of pile installation due to the depths of soft sediment in the area. Impact pile driving will likely only be used to seat the piles into bedrock. When impact hammers are used, additional mitigations, such as use of a bubble curtain and enforcement of a marine mammal safety zone will be implemented. A bubble curtain will also be used during low noise pile installation, to further reduce the extent over which underwater noise exceeds the behavioural threshold for marine mammals. In addition, if sound levels from blasting or pile installation exceed SPLrms of 160 dB re 1 µPa at the edge of the marine mammal exclusion zone, these activities will cease and potential additional mitigation measures will be considered in consultation with DFO. LNG carrier vessel speeds will be reduced when approaching the Triple Island Pilot Boarding Station. This will reduce the amount of underwater noise for gray whales that may be present near Triple Island.

Based on implementation of the mitigation measures, it is expected that the residual effects of project related underwater noise on gray whale behaviour during construction and operations will be moderate in magnitude, medium (construction) to long-term (operations) in duration, limited to the LAA, and reversible. Residual effects of project related underwater noise on gray whale behaviour during decommissioning are predicted to be low in magnitude, short-term in duration occurring over multiple regular events, limited to the LAA, and reversible within a context of moderate ecological resilience. The residual, project related effects of this increase in underwater noise could affect localized distributions and communication of the species over the short-term (since potential exposure to a passing vessel will be transient in nature). The likelihood of a residual effect on marine mammals' behaviour is high, although gray whales are generally sighted outside the LAA. Mitigation for construction activities is expected to reduce the number of gray whales that may be exposed to underwater noise that could result in changes in behaviour. Reductions in vessel speed when approaching the pilot boarding station is expected to reduce the extent of underwater noise produced and likely reduce the number of gray whales near Triple Island potentially exposed to underwater noise that could result in change in behaviour. Although gray whale behaviour could be affected by underwater noise associated with project construction and operations (shipping), this is not expected to affect the overall gray whale population viability, therefore residual effects will be not significant. The level of confidence associated with this significance assessment is moderate as there is uncertainty associated with how changes in behaviour from underwater noise can affect gray whale populations. This uncertainty is not unique to the Project as there are a limited number of studies available on behavioural responses of baleen whales (i.e., gray whales) and population level effects from underwater noise produced during in-water construction activities and noise generated by large vessels such as LNG carriers.

Cumulative Effects Assessment
The Project will result in residual effects that are not significant after applying all mitigation measures, as these effects are not anticipated to affect the overall gray whale population viability. If project construction activities overlap temporally with the Project and the Canpotex Project, it will contribute to the overall cumulative effects.

The cumulative effect could result in a larger area of underwater noise that may result in auditory injury to gray whales. However, the Project is unlikely to contribute to these effects in a way that affects the population viability and sustainability of gray whales. Therefore, the Project's contribution to the cumulative effect of direct mortality or physical injury to the gray whale population is predicted to be not significant.

The Project is likely to contribute to cumulative changes in gray whale behaviour. However, after appropriate mitigation measures are implemented, the contribution to cumulative change in behaviour is predicted to be not significant as changes to behaviour are not expected to affect the sustainability of the North Pacific population.

Northern Resident Killer Whale

Baseline Conditions
The northern resident killer whale population is small, but increasing, with 244 individuals counted in 2006 (COSEWIC 2008c). They are listed as *threatened* by both COSEWIC (COSEWIC 2008c) and on Schedule 1 of SARA (Government of Canada 2014). This population of killer whales is red-listed in BC (BC CDC 2014).

The distribution of northern resident killer whales is highly seasonal in BC waters. Their abundance in BC is largely related to prey availability, primarily salmon returning to natal streams to spawn. From June to October they are primarily located from Dixon Entrance to central Vancouver Island, while their winter and spring distribution in BC waters is poorly understood (DFO 2011). Chatham Sound and adjoining waters are important areas for this species. The whales frequent this area from May to mid-July to feed on Chinook salmon migrating to the Skeena and Nass river systems (Ford 2006; Ford and Ellis 2006). They then move farther down the coast, with the arrival of migrating to those areas (Ford and Ellis 2006). Northern resident killer whales rely on the ability to acoustically detect their prey, e.g., Chinook salmon.

"Important areas", defined by DFO, for this species include the LAA (Clarke and Jamieson 2006). The LAA is 'moderate' in importance and selected based on use for socialization and migration aggregations. Northern resident killer whales have been observed in the LAA and inland waters surrounding the LAA and in Hecate Strait by Ford et al. (2010). The BC Cetacean Sightings Network (2013) reports multiple sightings of killer whales (not distinguished by ecotype) within the LAA.

A population census of the species showed an 11% increase between 1997 and 2006 (COSEWIC 2008c). Population estimates for the Queen Charlotte Sound suggest there are 128 whales in the region, based on data collected in 2004 and 2005 (Williams and Thomas 2007).

Effects Assessment
Project construction activities (e.g., blasting and pile driving) could result in the residual effect of direct mortality or physical injury of northern resident killer whales. Unmitigated blasting could result in injury or mortality of a northern resident killer whale, if close to the source, and underwater noise from unmitigated blasting and pile driving can cause auditory injury. Mitigation measures will be applied to reduce the potential for direct mortality (blasting only) or physical injury caused by underwater noise.

Mitigation measures for blasting will include using DFO's Blasting Guidelines (Wright and Hopky 1998), and enforcing a safety radius of 500 m (marine mammal exclusion zone) to ensure that northern resident killer whales are not present in the safety radius prior to blasting. A marine mammal observation program will be

implemented and MMOs will terminate blasting activities if cetaceans or marine mammals listed under SARA enter the 500 m blasting safety radius (detailed below). A Pile Driving Management plan for planning and operating will adhere to the Best Management Practices Policy for Pile Driving and Related Operations developed by the BC Marine and Pile Driving Contractors Association and DFO (BC Marine and Pile Driving Contractors Association 2003) wherever and whenever feasible. Pile installation with a bubble curtain will be used as a mitigation measure to prevent auditory injury from pile driving and reduce areal extents of underwater noise that could result in auditory threshold shifts in marine mammals (based on injury criteria given by NOAA and Southall et al. (2007)). A vibratory hammer (with bubble curtain at the marine terminal) will be used instead of an impact hammer to install piles whenever technically feasible. Bubble curtains with bubble-containment casing will be used with an impact hammer constructed of sound absorbent material, when a vibratory hammer is not technically feasible (e.g., due to unfavorable substrate). During all pile installation activities, a marine mammal observation program will be implemented. Marine mammal observers (MMOs) will monitor a safety (i.e., exclusion) zone around pile installation, including during pile seating, and will halt the activities if cetaceans or other marine mammal species that are listed under SARA enter this zone. Underwater sound levels will also be measured/monitored in situ during the first seven days of underwater blasting and impact pile driving to acquire baseline data on sound pressure levels produced during each activity, and to field-validate the effectiveness of bubble curtains and the size of the safety zone (currently set at 500 m and 1.0 km respectively). If conditions or methodology change, monitoring will be re-started for another seven day period. If monitoring indicates sound levels in excess of 160 dB at the edge of the marine mammal safety (exclusion) zone for any activity, the activity will cease and DFO will be notified. The activity will resume after additional mitigation measures are implemented. Additional measures could include type/configuration of bubble curtain and size of safety radius for marine mammals. If monitoring indicates sound levels at or below 160 dB are being achieved at a distance of 500 m or less, the marine mammal safety (exclusion) zone for that activity may be reduced to 500 m. The duties and responsibilities of the MMOs will include the following protocols:

- Prior to commencement of impact pile installation activities and any time there is a pause in impact pile installation for more than 30 minutes, the safety zone will be surveyed visually by the MMO, and impact pile installation will not commence until (i) any observed cetacean or SARA-listed marine mammal is seen leaving the safety zone, or (ii) none have been detected in the safety zone for a period of 30 minutes
- Upon commencement of impact pile installation activities or recommencement after a delay of 30 minutes or more, pile installation will ramp-up by starting with slower, quieter strikes. This is designed to enable any marine mammals in the area time to leave the area prior to attainment of underwater noise levels capable of causing injury
- During conditions of low visibility (i.e., when the safety zone cannot be monitored, during foggy conditions or darkness), if pile installation activities have ceased for more than 30 minutes, the MMO will delay recommencement of start-up until conditions improve. Once conditions improve, the safety zone will be monitored for cetaceans or other marine mammals listed under SARA for 30 minutes before commencing impact pile installation.

Mitigation measures are consistent with Recovery Strategy for the Northern and Southern Resident Killer Whales (*Orcinus orca*) in Canada (DFO 2011). A Draft Action Plan has just been through the public consultation process.

The likelihood of direct mortality or physical injury to northern resident killer whales is expected to be low for blasting activities, after implementation of blasting mitigation measures during construction activities, and low to moderate for underwater noise after pile installation mitigation measures. The magnitude of the effects are expected to be moderate for blasting, and underwater noise, with changes outside the range of natural variability that are not expected to affect population viability of northern resident killer whales. It is

expected that the northern resident killer whale population will demonstrate moderate resilience and recovery to individual injury effects. The highest underwater noise effects from blasting or pile driving is anticipated to be short term during construction phases, with highest noise levels localized within the PDA (MOF and marine terminal construction locations) and attenuating into the LAA. Mitigation is expected to limit the number of northern killer whales that may be exposed to underwater noise. As a result, northern resident killer whale population viability is unlikely to be affected and the residual effect of direct mortality or physical injury is predicted to be not significant. The confidence in the assessment is high for direct mortality or physical injury to northern resident killer whales from blasting, due to the implementation of effective mitigation measures (i.e., enforcement of a blasting safety radius). The overall confidence level for injury or mortality to northern resident killer whales is moderate based on the current understanding of the species' presence and distribution in the LAA, assumptions made in acoustic modelling of underwater noise from construction activities and the potential from change in project design and operational details.

Project construction (e.g., pile-driving), operations (i.e., shipping) and decommissioning (e.g., dismantling and associated vessel movement) can create underwater noise that may result in changes of behaviour of marine mammals, including northern resident killer whales. Behavioural effects caused by underwater noise are expected to be more prominent during the construction phase compared to operations, as in-water construction activities (e.g., pile installation) are known to produce louder underwater noise levels than operational activities (e.g., vessel movements).

Several of the mitigation measures recommended for reducing injury from blasting and pile installation will also reduce the potential for behavioural change in northern resident killer whales (e.g., MMO enforcement of an exclusion zone). Use of low noise piling techniques (e.g., vibratory hammers) is the key mitigation measure to prevent injury, but is also expected to reduce the extent of underwater noise that could result in behavioural effects. Low noise pile installation techniques will be the primary method of pile installation due to the depths of soft sediment in the area. Impact pile driving will likely only be used to seat the piles into bedrock. When impact hammers are used, additional mitigations, such as use of a bubble curtain and enforcement of a marine mammal safety zone will be implemented. A bubble curtain will also be used during low noise pile installation, to further reduce the extent over which underwater noise exceeds the behavioural threshold for marine mammals. In addition, if sound levels from blasting or pile installation exceed SPL rms of 160 dB re 1 µPa at the edge of the marine mammal exclusion zone, these activities will cease and potential additional mitigation measures will be considered in consultation with DFO. LNG carrier vessel speeds will be reduced when approaching the Triple Island Pilot Boarding Station. No Action Plan exists for this species. Mitigation measures are consistent with Recovery Strategy for the Northern and Southern Resident Killer Whales (*Orcinus orca*) in Canada (DFO 2011). A Draft Action Plan has just been through the public consultation process.

Based on implementation of the mitigation measures, it is expected that the residual effects of project related underwater noise on northern resident killer whale behaviour during construction and operations will be moderate in magnitude, medium (construction) to long-term (operations) in duration, limited to the LAA, and reversible. Residual effects of project related underwater noise on northern resident killer whale behaviour during decommissioning are predicted to be low in magnitude, short-term in duration occurring over multiple regular events, limited to the LAA, and reversible within a context of moderate ecological resilience. The residual, project related effects of this increase in underwater noise could affect localized distributions and communication of the species over the short-term (since potential exposure to a passing vessel will be transient in nature). With mitigation, northern resident killer whales may still avoid portions of the LAA/RAA due to underwater noise from project related activities, particularly during construction. While the Project may affect the localized distributions of northern resident killer whales over the short-term, it is not expected to affect the population viability of this species. It is expected that northern resident killer whales will demonstrate moderate resilience to acoustic disturbance from project construction (e.g., pile installation) and operations (i.e., shipping), with the magnitude of the effect being moderate. Therefore, although northern resident killer whales might exhibit changes in behaviour over the large areas of the LAA

as a result of project activities, it is likely only to occur mainly during the pile installation phase over three years, which is a short-term effect relative to the operations phase of the Project. Although northern resident killer whale behaviour will likely be affected by underwater noise associated with project construction and operations (shipping), this is not expected to affect their overall population viability, therefore residual effects will be not significant. The level of confidence associated with this significance assessment is moderate as there is uncertainty associated with population level effects from changes in behaviour.

Cumulative Effects

The Project will result in residual effects that are not significant after applying all mitigation measures, as these effects are not anticipated to affect the overall northern resident killer whale population viability. If project construction activities overlap temporally with the Project and the Canpotex Project, it will contribute to the overall cumulative effects.

The cumulative effect could result in a larger area of underwater noise that may result in auditory injury to northern resident killer whales. However, the Project is unlikely to contribute to these effects in a way that affects the population viability and sustainability of northern resident killer whales. Therefore, the Project's contribution to the cumulative effect of direct mortality or physical injury to the northern resident killer whale population is predicted to be not significant.

The Project is likely to contribute to cumulative changes in northern resident killer whale behaviour. However, after appropriate mitigation measures are implemented, the contribution to cumulative change in behaviour is predicted to be not significant as changes to behaviour are not expected to affect the sustainability of the northern resident killer whale population.

Bigg's Killer Whale

Baseline Conditions

There are three populations of Bigg's (transient) killer whales, with the West Coast population estimated to be 243 individuals in 2006 (Ford et al. 2007). Due to their small population size and their potential exposure to anthropogenic effects they are red-listed by the provincial government and as threatened by COSEWIC and under Schedule 1 of the SARA (BC CDC 2014).

This mammal-hunting ecotype of the killer whale species are difficult to detect visually and acoustically; subsequently, less is known about them than resident killer whales (DFO 2007). The west coast population ranges from Washington to southeast Alaska and frequents BC waters year round (COSEWIC 2008c) with their distribution highly related to prey distributions. They tend to move through areas quickly but may have preferential areas or 'home ranges' where they prefer to hunt due to previous knowledge that may give them an advantage (Ford and Ellis 1999). Bigg's killer whales rely on the ability to acoustically detect their prey (e.g., harbour seals and harbour porpoises).They have been sighted in waters around the LAA on recent DFO surveys (Ford et al. 2010). Killer whale sightings have been reported in the LAA by BC Cetacean Sightings Network (2013), but not separated by ecotype (see Figure 9 in the Technical Data Report). The LAA has not been identified as critical habitat or a DFO Important Area for killer whales (Clarke and Jamieson 2006). Recent scientific advice from DFO has indicated that waters within 3 nautical miles of Pacific coast are necessary habitat to meet the recovery objectives for Bigg's killer whale (DFO 2013c).

Effect Assessment

Project construction activities (e.g., blasting and pile driving) could result in residual effects of direct mortality or physical injury to Bigg's killer whales. Unmitigated blasting could result in injury or mortality of a Bigg's killer whale, if close to the source, and underwater noise from unmitigated blasting and pile driving can cause auditory injury. Mitigation measures will be applied to reduce the potential for direct mortality (blasting only) or physical injury caused by underwater noise.

Mitigation measures for blasting will include using DFO's Blasting Guidelines (Wright and Hopky 1998), and enforcing a safety radius of 500 m (marine mammal exclusion zone) to ensure that Bigg's killer whales are not present in the safety radius prior to blasting. A marine mammal observation program will be implemented and MMOs will terminate blasting activities if cetaceans or marine mammals listed under SARA enter the 500 m blasting safety radius (detailed below). A Pile Driving Management plan for planning and operating will adhere to the Best Management Practices Policy for Pile Driving and Related Operations developed by the BC Marine and Pile Driving Contractors Association and DFO (BC Marine and Pile Driving Contractors Association 2003) wherever and whenever feasible. Pile installation with a bubble curtain will be used as a mitigation measure to prevent auditory injury from pile driving and reduce areal extents of underwater noise that could result in auditory threshold shifts in marine mammals (based on injury criteria given by NOAA and Southall et al. (2007)). A vibratory hammer (with bubble curtain at the marine terminal) will be used instead of an impact hammer to install piles whenever technically feasible. Bubble curtains with bubble-containment casing will be used with an impact hammer constructed of sound absorbent material, when a vibratory hammer is not technically feasible (e.g., due to unfavorable substrate). During all pile installation activities, a marine mammal observation program will be implemented. Marine mammal observers (MMOs) will monitor a safety (i.e., exclusion) zone around pile installation, including during pile seating, and will halt the activities if cetaceans or other marine mammal species that are listed under SARA enter this zone. Underwater sound levels will also be measured/monitored in situ during the first seven days of underwater blasting and impact pile driving to acquire baseline data on sound pressure levels produced during each activity, and to field-validate the effectiveness of bubble curtains and the size of the safety zone (currently set at 500 m and 1.0 km respectively). If conditions or methodology change, monitoring will be re-started for another seven day period. If monitoring indicates sound levels in excess of 160 dB at the edge of the marine mammal safety (exclusion) zone for any activity, the activity will cease and DFO will be notified. The activity will resume after additional mitigation measures are implemented. Additional measures could include type/configuration of bubble curtain and size of safety radius for marine mammals. If monitoring indicates sound levels at or below 160 dB are being achieved at a distance of 500 m or less, the marine mammal safety (exclusion) zone for that activity may be reduced to 500 m. The duties and responsibilities of the MMOs will include the following protocols:

- Prior to commencement of impact pile installation activities and any time there is a pause in impact pile installation for more than 30 minutes, the safety zone will be surveyed visually by the MMO, and impact pile installation will not commence until (i) any observed cetacean or SARA-listed marine mammal is seen leaving the safety zone, or (ii) none have been detected in the safety zone for a period of 30 minutes
- Upon commencement of impact pile installation activities or recommencement after a delay of 30 minutes or more, pile installation will ramp-up by starting with slower, quieter strikes. This is designed to enable any marine mammals in the area time to leave the area prior to attainment of underwater noise levels capable of causing injury
- During conditions of low visibility (i.e., when the safety zone cannot be monitored, during foggy conditions or darkness), if pile installation activities have ceased for more than 30 minutes, the MMO will delay recommencement of start-up until conditions improve. Once conditions improve, the safety zone will be monitored for cetaceans or other marine mammals listed under SARA for 30 minutes before commencing impact pile installation.

No Action Plan exists for this species. Mitigation measures are consistent with Recovery Strategy for the Transient Killer Whale (*Orcinus orca*) in Canada (DFO 2007).

The likelihood of direct mortality or physical injury to Bigg's killer whales is expected to be low for blasting activities, after implementation of blasting mitigation measures during construction activities, and low to moderate for underwater noise after pile installation mitigation measures. The magnitude of the effects are

expected to be moderate for blasting, and underwater noise, with changes outside the range of natural variability that are not expected to affect population viability of Bigg's killer whales. It is expected that the Bigg's killer whale population will demonstrate moderate resilience and recovery to individual injury effects. The highest underwater noise effects from blasting or pile driving is anticipated to be short term during construction phases, with highest noise levels localized within the PDA (MOF and marine terminal construction locations) and attenuating into the LAA. Mitigation is expected to limit the number of Bigg's killer whales that may be exposed to underwater noise. As a result, Bigg's killer whale population viability is unlikely to be affected and the residual effect of direct mortality or physical injury is predicted to be not significant. The confidence in the assessment is high for direct mortality or physical injury to Bigg's killer whales from blasting, due to the implementation of effective mitigation measures (i.e., enforcement of a blasting safety radius). The overall confidence level for injury or mortality to Bigg's killer whales is moderate based on the current understanding of the species' presence and distribution in the LAA, assumptions made in acoustic modelling of underwater noise from construction activities and the potential from change in project design and operational details.

Project construction (e.g., pile-driving), operations (i.e., shipping) and decommissioning (e.g., dismantling and associated vessel movement) can create underwater noise that may result in changes of behaviour in marine mammals, including Bigg's killer whales. Behavioural effects caused by underwater noise are expected to be more prominent during the construction phase compared to operations, as in-water construction activities (e.g., pile installation) are known to produce louder underwater noise levels than operational activities (e.g., vessel movements).

Several of the mitigation measures recommended for reducing injury from blasting and pile installation will also reduce the potential for behavioural change in Bigg's killer whales (e.g., MMO enforcement of an exclusion zone). Use of low noise piling techniques (e.g., vibratory hammers) is the key mitigation measure to prevent injury, but is also expected to reduce the extent of underwater noise that could result in behavioural effects. Low noise pile installation techniques will be the primary method of pile installation due to the depths of soft sediment in the area. Impact pile driving will likely only be used to seat the piles into bedrock. When impact hammers are used, additional mitigations, such as use of a bubble curtain and enforcement of a marine mammal safety zone will be implemented. A bubble curtain will also be used during low noise pile installation, to further reduce the extent over which underwater noise exceeds the behavioural threshold for marine mammals. In addition, if sound levels from blasting or pile installation exceed SPL rms of 160 dB re 1 µPa at the edge of the marine mammal exclusion zone, these activities will cease and potential additional mitigation measures will be considered in consultation with DFO. LNG carrier vessel speeds will be reduced when approaching the Triple Island Pilot Boarding Station. No Action Plan exists for this species. Mitigation measures are consistent with Recovery Strategy for the Transient Killer Whale (Orcinus orca) in Canada (DFO 2007).

Based on implementation of the mitigation measures, it is expected that the residual effects of project related underwater noise on Bigg's killer whale behaviour during construction and operations will be moderate in magnitude, medium (construction) to long-term (operations) in duration, limited to the LAA, and reversible. Residual effects of project related underwater noise on Bigg's killer whale behaviour during decommissioning are predicted to be low in magnitude, short-term in duration occurring over multiple regular events, limited to the LAA, and reversible within a context of moderate ecological resilience. The residual, project related effects of this increase in underwater noise could affect localized distributions and communication of the species over the short-term (since potential exposure to a passing vessel will be transient in nature). With mitigation, Bigg's killer whales may still avoid portions of the LAA/RAA due to underwater noise from project related activities, particularly during construction. Habour porpoise and other marine mammals in the LAA are important prey species for Bigg's killer whales; potential displacement of these species during pile installation could indirectly result in displacement of Bigg's killer whales. However, given the relatively small spatial scale of potential effects relative to the habitat area used by these species, effects on predator-prey relationships are expected to be negligible. While the Project may

affect the localized distributions of Bigg's killer whales over the short-term, it is not expected to affect the population viability of this species. DFO indicates that waters within 3 nautical miles of the Pacific coast are necessary habitat to meet the recovery objectives of the Bigg's killer whales (DFO 2013c) and acoustic disturbance might impact the recovery of the species but is dependent upon the geographic extent, duration and intensity of the activity (DFO 2013c). It is expected that Bigg's killer whales will demonstrate moderate resilience to acoustic disturbance from project construction (e.g., pile installation) and operations (i.e., shipping), with the magnitude of the effect being moderate. Therefore, although Bigg's killer whales might exhibit changes in behaviour over the large areas of the LAA as a result of project activities, it is likely only to occur mainly during the pile installation phase over three years, which is a short-term effect relative to the operations phase of the Project. Although Bigg's killer whale behaviour will likely be affected by underwater noise associated with project construction and operations (shipping), this is not expected to affect the overall Bigg's killer whale population viability, therefore residual effects will be not significant. The level of confidence associated with this significance assessment is moderate as there is uncertainty associated with population level effects from changes in behaviour.

Cumulative Effects

The Project will result in residual effects that are not significant after applying all mitigation measures, as these effects are not anticipated to affect the overall Bigg's killer whale population viability. If project construction activities overlap temporally with the Project and the Canpotex Project, it will contribute to the overall cumulative effects.

The cumulative effect could result in a larger area of underwater noise that may result in auditory injury to Bigg's killer whales. However, the Project is unlikely to contribute to these effects in a way that affects the population viability and sustainability of Bigg's killer whales. Therefore, the Project's contribution to the cumulative effect of direct mortality or physical injury to the Bigg's killer whale population is predicted to be not significant.

The Project is likely to contribute to cumulative changes in Bigg's killer whale behaviour. However, after appropriate mitigation measures are implemented, the contribution to cumulative change in behaviour is predicted to be not significant as changes to behaviour are not expected to affect the sustainability of the Bigg's killer whale population.

Harbour Porpoise

Baseline Conditions

The harbour porpoise population in the Queen Charlotte Basin is estimated to be approximately 2,806 – 3,647 individuals (Best and Halpin 2011). There is limited information available on population trends for this species and they are susceptible to disturbance from human activity. Therefore, they are listed as special concern under both COSEWIC (2003) and Schedule 1 of SARA (BC CDC 2014). The species is blue-listed by the Province of BC (BC CDC 2014).

Habour porpoise are found in the Northern Hemisphere in cold temperate and sub-polar waters and are seen year round in BC waters. This species does not appear to migrate, but they are not very well studied along the north coast (COSEWIC 2003). They are often found in shallow waters (< 200 m deep) and within 20 km of shore, although sightings have been recorded in deeper, offshore waters (Ford et al. 2010; Heise et al. 2007). Seasonal changes in abundance have been noted with possible movements to deeper offshore waters in winter, but this is poorly understood (Carretta et al. 2009). Harbour porpoise have been frequently sighted within the LAA with numerous sightings in the waters east and southeast of Digby Island (BC Cetacean Sighting Network 2013; Best and Halpin 2011; Ford et al. 2010). Harbour porpoise were observed, throughout Porpoise Channel and Porpoise Harbour, during all field surveys (described in Section 4 of the Technical Data Report). They were observed typically alone or in groups of 2 to 3 individuals.

Effects Assessment

Project construction activities (e.g., blasting and pile driving) could result in the residual effect of direct mortality or physical injury to harbour porpoise. Unmitigated blasting could result in injury or mortality of a harbour porpoise, if close to the source, and underwater noise from unmitigated blasting and pile driving can cause auditory injury. Mitigation measures will be applied to reduce the potential for direct mortality (blasting only) or physical injury caused by underwater noise.

Mitigation measures for blasting will include using DFO's Blasting Guidelines (Wright and Hopky 1998), and enforcing a safety radius of 500 m (marine mammal exclusion zone) to ensure that harbour porpoise are not present in the safety radius prior to blasting. A marine mammal observation program will be implemented and MMOs will terminate blasting activities if cetaceans or marine mammals listed under SARA enter the 500 m blasting safety radius (detailed below). A Pile Driving Management plan for planning and operating will adhere to the Best Management Practices Policy for Pile Driving and Related Operations developed by the BC Marine and Pile Driving Contractors Association and DFO (BC Marine and Pile Driving Contractors Association 2003) wherever and whenever feasible. Pile installation with a bubble curtain will be used as a mitigation measure to prevent auditory injury from pile driving and reduce areal extents of underwater noise that could result in auditory threshold shifts in marine mammals (based on injury criteria given by NOAA and Southall et al. (2007)). A vibratory hammer (with bubble curtain at the marine terminal) will be used instead of an impact hammer to install piles whenever technically feasible. Bubble curtains with bubble-containment casing will be used with an impact hammer constructed of sound absorbent material, when a vibratory hammer is not technically feasible (e.g., due to unfavorable substrate). During all pile installation activities, a marine mammal observation program will be implemented. Marine mammal observers (MMOs) will monitor a safety (i.e., exclusion) zone around pile installation, including during pile seating, and will halt the activities if cetaceans or other marine mammal species that are listed under SARA enter this zone. Underwater sound levels will also be measured/monitored in situ during the first seven days of underwater blasting and impact pile driving to acquire baseline data on sound pressure levels produced during each activity, and to field-validate the effectiveness of bubble curtains and the size of the safety zone (currently set at 500 m and 1.0 km respectively). If conditions or methodology change, monitoring will be re-started for another seven day period. If monitoring indicates sound levels in excess of 160 dB at the edge of the marine mammal safety (exclusion) zone for any activity, the activity will cease and DFO will be notified. The activity will resume after additional mitigation measures are implemented. Additional measures could include type/configuration of bubble curtain and size of safety radius for marine mammals. If monitoring indicates sound levels at or below 160 dB are being achieved at a distance of 500 m or less, the marine mammal safety (exclusion) zone for that activity may be reduced to 500 m. The duties and responsibilities of the MMOs will include the following protocols:

- Prior to commencement of impact pile installation activities and any time there is a pause in impact pile installation for more than 30 minutes, the safety zone will be surveyed visually by the MMO, and impact pile installation will not commence until (i) any observed cetacean or SARA-listed marine mammal is seen leaving the safety zone, or (ii) none have been detected in the safety zone for a period of 30 minutes
- Upon commencement of impact pile installation activities or recommencement after a delay of 30 minutes or more, pile installation will ramp-up by starting with slower, quieter strikes. This is designed to enable any marine mammals in the area time to leave the area prior to attainment of underwater noise levels capable of causing injury
- During conditions of low visibility (i.e., when the safety zone cannot be monitored, during foggy conditions or darkness), if pile installation activities have ceased for more than 30 minutes, the MMO will delay recommencement of start-up until conditions improve. Once conditions improve, the safety zone will be monitored for cetaceans or other marine mammals listed under SARA for 30 minutes before commencing impact pile installation.

DFO's 2009 management plan for the Pacific harbour porpoise identifies acoustic disturbance as a threat to harbour porpoises of a medium to high concern. There is currently no Recovery Strategy or Action plan in draft stage or finalized for this species. The mitigation measures presented will help to reduce the potential effect from the project.

The likelihood of direct mortality or physical injury to harbour porpoise is expected to be low for blasting activities, after implementation of blasting mitigation measures during construction activities, and low to moderate for underwater noise after pile installation mitigation measures. The magnitude of the effects are expected to be moderate for blasting, and underwater noise, with changes outside the range of natural variability that are not expected to affect population viability of harbour porpoise. It is expected that harbour porpoises will demonstrate moderate resilience to project activities involving blasting and pile installation. The highest underwater noise effects from blasting or pile driving is anticipated to be short term during construction phases, with highest noise levels localized within the PDA (MOF and marine terminal construction locations) and attenuating into the LAA. Mitigation is expected to limit the number of harbour porpoise that may be exposed to underwater noise. As a result, harbour porpoise population viability is unlikely to be affected and the residual effect of direct mortality or physical injury is predicted to be not significant.

The overall confidence level for injury or mortality to harbour porpoise is moderate based on the current understanding of the species' presence and distribution in the LAA, assumptions made in acoustic modelling of underwater noise from construction activities and the potential from change in project design and operational details.

Project construction (e.g., pile-driving), operations (i.e., shipping) and decommissioning (e.g., dismantling and associated vessel movement) can create underwater noise may result in changes of behaviour of marine mammals, including harbour porpoise. Behavioural effects caused by underwater noise are expected to be more prominent during the construction phase compared to operations, as in-water construction activities (e.g., pile installation) are known to produce louder underwater noise levels than operational activities (e.g., vessel movements).

Several of the mitigation measures recommended for reducing injury from blasting and pile installation will also reduce the potential for behavioural change in harbour porpoise (e.g., MMO enforcement of an exclusion zone). Use of low noise piling techniques (e.g., vibratory hammers) is the key mitigation measure to prevent injury, but is also expected to reduce the extent of underwater noise that could result in behavioural effects. Low noise pile installation techniques will be the primary method of pile installation due to the depths of soft sediment in the area. Impact pile driving will likely only be used to seat the piles into bedrock. When impact hammers are used, additional mitigations, such as use of a bubble curtain and enforcement of a marine mammal safety zone will be implemented. A bubble curtain will also be used during low noise pile installation, to further reduce the extent over which underwater noise exceeds the behavioural threshold for marine mammals. In addition, if sound levels from blasting or pile installation exceed SPL rms of 160 dB re 1 µPa at the edge of the marine mammal exclusion zone, these activities will cease and potential additional mitigation measures will be considered in consultation with DFO. LNG carrier vessel speeds will be reduced when approaching the Triple Island Pilot Boarding Station. DFO's 2009 management plan for the Pacific harbour porpoise identifies acoustic disturbance as a threat to harbour porpoises of a medium to high concern. There is currently no Recovery Strategy or Action plan in draft stage or finalized for this species. The mitigation measures presented will help to reduce the potential effect from the project.

Based on implementation of the mitigation measures, it is expected that the residual effects of project related underwater noise on harbour porpoise behaviour during construction and operations will be moderate in magnitude, medium (construction) to long-term (operations) in duration, limited to the LAA, and reversible. Residual effects of project related underwater noise on harbour porpoise behaviour during decommissioning are predicted to be low in magnitude, short-term in duration occurring over multiple regular events, limited to the LAA, and reversible within a context of moderate ecological resilience. The residual, project related effects of this increase in underwater noise could affect localized distributions and communication of the species over the short-term (since potential exposure to a passing vessel will be transient in nature). With these mitigation applied, harbour porpoises may be displaced from the LAA/RAA due to underwater noise from project related activities, particularly during the 3-year construction over a distance of 5.3 km. However, the actual reactions of marine mammals are difficult to predict and depends on many variables including the type, magnitude and duration of noise, the species and its distance from the sound source, and the activity state of the animal at the time (Richardson et al. 1995). The prey species of harbour porpoises are anticipated to remain in the general area during construction and operations of the Project, and the probable avoidance of the RAA by harbour porpoises, might result in result in less predation on common prey species, including Pacific herring. The abundance and population trends of the harbour porpoise in the area are largely unknown; estimates by Best and Halpin 2011 indicate there are 2,806 to 3,647 individuals in the Queen Charlotte Basin, with high densities around Prince Rupert, southern portion of Chatham Sound and a very large area of Hecate Strait. It is expected that harbour porpoise will demonstrate moderate resilience to acoustic disturbance from project construction (e.g., pile installation) and operations (i.e., shipping). However, under the worst case scenario, harbour porpoise displaced by project activities for 3-years due to pile installation, will still have other suitable habitat available to them in the immediate vicinity. While the Project may affect the localized distributions of harbour porpoise over the short-term, it is not expected to affect the population viability of this species. Therefore, residual effects will be not significant. The level of confidence associated with this significance assessment is moderate as there is uncertainty associated with population level effects from changes in behaviour.

Cumulative Effects

The Project will result in residual effects that are not significant after applying all mitigation measures, as these effects are not anticipated to affect the overall harbour porpoise population viability. If project construction activities overlap temporally with the Project and the Canpotex Project, it will contribute to the overall cumulative effects.

The cumulative effect could result in a larger area of underwater noise that may result in auditory injury to harbour porpoise. However, the Project is unlikely to contribute to these effects in a way that affects the population viability and sustainability of harbour porpoise. Therefore, the Project's contribution to the cumulative effect of direct mortality or physical injury to the harbour porpoise population is predicted to be not significant.

The Project is likely to contribute to cumulative changes in harbour porpoise behaviour. However, after appropriate mitigation measures are implemented, the contribution to cumulative change in behaviour is predicted to be not significant as changes to behaviour are not expected to affect the sustainability of the harbour porpoise population.

Sea Otter

Baseline Conditions

Sea otters are listed as endangered by the IUCN as they are vulnerable to large scale population declines and declined by 50% in the past 30 years (IUCN 2012). They are listed as a species of special concern under Schedule 1 of the SARA and by COSEWIC (BC CDC 2014). Sea otters are blue-listed by the provincial government of BC (BC CDC 2014).

The current distribution of sea otters has changed dramatically compared to historic distributions. They were historically found from Japan to California. Due to the fur trade, they faced extinction by the mid-1800s but were successfully reintroduced and re-established along the north coast of Vancouver Island in the 70s (Bigg and MacAskie 1978). Sea otters' range has expanded to the northern tip of Aristazabal Island (Nichol et al. 2009). The BC population of sea otters exceeded 4,700 individuals in 2008, with approximately 600 individuals located on the central coast where numbers increased by 11.4% from 1990-2008 (Nichol et al. 2009). Although suitable sea otter habitat likely occurs within the LAA (Gregr et al. 2008), the area is currently beyond their northern range and no sightings have been recorded within the LAA.

Effects Assessment

Project construction activities (e.g., blasting and pile driving) that will occur in the LAA are currently beyond the northern range of sea otter distribution. Therefore, the potential effects of mortality (blasting only) or physical injury from underwater noise as a result of project construction activities are unlikely to impact the sea otter. If sea otters were to occur within the LAA, unmitigated blasting could result in injury or mortality of a sea otter, if close to the source, and underwater noise from unmitigated blasting and pile driving can cause auditory injury. Mitigation measures will be applied to reduce the potential for direct mortality (blasting only) or physical injury caused by underwater noise.

Mitigation measures for blasting will include using DFO's Blasting Guidelines (Wright and Hopky 1998), and enforcing a safety radius of 500 m (marine mammal exclusion zone) to ensure that marine mammals are not present in the safety radius prior to blasting. A marine mammal observation program will be implemented and MMOs will terminate blasting activities if cetaceans or marine mammals listed under SARA enter the 500 m blasting safety radius (detailed below). A Pile Driving Management plan for planning and operating will adhere to the Best Management Practices Policy for Pile Driving and Related Operations developed by the BC Marine and Pile Driving Contractors Association and DFO (BC Marine and Pile Driving Contractors Association 2003) wherever and whenever feasible. Pile installation with a bubble curtain will be used as a mitigation measure to prevent auditory injury from pile driving and reduce areal extents of underwater noise that could result in auditory threshold shifts in marine mammals (based on injury criteria given by NOAA and Southall et al. (2007)). A vibratory hammer (with bubble curtain at the marine terminal) will be used instead of an impact hammer to install piles whenever technically feasible. Bubble curtains with bubble-containment casing will be used with an impact hammer constructed of sound absorbent material, when a vibratory hammer is not technically feasible (e.g., due to unfavorable substrate). During all pile installation activities, a marine mammal observation program will be implemented. Marine mammal observers (MMOs) will monitor a safety (i.e., exclusion) zone around pile installation, including during pile

seating, and will halt the activities if cetaceans or other marine mammal species that are listed under SARA enter this zone. Underwater sound levels will also be measured/monitored in situ during the first seven days of underwater blasting and impact pile driving to acquire baseline data on sound pressure levels produced during each activity, and to field-validate the effectiveness of bubble curtains and the size of the safety zone (currently set at 500 m and 1.0 km respectively). If conditions or methodology change, monitoring will be re-started for another seven day period. If monitoring indicates sound levels in excess of 160 dB at the edge of the marine mammal safety (exclusion) zone for any activity, the activity will cease and DFO will be notified. The activity will resume after additional mitigation measures are implemented. Additional measures could include type/configuration of bubble curtain and size of safety radius for marine mammals. If monitoring indicates sound levels at or below 160 dB are being achieved at a distance of 500 m or less, the marine mammal safety (exclusion) zone for that activity may be reduced to 500 m. The duties and responsibilities of the MMOs will include the following protocols:

- Prior to commencement of impact pile installation activities and any time there is a pause in impact pile installation for more than 30 minutes, the safety zone will be surveyed visually by the MMO, and impact pile installation will not commence until (i) any observed cetacean or SARA-listed marine mammal is seen leaving the safety zone, or (ii) none have been detected in the safety zone for a period of 30 minutes
- Upon commencement of impact pile installation activities or recommencement after a delay of 30 minutes or more, pile installation will ramp-up by starting with slower, quieter strikes. This is designed to enable any marine mammals in the area time to leave the area prior to attainment of underwater noise levels capable of causing injury
- During conditions of low visibility (i.e., when the safety zone cannot be monitored, during foggy conditions or darkness), if pile installation activities have ceased for more than 30 minutes, the MMO will delay recommencement of start-up until conditions improve. Once conditions improve, the safety zone will be monitored for cetaceans or other marine mammals listed under SARA for 30 minutes before commencing impact pile installation.

There is currently no Recovery Strategy or Action plan in draft stage or finalized for this species. The mitigation measures presented in the Applicable Mitigation Measures column will help to reduce the potential effect from the project.

The likelihood of direct mortality or physical injury to marine mammals is expected to be low for blasting activities and low to moderate for underwater noise from pile installation. If a sea otter were located within the vicinity of project activities, the likelihood would apply, although the LAA is currently beyond their range. Mortality is not be expected from blasting as mitigation measures such as a safety radii and MMO program will be in place. The likelihood for residual effects from pile installation is expected to be moderate for marine mammals due to mitigation, although there is low probability for a sea otter to be within the LAA. The magnitude of the effects are expected to be moderate for blasting, and underwater noise, with changes outside the range of natural variability that are not expected to affect population viability of sea otters. The highest underwater noise effects from blasting or pile driving is anticipated to be short term during construction phases, with highest noise levels localized within the PDA (MOF and marine terminal construction locations) and attenuating into the LAA. With mitigation measures in place and low possibility of sea otters occurring within the LAA, the residual effects from the direct mortality or physical injury to sea otters are not expected to affect the sustainability of the population. As a result, the residual effect of direct mortality or physical injury is predicted to be not significant. The confidence in the assessment is high for direct mortality or physical injury to sea otters from blasting, due to the implementation of effective mitigation measures (i.e., enforcement of a blasting safety radius). The overall confidence level for injury or mortality to marine mammals is moderate based on the assumptions made in acoustic modelling of

underwater noise from construction activities and the potential from change in project design and operational details.

Project construction (e.g., pile-driving), operations (i.e., shipping) and decommissioning (e.g., dismantling and associated vessel movement) that will occur in the LAA/RAA are beyond the northern range of the sea otter. The potential effects of change in behaviour as a result of acoustic disturbance are unlikely to impact the sea otter. If sea otters were to occur within the LAA the project construction, operations, and decommissioning can create underwater noise that may result in change in sea otter behaviour.

Several of the mitigation measures recommended for reducing injury from blasting and pile installation will also reduce the potential for behavioural change in sea otters (e.g., MMO enforcement of an exclusion zone). Use of low noise piling techniques (e.g., vibratory hammers) is the key mitigation measure to prevent injury, but is also expected to reduce the extent of behavioural effects. Low noise pile installation techniques will be the primary method of pile installation due to the depths of soft sediment in the area. Impact pile driving will likely only be used to seat the piles into bedrock. When impact hammers are used, additional mitigations, such as use of a bubble curtain and enforcement of a marine mammal safety zone will be implemented. A bubble curtain will also be used during low noise pile installation, to further reduce the extent over which underwater noise exceeds the behavioural threshold for marine mammals. In addition, if sound levels from blasting or pile installation exceed SPL rms of 160 dB re 1 µPa at the edge of the marine mammal exclusion zone, these activities will cease and potential additional mitigation measures will be considered in consultation with DFO. LNG carrier vessel speeds will be reduced when approaching the Triple Island Pilot Boarding Station.

Based on implementation of the mitigation measures, it is expected that the residual effects of project related underwater noise on marine mammal behaviour during construction and operations will be moderate in magnitude, medium (construction) to long-term (operations) in duration, limited to the LAA, and reversible. Residual effects of project related underwater noise on marine mammal behaviour during decommissioning are predicted to be low in magnitude, short-term in duration occurring over multiple regular events, limited to the LAA, and reversible within a context of moderate ecological resilience. The likelihood of a residual effect on sea otter behaviour is low, as the LAA is north of their current range. Mitigation for construction activities is expected to reduce the number of marine mammals that may be exposed to underwater noise that could result in changes in behaviour. Reductions in vessel speed when approaching the pilot boarding station is expected to reduce the extent of underwater noise produced. Although sea otter behaviour could be affected by underwater noise associated with project construction and operations (shipping), this is not expected to affect the overall sea otter population viability, therefore residual effects will be not significant. The level of confidence associated with this significance assessment is moderate as there is uncertainty associated with how changes in behaviour from underwater noise can affect sea otter populations. This uncertainty is not unique to the Project as there are a limited number of studies available on behavioural responses and population level effects to marine mammals from underwater noise produced during in-water construction activities and noise generated by large vessels such as LNG carriers.

Cumulative Effects

The Project will result in residual effects that are not significant after applying all mitigation measures. However, it is unlikely the residual effects of the projects activities and other anticipated projects occurring in the region (i.e., Canpotex) at the same time will impact sea otter population viability as these effects are occurring outside the northern range of the sea otter.

The cumulative effect could result in a larger area of underwater noise that may result in auditory injury to sea otters, if they were to occur within the RAA. However, the Project is unlikely to contribute to these effects in a way that affects the population viability and sustainability of sea otters. Therefore, the Project's

contribution to the cumulative effect of direct mortality or physical injury to the sea otter population is predicted to be not significant.

The Project could contribute to cumulative changes in sea otters behaviour, if they were to occur within the RAA. However, after appropriate mitigation measures are implemented, the contribution to cumulative change in behaviour is predicted to be not significant as changes to behaviour are not expected to affect the sustainability of the sea otter population.

Loughlin's Northern Sea Lion

Baseline Conditions

Loughlin's northern sea lions are an eastern subspecies of Steller sea lions that occur on BC coasts and North Pacific waters. They are listed as *least concern* by IUCN, *special concern* under SARA and by COSEWIC, and *blue* by the provincial government (BC CDC 2014; COSEWIC 2003d). The BC population currently exceeds peak historic levels (DFO 2010a) with abundance estimates between 2,692 – 4,817 individuals in the Queen Charlotte Basin based on five survey years (Best and Halpin 2011).

Loughlin's sea lions are distributed from southeast Alaska to Oregon and occupy the coastal waters of BC year round. They have five breeding sites (rookeries) along the BC coast and several haul outs that are occupied in winter or year round (DFO 2010a). There are no rookeries or haul outs in the LAA, but a winter haul out exists just north of the LAA boundary and a year round haul out exists at Warrior Rocks south of the LAA (DFO 2010a). Many sightings are reported within Queen Charlotte Basin (Best and Halpin 2011), with only one located in the LAA (BC Cetacean Sightings Network 2013).

Effects Assessment

Project construction activities (e.g., blasting and pile driving) could result in residual effects of direct mortality (blasting only) or physical injury to Loughlin's sea lions, however no major haulouts or rookeries overlap with the LAA. Unmitigated blasting could also result in injury or mortality of a Loughlin sea lion, if close to the source, and underwater noise from unmitigated blasting and pile driving can cause auditory injury. Mitigation measures will be applied to eliminate the potential for direct mortality (blasting only) or physical injury caused by underwater noise.

Mitigation measures for blasting will include using DFO's Blasting Guidelines (Wright and Hopky 1998), and enforcing a safety radius of 500 m (marine mammal exclusion zone) to ensure that Loughlin sea lions are not present in the safety radius prior to blasting. A marine mammal observation program will be implemented and MMOs will terminate blasting activities if cetaceans or marine mammals listed under SARA enter the 500 m blasting safety radius (detailed below).

A Pile Driving Management plan for planning and operating will adhere to the Best Management Practices Policy for Pile Driving and Related Operations developed by the BC Marine and Pile Driving Contractors Association and DFO (BC Marine and Pile Driving Contractors Association 2003) wherever and whenever feasible. Pile installation with a bubble curtain will be used as a mitigation measure to prevent auditory injury from pile driving and reduce areal extents of underwater noise that could result in auditory threshold shifts in marine mammals (based on injury criteria for pinnipeds given by NOAA and Southall et al. (2007)). A vibratory hammer (with bubble curtain at the marine terminal) will be used instead of an impact hammer to install piles whenever technically feasible. Bubble curtains with bubble-containment casing will be used with an impact hammer constructed of sound absorbent material, when a vibratory hammer is not technically feasible (e.g., due to unfavourable substrate). During all pile installation activities, a marine mammal observation program will be implemented. Marine mammal observers (MMOs) will monitor a safety (i.e., exclusion) zone around pile installation, including during pile seating, and will halt the activities if cetaceans (of any species) or other marine mammal species that are listed under SARA enter this zone (i.e. Loughlin's sea lions). Underwater sound levels will also be measured/monitored in situ during the first seven days of underwater blasting and impact pile driving to acquire baseline data on sound pressure levels produced

during each activity, and to field-validate the effectiveness of bubble curtains and the size of the safety zone (currently set at 500 m and 1.0 km respectively). If conditions or methodology change, monitoring will be re-started for another seven day period. If monitoring indicates sound levels in excess of 160 dB at the edge of the marine mammal safety (exclusion) zone for any activity, the activity will cease and DFO will be notified. The activity will resume after additional mitigation measures are implemented. Additional measures could include type/configuration of bubble curtain and size of safety radius for marine mammals. If monitoring indicates sound levels at or below 160 dB are being achieved at a distance of 500 m or less, the marine mammal safety (exclusion) zone for that activity may be reduced to 500 m. The duties and responsibilities of the MMOs will include the following protocols:

- Prior to commencement of impact pile installation activities and any time there is a pause in impact pile installation for more than 30 minutes, the safety zone will be surveyed visually by the MMO, and impact pile installation will not commence until (i) any observed cetacean or SARA-listed marine mammal is seen leaving the safety zone, or (ii) none have been detected in the safety zone for a period of 30 minutes
- Upon commencement of impact pile installation activities or recommencement after a delay of 30 minutes or more, pile installation will ramp-up by starting with slower, quieter strikes. This is designed to enable any marine mammals in the area time to leave the area prior to attainment of underwater noise levels capable of causing injury
- During conditions of low visibility (i.e., when the safety zone cannot be monitored, during foggy conditions or darkness), if pile installation activities have ceased for more than 30 minutes, the MMO will delay recommencement of start-up until conditions improve. Once conditions improve, the safety zone will be monitored for cetaceans or other marine mammals listed under SARA for 30 minutes before commencing impact pile installation.

There is currently no Recovery Strategy or Action plan in draft stage or finalized for this species. The mitigation measures will help to reduce the potential effect from the Project.

The likelihood of direct mortality or physical injury to Loughlin's sea lions is expected to be low for blasting activities, after implementation of blasting mitigation measures during construction as a safety radii and MMO program will be in place, and low to moderate for underwater noise after pile installation mitigation measures. Loughlin sea lions are usually found hauled out near Triple Islands within the LAA and not within the LAA, which reduces the likelihood of exposure to construction activities. If the sea lions are not hauled out and in their aquatic habitat, the magnitude of the effects are expected to be moderate for blasting, and underwater noise, with changes outside the range of natural variability that are not expected to affect population viability of Loughlin's sea lions. It is expected that the Loughlin's sea lion population will demonstrate moderate resilience and recovery to individual injury effects. No direct mortality or physical injury is expected on terrestrial breeding habitat. The highest underwater noise effects from blasting or pile driving is anticipated to be short term during construction phases, with highest noise levels localized within the PDA (MOF and marine terminal construction locations) and attenuating into the LAA. With mitigation measures in place, the residual effects from the direct mortality or physical injury to Loughlin's sea lions are not expected to affect the sustainability of the population. As Loughlin's sea lions are not expected to be near the PDA, and are usually found hauled out near Triple Island, population viability is unlikely to be affected and the likelihood of mortality as a result of the Project is low, the residual effect of direct mortality or physical injury to Loughlin's sea lions is predicted to be not significant. The confidence in the assessment is high for direct mortality or physical injury to Loughlin's sea lions from blasting, due to the implementation of effective mitigation measures (i.e., enforcement of a blasting safety radius). The overall confidence level for injury or mortality to Loughlin's sea lions is moderate based on the current understanding of the species' presence and distribution in the LAA, assumptions made in acoustic modelling of underwater noise from construction activities and the potential from change in project design and operational details.

Project construction (e.g., pile-driving), operations (i.e., shipping) and decommissioning (e.g., dismantling and associated vessel movement) can create underwater noise that may result in changes of behaviour of marine mammals, including Loughlin's sea lions. Loughlin's sea lions are frequently observed hauled out near Triple Island of the LAA, however, if they are underwater, could be exposed to underwater noise from shipping. Behavioural effects caused by underwater noise are expected to be more prominent during the construction phase compared to operations, as in-water construction activities (e.g., pile installation) are known to produce louder underwater noise levels than operational activities (e.g., vessel movements).

Acoustic disturbance may affect Loughlin's northern sea lion aquatic habitat use (i.e., displacement from feeding areas), foraging success, and limit the availability of prey, potentially resulting in decreased reproductive rates (DFO 2010a). However, these effects are of primary concern near rookeries (i.e., breeding areas) and acoustic disturbance is considered a low concern for Loughlin's sea lion when in aquatic habitat, according to the SARA management plan for the species. Several of the mitigation measures recommended for reducing injury from blasting and pile installation will also reduce the potential for behavioural change in Loughlin's sea lions (e.g., MMO enforcement of an exclusion zone) Use of low noise piling techniques (e.g., vibratory hammers) is the key mitigation measure to prevent injury, but is also expected to reduce the extent of behavioural effects. Low noise pile installation techniques will be the primary method of pile installation due to the depths of soft sediment in the area. Impact pile driving will likely only be used to seat the piles into bedrock. When impact hammers are used, additional mitigations, such as use of a bubble curtain and enforcement of a marine mammal safety zone will be implemented. A bubble curtain will also be used during low noise pile installation, to further reduce the extent over which underwater noise exceeds the behavioural threshold for marine mammals. In addition, if sound levels from blasting or pile installation exceed an SPL rms of 160 dB re 1 µPa at the edge of the marine mammal exclusion zone, these activities will cease and potential additional mitigation measures will be considered in consultation with DFO. LNG carrier vessel speeds will be reduced when approaching the Triple Island Pilot Boarding Station. This will reduce the amount of underwater noise for Loughlin's sea lions that are present and potentially feeding in aquatic habitat of this area.

Based on implementation of the mitigation measures, it is expected that the residual effects of project related underwater noise on Loughlin's sea lions behaviour during construction and operations will be moderate in magnitude, medium (construction) to long-term (operations) in duration, limited to the LAA, and reversible. Residual effects of project related underwater noise on Loughlin's sea lion behaviour during decommissioning are predicted to be low in magnitude, short-term in duration occurring over multiple regular events, limited to the LAA, and reversible within a context of moderate ecological resilience. The likelihood of a residual effect to Loughlin's sea lions behaviour is high. Although behaviour will likely be affected by underwater noise associated with project construction and operations (shipping), this is not expected to affect population viability or important terrestrial breeding sites. The residual, project related effects of this increase in underwater noise could affect localized distributions and communication of the species over the short-term (since potential exposure to a passing vessel will be transient in nature).

The level of confidence associated with this significance assessment is moderate as there is uncertainty associated with how changes in behaviour from underwater noise can affect Loughlin's sea lion populations. The level of confidence associated with this significance assessment is moderate as there is uncertainty associated with population level effects from changes in behaviour.

Cumulative Effects Assessment

The Project will result in residual effects that are not significant after applying all mitigation measures, as these effects are not anticipated to affect the overall Loughlin's population viability. If project construction activities overlap temporally with the Project and the Canpotex Project, it will contribute to the overall cumulative effects.

The cumulative effect could result in a larger area of underwater noise that may result in auditory injury Loughlin's sea lions using aquatic habitat. However, the Project is unlikely to contribute to these effects in a way that affects the population viability and sustainability of Loughlin's sea lions. Therefore, the Project's contribution to the cumulative effect of direct mortality or physical injury to the of Loughlin's sea lion population is predicted to be not significant.

The Project is likely to contribute to cumulative changes of Loughlin's sea lion behaviour. However, after appropriate mitigation measures are implemented, the contribution to cumulative change in behaviour is predicted to be not significant as changes to behaviour are not expected to affect the sustainability of the Loughlin's sea lion population.

Table 9 Summary of Residual Effects Characterizations for Marine Fish

Species	Effect	Residual Effects Characterization								
		Context	Magnitude	Extent	Duration	Reversibility	Frequency	Likelihood	Significance	Confidence
Bluntnose sixgill shark	Change in Marine Habitat Availability	-	-	-	-	-	-	-	-	-
	Direct Mortality or Physical Injury	M	L	L	L	R	C	L	N	M
	Change in Behaviour		M	L	S	R	C	H	N	M
	Change in Sediment or Water Quality		M	L	L	R	C	M	N	M
Bocaccio	Change in Marine Habitat Availability	M	M	P	P	R	S	L	N	M
	Direct Mortality or Physical Injury		L	L	L	R	C	L	N	M
	Change in Behaviour		M	L	S	R	C	H	N	M
	Change in Sediment or Water Quality		M	L	L	R	C	H	N	M
Canary rockfish	Change in Marine Habitat Availability	M	M	P	P	R	S	L	N	M
	Direct Mortality or Physical Injury		L	L	L	R	C	L	N	M
	Change in Behaviour		M	L	S	R	C	H	N	M
	Change in Sediment or Water Quality		M	L	L	R	C	H	N	M
Darkblotched rockfish	Change in Marine Habitat Availability	-	-	-	-	-	-	-	-	-
	Direct Mortality or Physical Injury	M	L	L	L	R	C	L	N	M
	Change in Behaviour		M	L	S	R	C	H	N	M
	Change in Sediment or Water Quality		M	L	L	R	C	H	N	M
Eulachon (Nass/Skeena Rivers population)	Change in Marine Habitat Availability	M	M	P	P	R	S	L	N	M
	Direct Mortality or Physical Injury		M	L	L	R	C	L	N	M
	Change in Behaviour		M	L	S	R	C	H	N	M
	Change in Sediment or Water Quality		M	L	L	R	C	M	N	M
Green sturgeon	Change in Marine Habitat Availability	M	L	P	P	R	S	L	N	M
	Direct Mortality or Physical Injury		L	L	L	R	C	M	N	M
	Change in Behaviour		M	L	S	R	C	H	N	M
	Change in Sediment or Water Quality		M	L	L	R	C	H	N	M
North Pacific Spiny Dogfish	Change in Marine Habitat Availability	M	L	P	P	R	S	L	N	M
	Direct Mortality or Physical Injury		L	L	L	R	C	L	N	M
	Change in Behaviour		M	L	S	R	C	H	N	M
	Change in Sediment or Water Quality		M	L	L	R	C	H	N	M
Northern abalone	Change in Marine Habitat Availability	-	-	-	-	-	-	-	-	-
	Direct Mortality or Physical Injury	-	-	-	-	-	-	-	-	-
	Change in Behaviour	-	-	-	-	-	-	-	-	-
	Change in Sediment or Water Quality	M	M	L	L	R	C	H	N	M

Species	Effect	Residual Effects Characterization								
		Context	Magnitude	Extent	Duration	Reversibility	Frequency	Likelihood	Significance	Confidence
Quillback rockfish	Change in Marine Habitat Availability	M	M	P	P	R	S	L	N	M
	Direct Mortality or Physical Injury		L	L	L	R	C	L	N	M
	Change in Behaviour		M	L	S	R	C	H	N	M
	Change in Sediment or Water Quality		M	L	L	R	C	H	N	M
Rougheye rockfish	Change in Marine Habitat Availability	M	M	P	P	R	S	L	N	M
	Direct Mortality or Physical Injury		L	L	L	R	C	L	N	M
	Change in Behaviour		M	L	S	R	C	H	N	M
	Change in Sediment or Water Quality		M	L	L	R	C	H	N	M
Yelloweye rockfish	Change in Marine Habitat Availability	-	-	-	-	-	-	-	-	-
	Direct Mortality or Physical Injury	M	L	L	L	R	C	L	N	M
	Change in Behaviour		M	L	S	R	C	H	N	M
	Change in Sediment or Water Quality		M	L	L	R	C	H	N	M

Table 10 Summary of Residual Effects Characterizations for Marine Mammals

Species	Effect	Residual Effects Characterization								
		ontext	lagnitude	xtent	uration	eversibility	requency	ikelihood	ignificance	onfidence
Fin whale	Direct Mortality or Physical Injury	M	M	L	S	R	M	L-M	N	M
	Change in Behaviour	L-M	M	L	L	R	M/C	H	N	M
Humpback whale	Direct Mortality or Physical Injury	M	M	L	S	R	M	L-M	N	M
	Change in Behaviour	L-M	M	L	L	R	M/C	H	N	M
Gray whale	Direct Mortality or Physical Injury	M	M	L	S	R	M	L-M	N	M
	Change in Behaviour	L-M	M	L	L	R	M/C	H	N	M
Northern resident killer whale	Direct Mortality or Physical Injury	M	M	L	S	R	M	L-M	N	M
	Change in Behaviour	L-M	M	L	L	R	M/C	H	N	M
Bigg's killer whale	Direct Mortality or Physical Injury	M	M	L	S	R	M	L-M	N	M
	Change in Behaviour	L-M	M	L	L	R	M/C	H	N	M
Harbour porpoise	Direct Mortality or Physical Injury	M	M	L	S	R	M	L-M	N	M
	Change in Behaviour	L-M	M	L	L	R	M/C	H	N	M
Sea Otter	Direct Mortality or Physical Injury	M	M	L	S	R	M	L-M	N	M
	Change in Behaviour	L-M	M	L	L	R	M/C	L	N	M
Loughlin's northern sea lion	Direct Mortality or Physical Injury	M	M	L	S	R	M	L-M	N	M
	Change in Behaviour	L-M	M	L	L	R	M/C	H	N	M

Summary

This memo addresses three comments received from Environment Canada requesting information on a species-by-species basis for SARA Schedule 1, 2, 3 listed and COSEWIC designated species likely to occur in the local and regional assessment areas for terrestrial wildlife and marine birds and marine resources valued components. For each species-at-risk, a screening exercise was performed to identify whether there is a potential pathway for interaction with a project effect. Species that have potential for an interaction with a project effect (i.e., at least one project effect has been identified) were carried forward to a more detailed assessment that identifies specific project effects, mitigation measures consistent with available recovery strategies, residual effects significance, and an evaluation of cumulative effects.

Information presented for individual species-at-risk in this technical memo are consistent with conclusions discussed for terrestrial wildlife and marine birds and marine resources valued components in Section 11 and Section 13 of the EIS. Based on the information provided in this report, combined with information presented in the EIS, characterizations of residual effects remain unchanged from the original assessment. Accordingly, conclusions of the assessment of project effects on species at risk remain the same and no additional changes to the cumulative effects assessment are considered necessary.

Closure

This letter provides the Outstanding Information requested by the Government of Canada. If you have any questions, please contact Pacific NorthWest LNG.

References

AECOM. 2013. Prince Rupert LNG Project Description. Prepared for Prince Rupert LNG Ltd., Vancouver, BC.

American Ornithologists' Union (AOU). 1983. Check-list of North American Birds. 6th ed. American Ornithologists' Union, Washington, D.C.

Apps, C.D., B.N. McLellan, J.G. Woods, and M.F. Proctor. 2004. Estimating Grizzly Bear Distribution and Abundance Relative to Habitat and Human Influence. Journal of Wildlife Management 68: 138-152.

Barlow, J., J. Calambokidis, E.A. Falcone, C.S. Baker, A.M. Burdin, P.J. Clapham, J.K. Ford, C.M. Gabriele, R. LeDuc and D.K. Mattila. 2011. Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. Marine Mammal Science 27(4):793-818.

BC Cetacean Sightings Network. 2013. BC Cetacean Sightings Database. Vancouver Aquarium Marine Science Centre, and Fisheries and Oceans Canada. Vancouver, B.C.

BC Conservation Data Centre. 2014. BC Species and Ecosystems Explorer. B.C. Ministry of Environment, Victoria B.C. Available: http://a100.gov.bc.ca/pub/eswp/. Accessed: November 14, 2014.

BC Marine and Pile Driving Contractors Association. 2003. Best management practices for pile driving and related operations.

British Columbia Ministry of Environment (BC MOE). 2013. Recovery Plan for the Western Screech-owl, kennicottii subspecies (Megascops kennicottii kennicottii) in British Columbia. B.C. Ministry of Environment, Victoria, BC 23pp.

BC Ministry of Sustainable Resource Management (BC MSRM). 2005. North Coast Land and Resource Management Plan: Final Recommendations. Victoria, BC. 217 pp.

BC Ministry of Water, Land and Air Protection (BC MWLAP). 2004. Accounts and Measures for Managing Identified Wildlife. Version 2004. Biodiversity Branch, Identified Wildlife Management Strategy, Victoria, B.C.

British Columbia Oil and Gas Commission (BC OGC). 2009. British Columbia Noise Control Best Practices Guideline, British Columbia Oil and Gas Commission. Victoria, BC.

Beebe, F.L. 1960. The Marine Peregrines of the Northwest Pacific Coast. Condor 62: 154-189.

Best, B. and P. Halpin. 2011. Predictive Marine Mammal Modelling for Queen Charlotte Basin, British Columbia: Technical Report. Raincoast Conservation Foundation. 120 pp.

Bigg, M.A. and I.B. MacAskie. 1978. Sea otters reestablished in British Columbia. *Journal of Mammalogy* 59(4):874-876.

Blood, D.A. 1998. Marbled Murrelet [brochure]. Ministry of Environment, Lands and Parks, Victoria, BC. 6 pp.

Blood, D.A. and F. Backhouse. 1999. Western Grebe. BC Ministry of Environment, Lands and Parks, Wildlife Branch. Victoria, BC 6 pp.

Boland, J.L., J.P. Hayes, W.P. Smith, and M.M. Huso. 2009. Selection of Day-Roosts by Keen's Myotis (Myotis Keenii) at Multiple Spatial Scales. Journal of Mammalogy 90(1): 222-234.

Braun, C.E. 1994. Band-tailed Pigeon. In Migratory shore and upland game bird management in North America. International Association of Fish and Wildlife Agencies. Allen Press, Lawrence, KS.

British Columbia Breeding Bird Atlas. 2014. Data accessed from NatureCounts, a node of the Avian Knowledge Network, Bird Studies Canada. Available: http://www.naturecounts.ca/. Accessed: November 14, 2014.

British Columbia Oil and Gas Commission (BC OGC). 2009. British Columbia Noise Control Best Practices Guideline, British Columbia Oil and Gas Commission. Victoria, BC.

Burger, A.E. 1997. Status of the Western Grebe in British Columbia. B.C. Ministry of Environment, Lands and Parks, Wildlife Branch. Working Report, WR-87. 40 pp.

Burger, A.E. 2001. Using radar to estimate populations and assess habitat associations of Marbled Murrelets. Journal of Wildlife Management 65: 696-715.

Calambokidis, J., G.H. Steiger, J.M. Straley, L.M. Herman, S. Cerchio, D.R. Salden, J. Urban R., J.K. Jacobsen, O. von Ziegesar, K.C. Balcomb and C.M. Gabriele. 2001. Movements and population structure of humpback whales in the North Pacific. Marine Mammal Science 17(4):769-794.Campbell, R. W., N. K. Dawe, I. McTaggart-Cowan, J. M. Cooper, G. W. Kaiser and M. C. E. McNall 1990a. The Birds of British Columbia. Volume 1—Introduction and Loons through Waterfowl. Royal British Columbia Museum, Victoria. 514 p.

Campbell, R.W., N.K. Dawe, I. McTaggart-Cowan, J.M. Cooper, G.W. Kaiser, and M.C.E. McNall. 1990b. The Birds of British Columbia. Volume 2 – Non-Passerines, Diurnal Birds of Prey through Woodpeckers. Royal BC Museum, Victoria and Canadian Wildlife Service, Delta, BC.

Canadian Environmental Assessment Agency (CEAA). 2013. Environmental Impact Statement Guidelines for the Pacific Northwest LNG Project. 44 pp.

Carretta, J.V., K.A. Forney, M.S. Lowry, J. Barlow, J. Baker, D. Johnston, B. Hanson, R.L. Brownell Jr., J. Robbins, D.K. Mattila, K. Ralls, M.M. Muto, D. Lynch and L. Carswell. 2009. U.S. Pacific Marine Mammal Stock Assessments. Publications Agencies and Staff of the U.S. Department of Commerce.

Clark, R.J. 1975. A field study of the short-eared owl (Asio flammeus) population in North America. Wildlife Monographs 47:1-67.

Clarke, C.L. and G.S. Jamieson. 2006. Identification of Ecologically and Biologically Significant Areas in the Pacific North Coast Integrated Management Area: Phase II - Final report. Canadian Technical Report of Fisheries and Aquatic Sciences 2678. Department of Fisheries and Oceans Canada. v + 25 pp.

Cornell Lab of Ornithology. 2013. Cackling Goose, Branta hutchinsii; All About Birds. Available: http://www.allaboutbirds.org/guide/Cackling_Goose/lifehistory. Accessed: December 11, 2013.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2002a. COSEWIC assessment and update status report on the Grizzly Bear *Ursus arctos* in Canada. Committee on the Status of Endangered Wildife in Canada. Ottawa, ON. vii + 91 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2002b. COSEWIC assessment and update status report on the Western Screech-owl (Otus kennicottii) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. vi + 31 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2002c. COSEWIC Assessment and Status Report on the Western Toad Bufo boreas in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. vi + 31 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2003a. COSEWIC assessment and update status report on Keen's long-eared bat (Myotis keenii) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. vii + 35pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2003b. COSEWIC assessment and Update Status Report on the Harbour Porpoise Phocoena phocoena (Pacific ocean population) in Canada. Canadian Wildlife Service, Environment Canada. Ottawa, ON. vi + 22 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2003c. COSEWIC Assessment and Update Status Report on the Wolverine *Gulo gulo* in Canada. Committee on the Status of Endangered Wildife in Canada. Ottawa, ON. vi + 41 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2003d. COSEWIC Assessment and Update Status Report on the Steller Sea Lion Eumetopias jubatus in Canada. Canadian Wildlife Service, Environment Canada. Ottawa, ON. vii + 47 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2004a. COSEWIC assessment and update status report on the Ancient Murrelet Synthliboramphus antiquus in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. vi + 31pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2004b. COSEWIC Assessment and Status Report on the Green Sturgeon Acipenser medirostris in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. Vii + 31 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2005. COSEWIC assessment and Update Status Report on the Fin Whale Balaenoptera physalus in Canada. Canadian Wildlife Service, Environment Canada. Ottawa, ON. ix + 37 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2007a. COSEWIC assessment and status report on the bluntnose sixgill shark Hexanchus griseus in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. vii + 33 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2007b. COSEWIC Assessment and Status Report on the Canary Rockfish Sebastes pinniger in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. vii + 7l pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2007c. COSEWIC assessment and status report on the Common Nighthawk (Chordeiles minor) in Canada. Ottawa, ON. vi + 25pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2007d. COSEWIC assessment and status report on the Olive-sided Flycatcher Contopus cooperi in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. vii + 25 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2007e. COSEWIC assessment and status report on the Peregrine Falcon *Falco peregrinus* (*pealei* subspecies – *Falco peregrinus* and *pealei anatum/tundrius – Falco peregrinus anatum/tundrius*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. vii + 45 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2007f. COSEWIC Assessment and Status report on the Rougheye Rockfish Sebastes sp. Type I and Sebastes sp. Type II in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. viii + 36 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2008a. COSEWIC assessment and status report on the Band-tailed Pigeon Patagioenas fasciata in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. vii + 42 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2008b. COSEWIC assessment and update status report on the Great Blue Heron fannini subspecies Ardea herodias fannini in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. vii + 39pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2008c. COSEWIC Assessment and Update Status Report on the Killer Whale Orcinus orca, Southern Resident Population, Northern Resident Population, West Coast Transient Population, Offshore Population and Northwest Atlantic / Eastern Arctic Population, in Canada. Canadian Wildlife Service, Environment Canada. Ottawa, ON. viii + 65 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2008d. COSEWIC Assessment and Status Report on Yelloweye Rockfish Sebastes ruberrimus, Pacific Ocean Inside Waters Population and Pacific Ocean Outside Waters Population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. xi + 75 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2009a. COSEWIC Assessment and Status Report on the Darkblotched Rockfish Sebastes crameri in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. vii + 48 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2009b. COSEWIC assessment and status report on the Horned Grebe Podiceps auritus, Western population and Magdalen Islands population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. vii + 42 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2009c. COSEWIC Assessment and Update Status Report on the Northern Abalone Haliotis kamtschatkana in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. vii + 48 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2011a. COSEWIC assessment and status report on the North Pacific Spiny Dogfish Squalus suckleyi in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. x + 45 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2011b. COSEWIC assessment and status report on the Humpback Whale Megaptera novaeangliae in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. X + 32 pp. (www.sararegistry.gc.ca/status_e.cfm).

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2012. COSEWIC assessment and status report on the Western Screech-Owl kennicottii subspecies Megascops kennicottii kennicottii and

the Western Screech-Owl macfarlanei subspecies Megascops kennicottii macfarlanei in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. xii + 30 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2013a. COSEWIC Assessment and Status report on Bocaccio Sebastes paucispinis in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. xi + 49 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2013b. COSEWIC Assessment and Status Report on the Eulachon, Nass/Skeena River population, Central Pacific Coast Population and the Fraser River Population Thaleichthys pacificus in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. xv + 88 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2013c. COSEWIC assessment and status report on the Little Brown Myotis Myotis lucifugus, Northern Myotis Myotis septentrionalis and Tri-colored Bat Perimyotis subflavus in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. xxiv + 93 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2013d. COSEWIC assessment and status report on the Northern Goshawk Accipiter gentilis laingi in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. x + 56 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2013e. COSEWIC Assessment and Status Report on Quillback Rockfish Sebastes maliger in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. vii + 71 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2014. COSEWIC assessment and status report on the Western Grebe *Aechmophorus occidentalis*, in Canada. Committee on the Status of Endangered Wildlife in Canda. Ottawa. x + 49 pp.

Corkran, C.C. and C.R. Thoms. 2006. Amphibians of Oregon, Washington, and British Columbia. Lone Pine Publishing. Vancouver, BC.

Dalla Rosa, L., J.K.B. Ford and A.W. Trites. 2012. Distribution and relative abundance of humpback whales in relation to environmental variables in coastal British Columbia and adjacent waters. Continental Shelf Research 36:89-104.Doyle, F. 2003. Biological review and interim strategy for goshawks on Haida Gwaii/Queen Charlotte Islands. Ministry of Water, Land, and Air Protection. Smithers, BC. 65 pp.

Department of Justice Canada. 2011. Order Giving Notice of Decisions Not to Add Certain Species to the List of Endangered Species, SI/2011-56. Available at: http://laws-lois.justice.gc.ca/PDF/SI-2011-56.pdf. Accessed November 2014.

Dunbrack R. and R. Zielinski. 2003. Seasonal and diurnal activity of sixgill sharks (Hexanchus griseus) on a shallow water reef in the Strait of Georgia, British Columbia. Canadian Journal of Zoology 81:1107-1111.

Environment Canada. 2014a. Avoidance Guidelines for Incidental Take. Available at: http://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=AB36A082-1. Accessed: October 31, 2014.

Environment Canada. 2014b. Recovery Strategy for Marbled Murrelet (Brachyramphus marmoratus) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. v + 49 pp.

Environmental Assessment Office (EAO). 2013. Guideline for the Selection of Valued Components and Assessment of Potential Effects. Victoria, BC. 45 pp.

Ehrlich, P.R., D.S. Dobkin, and D. Wheye. 1992. Birds in Jeopardy: the Imperiled and Extinct Birds of the United States and Canada, Including Hawaii and Puerto Rico. Stanford University Press, Stanford, California. 259 pp.

Firman, M., M. Gety, and R.M.R. Barclay. 1993. Status of Keen's Long-eared Myotis in British Columbia. BC Ministry of Environment, Victoria, BC. Wildlife Working Report WR-59.

Fisheries and Oceans Canada (DFO). 2003. Tidal Waters Sport Fishing Guide. Available at: http://www-comm.pac.dfo-mpo.gc.ca/pages/sfg/tables_e.htm. Accessed November 2014.

Fisheries and Oceans Canada. 2005. MAPSTER (version 3.0). Fisheries and Oceans Canada, Pacific Region, Oceans, Habitat and Enhancement Branch. Fish and fish habitat related information served from an ESRI ArcIMS Server using the WMS Connector. Available at: http://www-heb.pac.dfo-mpo.gc.ca/maps/mapsdata_e.htm. Accessed: September, 2014.

Fisheries and Oceans Canada (DFO). 2007. Recovery Strategy for the Transient Killer Whale (Orcinus orca) in Canada. Fisheries and Oceans Canada. Vancouver, BC. vi + 46 pp.

Fisheries and Oceans Canada (DFO) and BC Ministry of Sustainable Resource Management. 2007. Cetacean Distribution on the North and South Coast. Vector Digital Data, OHEB Data. DFO Oceans, Habitat Enhancement Branch.

Fisheries and Oceans Canada (DFO). 2009. Management Plan for the Pacific Harbour Porpoise (Phocoena phocoena) in Canada. Fisheries and Oceans Canada. Ottawa. v + 49 pp. pp.

Fisheries and Oceans Canada (DFO). 2010a. Management Plan for the Steller Sea Lion (Eumetopias jubatus) in Canada [Final]. Species at Risk Act Management Plan Series. Fisheries and Oceans Canada. Ottawa, ON. vi + 69 pp.

Fisheries and Oceans Canada (DFO). 2010b. Pacific Region Cold-Water Coral and Sponge Conservation Strategy 2010-2015. Vancouver, BC. Available at: http://www.dfo-mpo.gc.ca/Library/344719.pdf. Accessed November 2014.

Fisheries and Oceans Canada (DFO). 2011. Recovery Strategy for the Northern and Southern Resident Killer Whales (Orcinus orca) in Canada. Species at Risk Act Recovery Strategy Series, Fisheries & Oceans Canada. Fisheries and Oceans Canada. Ottawa. ix + 80 pp.

Fisheries and Oceans Canada (DFO). 2012a. Action Plan for the Northern Abalone (Haliotis kamtschatkana) in Canada Species at Risk Act Action Plan Series. Fisheries and Oceans Canada, Ottawa. vii + 65 pp.

Fisheries and Oceans Canada (DFO). 2012b. Information relevant to the assessment of critical habitat for Blue, Fin, Sei and North Pacific Right Whales in British Columbia. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2011/078.

Fisheries and Oceans Canada (DFO). 2013a. Partial Action Plan for Blue, Fin, Sei and North Pacific Right Whales (Balaenoptera musculus, B. physalus, B. borealis, and Eubalaena japonica) in Pacific Canadian Waters. Species at Risk Act Action Plan Series. Fisheries and Oceans Canada, Ottawa. iv + 23 pp.

Fisheries and Oceans Canada (DFO). 2013b. Recovery Strategy for the North Pacific Humpback Whale (Megaptera novaeangliae) in Canada Species at Risk Act Recovery Strategy Series. Fisheries and Oceans Canada. Ottawa, ON. x + 67 pp.

Fisheries and Oceans Canada (DFO). 2013c. Information in Support of the Identification of Critical Habitat for Transient Killer Whales (Orcinus orca) Off the West Coast of Canada 2013/025. Fisheries and Oceans Canada.Fisheries and Oceans Canada (DFO). 2014. Pacific Region: Integrated Fisheries Management Plan Groundfish, February 21, 2014. Available at: http://www.pac.dfo-mpo.gc.ca/fm-gp/mplans/2014/ground-fond/ground-fond-sm-2014-eng.pdf. Accessed November 2014.

Flinn, R.D., A.W. Trites, E.J. Gregr and R.I. Perry. 2002. Diets of Fin, Sei, and Sperm whales in British Columbia: an analysis of commercial whaling records. Marine Mammal Science 18(3):663-679.

Ford, J.K.B. and G.M. Ellis. 1999. Transients : Mammal-Hunting Killer Whales of British Columbia, Washington, and Southeastern Alaska. UBC Press. Vancouver, B.C.

Ford, J.K.B. 2006. Assessment of Critical Habitats of Resident Killer Whales in Waters off the Pacific Coast of Canada. Canadian Science Advisory Secretariat, Research Document. Nanaimo, BC. 1-34 pp.

Ford, J.K.B. and G.M. Ellis. 2006. Selective foraging by fish-eating killer whales Orcinus orca in British Columbia. Marine Ecology Progress Series 316:185-199.Gaston, A.J., and D.N. Nettleship. 1981. Thick-billed murres of Prince Leopold Island. Canadian Wildlife Service, Ottawa, ON. 350 pp.

Ford, J.K.B., G.M. Ellis and J.W. Durban. 2007. *Recovery potential assessment for West Coast transient killer whales in using coastal waters of British Columbia*. DFO Canadian Science Advisory Secretariat Research Document 2007/088.

Ford, J.K.B., A.L. Rambeau, R.M. Abernethy, M.D. Boogaards, L.M. Nichol and L.D. Spaven. 2009. An assessment of the potential for recovery of humpback whales off the Pacific coast of Canada. DFO Canadian Science Advisory Secretariat Research Document 2009/015. iv + 33 pp.

Ford, J.K.B., R.M. Abernathy, A.V. Phillips, J. Calambokidis, G.M. Ellis and L.M. Nichol. 2010. Distribution and Relative Abundance of Cetaceans in Western Canadian Waters from Ship Surveys, 2002-2008. Canadian Technical Report of Fisheries and Aquatic Sciences 2913:v + 51 pp.

Ford, J.K.B., J.W. Durban, G.M. Ellis, J.R. Towers, J.F. Pilkington, L.G. Barrett-Lennard and R.D. Andrews. 2012. New insights into the northward migration route of gray whales between Vancouver Island, British Columbia, and southeastern Alaska. Marine Mammal Science:1- 13.

Gaston, A.J. 1994. Status of the Ancient Murrelet, (Synthliboramphus antiquus) in Canada and the Effects of Introduce Predators. The Canadian Field-Naturalist 108: 212-222.

Gregr, E.J. and A.W. Trites. 2001. Predictions of critical habitat for five whale species in the waters of coastal British Columbia. Canadian Journal of Fisheries and Aquatic Sciences 58(7):1265- 1285.

Gregr, E.J., J. Calambokidis, L. Convey, J.K.B. Ford, R.I. Perry, L.D. Spaven and M. Zacharias. 2006. Recovery Strategy for Blue, Fin, and Sei Whales (Balaenoptera musculus, B. physalus, B. borealis) in Pacific Canadian Waters. In Species at Risk Act Recovery Strategy Series. Vancouver: Fisheries and Oceans Canada. vii + 53 pp.

Gregr, E.J., L.M. Nichol, J.C. Watson, J.K.B. Ford and G.M. Ellis. 2008. Estimating carrying capacity for sea otters in British Columbia. The Journal of Wildlife Management 72(2):382-388.

Hart, J.L. 1988. Pacific Fishes of Canada. Fisheries Research Board of Canada. Ottawa, ON

Heise, K., J.K.B. Ford and P.F. Olesiuk. 2007. Appendix J: Marine mammals and turtles. In B. G. Lucas, S. Verrin & R. Brown (Eds.), Ecosystem overview: Pacific North Coast Integrated Management Area (PNCIMA). Canadian Technical Report of Fisheries and Aquatic Sciences Vol. 2667, iv + 35.

Hilty, S.L. and W.L. Brown. 1986. A Guide to the Birds of Colombia. Princeton University Press, Princeton, NJ. 836 pp.

International Union for Conservation of Nature (IUCN). 2012a. IUCN Red List of Threatened Species. Version 2012.2. Available at: http://www.iucnredlist.org/details/13006/0. Accessed: June, 2013.

Kelson, J. 2011. 2011 Skeena Estuary Study. Smithers, BC.

Kissling, M.L. and S.B. Lewis. 2009. Distribution, Abundance, and Ecology of Forest Owls in Southeast Alaska. U.S. Fish and Wildlife Service, Juneau Field Office, Alaska, and Alaska Deparment of Fish and Game, Division of Wildlife Conservation, Douglas, Alaska. 215 pp.

Klinkenberg, B. 2012. E-Fauna BC: Electronic Atlas of the Fauna of British Columbia. Available at: www.efauna.bc.ca. University of British Columbia, Vancouver, BC. Accessed: August 1, 2013.

Krebs, J.A. and D.Lewis. 2000. Wolverine Ecology and Habitat Use in the North Columbia Mountains: Progress Report. Ministry of Environment, Lands, and Parks, Victoria, BC.Leonard, J.P. 1998. Nesting and Foraging Ecology of Band-tailed Pigeons in Western Oregon. PhD Thesis. Oregon State University, Corvallis, Oregon.

Love, M.S., M. Yaklovich and L. Thorsteinson. 2002. The Rockfishes of the Northeast Pacific. University of California Press. 404 pp.

Mace, R.D., J.S. Waller, T.L. Manley, K. Ake, and W.T. Wittinger. 1999. Landscape Evaluation of Grizzly Bear Habitat in Western Montana. Conservation Biology 13(2): 367-377.

Mahon, T., E.L. McClaren, and F.I. Doyle. 2008. Parameterization of the Northern Goshawk (Accipiter gentilis laingi) Habitat Model for Coastal British Columbia: Nesting and Foraging Habitat Suitability Models and Territory Analysis Model (Working Draft). WildFor Consultants Ltd., BC Ministry of Environment, and Wildlife Dynamics, BC. 52 pp.

Mallory, M.L., S.A. Hatch, and D.N. Nettleship. 2012. Northern Fulmar (Fulmarus glacialis), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. Available: http://bna.birds.cornell.edu/bna/species/361. Accessed: December 11, 2013.

Matsuda B. M., D.M. Green, P.T. Gregory. 2006. Amphibians and Reptiles of British Columbia. Royal BC Museum, Victoria, BC.

McCarter, P.B. and D.E. Hay. 1999. Distribution of Spawning Eulachon Stocks in the Central Coast of British Columbia as Indicated by Larval Surveys. (Research Document 99/177). Canadian Stock Assessment Secretariat. Fisheries and Oceans Canada. Nanaimo, BC. 67 pp

McLellan, B.N. 1998. Maintaining Viability of Brown Bears Along the Southern Fringe of their Distribution. Ursus 10: 607-611.

Ministry of Environment (MOE). 2013. Recovery plan for the Western Screech-Owl, kennicottii subspecies (Megascops kennicottii kennicottii) in British Columbia. B.C. Ministry of Environment, Victoria, BC. 23 pp.

Ministry of Forests, Lands, and Natural Resource Operations and Ministry of Environment (MFLNRO). 2013. Management plan for the Northern Goshawk, laingi subspecies (Accipiter gentilis laingi) in British Columbia. B.C. Ministry of Forests, Lands, and Natural Resource Operations and B.C. Ministry of Environment, Victoria, BC. 30 pp.

Mizroch, S.A., D.W. Rice, D. Zwiefelhofer, J. Waite and W.L. Perryman. 2009. Distribution and movements of fin whales in the North Pacific Ocean. Mammal Review 39(3):193-227.

Moody, M. F. 2008. Eulachon past and present. Master's thesis. University of British Columbia: Vancouver, BC.

Nagorsen, D.W. and R.M. Brigham. 1993. Bats of British Columbia. Vancouver, BC. 164 pp.

Nichol, L.M., M.D. Boogaards and R. Abernethy. 2009. *Recent Trends in the Abundance and Distribution of Sea Otters (Enhydra lutris) in British Columbia.* DFO Canadian Science Advisory Secretariat. iv+16 pp.

Nichol, L.M., R. Abernethy, L. Flostrand, T.S. Lee and J.K.B. Ford. 2010. Information Relevant for the Identification of Critical Habitats of North Pacific Humback Whales (Megaptera novaeangliae) in British Columbia. DFO Canadian Science Advisory Secretariat Research Document 2009/116. 40 pp.

Northern Goshawk Accipiter gentilis laingi Recovery Team (NGRT). 2008. Recovery Strategy for the Northern Goshawk, laingi Subspecies (Accipiter gentilis laingi) in British Columbia. Prepared for the BC Ministry of Environment, Victoria, BC. 56 pp.

Olsen, N. and Wallace, S.S. 2006. A Review of Yelloweye Rockfish Sebastes ruberrimus along the Pacific coast of Canada: Biology, Distribution and Abundance Trends. Canadian Science Advisory Secretariat Research Document. 2006/076. x + 54 pp.

Olson, D.H. 2001. Ecology and management of montane amphibians of the U.S. Pacific Northwest. Biota 2: 51-74.

Poll, O.M., M.M. Porter, G.L. Holroyd, R.M. Wershler, and L.W. Gyug. 1984. Ecological Land Classification of Kootenay National Park, BC. Volume II. Canadian Wildlife Service, Edmonton, AB.

Rambeau, A.L. 2008. Determining Abundance and Stock Structure for a Widespread, Migratory Animal: The Case of Humpback Whales (Megaptera novaeangliae) in British Columbia, Canada. MSc Thesis. University of British Columbia. Vancouver, BC.

Ramsay, L.R. and S.G. Cannings. 2000. Dragonflies at Risk in British Columbia. Ministry of Environment, Lands, and Parks, Victoria, BC. 490 pp.

Reed, A., D.H. Ward, D.V. Derksen, and J.S. Sedinger. 1998. Brant (Branta bernicla), The Birds of North America Online. Available at: http://bna.birds.cornell.edu/bna/. Accessed: August 1, 2013.

Richardson, J., C.R. Greene Jr, C. Malme and D. Thomson. 1995. Marine Mammals and Noise. Academic Press. San Diego.

Robertson, G.J. and J.P.L. Savard. 2002. Long-tailed Duck (Clangula hyemalis), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. Available: http://bna.birds.cornell.edu/bna/species/651. Accessed: December 11, 2013.

Rolston, D. 2011. Final Report on 2010 Survey of Eulachon Adult Spawner and Egg Distribution in the Lower Skeena River and Tributaries. Kitsumkalum Fisheries Department.Sanders, T.A. 2012. Band-tailed Pigeon Population Status, 2012. US Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C.

Sealy, S.G., H.R. Carter, R.E. Thomson, and K.H. Morgan. 2013. Movements of Ancient murrelet family groups to Northern Vancouver Island, British Columbia. Northwestern Naturalist, 94: 209-226.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene, D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas and P.L. Tyack. 2007b. Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals 33(4).

Spendelow, J.A. and S.R. Patton. 1988. National Atlas of Coastal Waterbird Colonies in the Contiguous United States: 1976-1982. U.S. Fish and Wildlife Service, Biological Report 88(5). x + 326 pp.

Stantec Consulting Ltd. (Stantec). 2011a. Canpotex Potash Export Terminal and Ridley Island Road, Rail, and Utility Corridor – Wildlife Technical Data Report. Prepared for Canpotex Terminals Limited, West Vancouver, BC and Prince Rupert Port Authority, Prince Rupert, BC. 67 pp.

Stantec Consulting Ltd. (Stantec). 2011b. Canpotex Potash Export Terminal and Ridley Island Road, Rail, and Utility Corridor: Aquatic Environmental Assessment – Aquatic Environment, November 2011. Prepared for Canpotex Terminals Limited, West Vancouver, BC and Prince Rupert Port Authority, Prince Rupert, BC. 65 pp.

Stedman, S.J. 2000. Horned Grebe (Podiceps auritus), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. Available: http://bna.birds.cornell.edu/bna/species/505. Accessed: December 11, 2013.

Stoffels, D. 2001. Background Report- Eulachon in the North Coast. Government of British Columbia. Victoria, BC.

Stuart-Smith, A.K., W.L. Harrower, T. Mahon, E.L. McClaren, and F.I. Doyle. 2012. A Scientific Basis for Managing Northern Goshawk Breeding Areas in the Interior of British Columbia: Best Management Practices. FORREX Forum for Research and Extension in Natural Resources, Kamloops, BC. 115 pp.

Terres, J. K. 1980. The Audubon Society Encyclopedia of North American Birds. Alfred A. Knopf, New York, NY.

Wallace, E.A. and G.E. Wallace. 1998. Brandt's Cormorant (Phalacrocorax penicillatus), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. Available: http://bna.birds.cornell.edu/bna/species/362. Accessed: December 11, 2013.

Williams, R., D. Lusseau and P.S. Hammond. 2006. Estimating relative energetic costs of human disturbance to killer whales (*Orcinus orca*). *Biological Conservation* 133:301-311.

Williams, R. and L. Thomas. 2007. Distribution and abundance of marine mammals in the coastal waters of British Columbia, Canada. Journal of Cetacean Resource Management 9(1):15-28.

Wright, D.L. and G.E. Hopky. 1998. *Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters.* Canadian Technical Report of Fisheries and Aquatic Sciences,. (No. 2107). Minister of Public Works and Government Services Canada. Winnipeg, MB. 39 pp

Yamanaka, K.L., Lacko, L.C., Withler, R., Grandin, C., Lochead, J.K., Martin, J.C., Olsen, N. and Wallace, S.S. 2006. A review of Yelloweye Rockfish Sebastes ruberrimus along the Pacific coast of Canada: Biology, Distribution and Abundance Trends. Canadian Science Advisory Secretariat Research Document. 2006/076. x + 54 pp.