

Appendix G

Biophysical Survey / Habitat Assessment Report



DILLON
CONSULTING

CANADIAN PACIFIC RAILWAY

Habitat Assessment Report

Cascade Capacity Expansion Project

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Acronyms and Abbreviations

These are acronyms, abbreviations and definitions used and applied throughout this document.

– B –

BMP, Best Management Practice

– C –

CD, Chart Datum, reference to Canadian Hydrographic Service Chart Datum

CEMP, Construction Environmental Management Plan

COSEWIC, Committee on the Status of Endangered Wildlife in Canada

CP, Canadian Pacific Railway

– D –

DFO, Fisheries and Oceans Canada

Dillon, Dillon Consulting Limited

– H –

HWM, High Water Mark indicates the usual or average level to which a body of water rises at its highest point and remains for sufficient time so as to change the characteristics of the land. In flowing waters (rivers, streams) this refers to the active channel or bank-full level which is often the 1:2 year flood flow return level. In inland lakes, wetlands or marine environments it refers to those parts of the water body bed and banks that are frequently flooded by water so as to leave a mark on the land and where the natural vegetation changes from predominately aquatic vegetation to terrestrial vegetation.

HHWM, Higher High Water Mark (Mean Higher High Water Mark), the average of the higher high water height of each tidal day observed over the National Tidal Datum Epoch. For stations with shorter series, comparison of simultaneous observations with a control tide station is made in order to derive the equivalent datum of the National Tidal Datum Epoch. For this Project, indicated on engineering drawings in **Appendix A**.

– P –

PSL, Pacific Sand lance (*Ammodytes personatus*), a species of forage fish

– Q –

QEP, Qualified Environmental Professional, means an applied scientist or technologist who is registered and in good standing with an appropriate BC professional organization or who, through demonstrated suitable education, experience and knowledge relevant to the particular matter, may be reasonably relied on to provide advice within their area of expertise. A qualified environmental professional could be a biologist, agrologist, forester, geoscientist, engineer, or technologist.

– R –

ROW, *Right-of-way*

– S –

SARA, *Species at Risk Act*

Species at risk, *means species designated as extirpated, endangered, threatened or or special concern in Appendices 1 through 3 of the federal Species at Risk Act.*

SS, *Surf Smelt (Hypomesus pretiosus), a species of forage fish*

Suncor, *Suncor Energy*

– V –

VFPA, *Vancouver Fraser Port Authority*

1.0 Project Overview

Canadian Pacific Railway (CP) is proposing to expand existing railway infrastructure to increase capacity along a section of their mainline right-of-way (ROW) within the Vancouver Terminal of the Cascade Subdivision. The Cascade Subdivision is one of CP's busiest and the proposed Project will expand rail capacity into and out of the Port of Vancouver. Facility expansion at the Burrard Products Terminal by Suncor Energy (Suncor) requires a new track to serve as the switching lead/service track situated within CP's ROW on the north side of the existing mainline tracks. The addition of the proposed switching lead/service track will require extending the existing embankment north into riparian and foreshore areas of Burrard Inlet at several locations.

This document provides information and materials in support of a Project and Environmental Review (PER) Application for the Vancouver Fraser Port Authority (VFPA) and a *Fisheries Act* Authorization application to Fisheries and Oceans Canada (DFO). The format and content of this document follows guidance provided by the VFPA in their PER Guidelines and includes Project overview and description, description of the existing environment, summary of the temporary and permanent impacts, proposed mitigation measures, summary and conclusion.

1.1 Project Location

The proposed Cascade Capacity Expansion Project is located on the south shore of Burrard Inlet in the Greater Vancouver Area of southwestern British Columbia (**Figure 1**). More specifically, the Project is situated within the CP ROW adjacent to the Port Moody Arm of Burrard Inlet between CP Mile 118.00 and 118.82 of the Cascade Subdivision (**Figure 2**). Corresponding geographic coordinates of the east and west Project limits are 49° 17' 28.38" N, 122° 53' 20.43" W and 49° 17' 17.6" N, 122° 54' 19.2" W, respectively. The areas of interest for the proposed track expansion are situated west and east of Suncor's Burrard Products Terminal and include the marine riparian and intertidal zones. The Project is situated in both of the City of Port Moody to the east and the City of Burnaby to the west.

The Project area extending approximately 450 metres to the west from the existing Burrard Terminal to the western extent of the proposed alignment is hereafter referred to as Area 1 (**Figure 3**); the Project area extending approximately 294 metres to the east from the eastern edge of the Burrard Terminal trestle to the west end of the Reed Point Marina parking lot is referred to as Area 2 (**Figure 4**). The Project area between Areas 1 and 2 is referred to as Burrard Terminal Area (**Figure 5**).

The Project straddles the municipal boundary between the City of Port Moody to the east and the City of Burnaby to the west and is not accessible from public roadways. The closest public roads are the access road to Reed Point Marina (Port Moody) and Cariboo Road (Burnaby). The closest residential areas are located in the Harbour Heights/College Park Neighbourhood (Port Moody) some 900 metres east of the Project.

1.2 Project Dates

The three project phases (**Table 1**) will include pre-construction works, construction of the rail embankment upon which the new lead/service track will be situated, and construction of the new track and associated rail infrastructure (e.g., ballast, ties, rail, switches, etc.).

Table 1. Phased Construction Overview

Construction Phase	Construction Duration	Notes
Project Phase 1: Pre-Construction Works	7 days	Mobilize contractor on-site. Construction of Temporary Works Pads on west side of Project area. Construction of Temporary Unloading Pad for barge access and delivery of materials on west side of Project area. Coordination of site access requirements. Obtain required permissions from leaseholders/property owners. Start date to be determined by issuance of regulatory permits and opening of Fisheries Window.
Project Phase 2: Embankment Construction	120 days	Construction of proposed embankment including rail platform sub-ballast.
Project Phase 3: Track Construction	14 days	Start date to be determined following completion of embankment construction.

The timing window of least risk to fish in Burrard Inlet is August 16 – February 28. Construction is, therefore, proposed to begin following project approval from DFO and as close to August 16 as possible.

The timing window of least risk to nesting birds is August 16 – March 14; vegetation removal outside of this window will require a Nesting Bird survey by a QEP to minimize risks to birds protected under the *Migratory Birds Convention Act*.

Additional details regarding the temporary silt curtain and other mitigation measures are outlined in **Sections 4.1** and **4.2**, and the Construction Environmental Management Plan (CEMP) attached as **Appendix D**.

1.3 Project Rationale

Increasing freight rail volumes into and out of the south shore of Burrard Inlet has led to a shortage of train capacity on the west end of CP's Vancouver Terminal of the Cascade Subdivision during peak shipping season. In order to increase train capacity (and reduce the potential for delays to both freight and passenger trains), CP must reduce the amount of mainline switching at customer facilities such as Suncor's. Expansion of the Burrard Products Terminal by Suncor requires expansion of switching lead/service track capacity in order to accommodate an increased volume of rail cars entering, staging and exiting their facility. Together, these conditions necessitate the construction of a third "lead/service track" adjacent to the Suncor facility.

2.0 Project Description

The proposed lead/service track will be situated on the north side of CP's two existing mainline tracks. All rail infrastructure will be located within the CP ROW however a small portion of the grading works and erosion protection requirements will occur on land under the jurisdiction of the VFPA.

To accommodate the installation of the new service/lead track and its connection with the CP mainline, the widening of the existing CP rail embankment and establishment of a new track grade is required. Due to steep terrain to the south (Burnaby Mountain) and the close proximity of Burrard Inlet to the north, development of the new embankment will result in the removal of existing riparian vegetation and, at select locations, encroachment on areas below the high high water mark (HHWM) (*i.e.*, onto the intertidal zone) of Burrard Inlet.

The railway expansion will have the following attributes:

- It will be governed as non-main track with a track speed of 15 miles per hour;
- It will be constructed with continuous welded rail, wood track ties, and other standard materials including spikes, anchors, ballast, sub-ballast, etc.;
- It will include derail equipment; and
- It will include turnouts connecting the CP mainline (north track) with the service/lead track and Suncor's private trackage.

The completed embankment and new track will be permanent structures. Several temporary work areas are required to facilitate construction and will be removed following the completion of the Project. During construction, CP anticipates there will be a small number of temporary structures in the form of a temporary office, a lunchroom trailer and portable toilets for workers. There will be no permanent buildings or related building structures.

No new permanent roadways are proposed. Temporary access roads may be required to improve construction access/egress into the Project area however their locations have not been confirmed. One option being contemplated is the development of an access road on the south side of CP's mainline tracks from beyond the west end of the project off Cariboo Road. There are no public road crossings within the Project limits. One private overhead crossing (trestle bridge to Burrard Products Terminal) is located at Mile 118.11 of the Cascade Subdivision (at Station 0+180) and will be unaffected by the Project.

Existing track drainage and culverts along the proposed service/lead track will be upgraded to achieve local drainage and environmental requirements. All existing above and below ground utilities will be identified and assessed for compliance with applicable railway requirements for utility crossings. Where modification or additional protection is required, the necessary upgrades will be incorporated into the

construction program. Utility owners have been advised of the proposed Project and Utility Agreements are, or will be, in place between the utility owner and CP. During construction, temporary electric power will be required and supplied by portable generators and/or temporary power line connections.

Construction activities contemplated for the development of the new lead/service track include:

- Vegetation clearing;
- Minor excavation of soils;
- Placement and grading of structural fill; and
- Placement of riprap erosion protection.

There are two components to the development of the proposed Project: construction of the rail embankment upon which the new lead/service track will be situated; and construction of the new track and associated rail infrastructure (*e.g.*, ballast, ties, rail, switches). Upon completion of embankment construction, rail infrastructure will be installed and connected to Suncor's private trackage at the Burrard Products Terminal. Structural fill, riprap and ballast will be sourced from existing CP facilities and other sources to meet engineering and environmental specifications for the Project. At this time, it is anticipated that granular fills will be delivered to the Project by barge and/or rail. The toe of the expanded fill and riprap will extend beyond CP's ROW at a number of locations, up to 12 metres north of the existing mainline track. The total amount of material anticipated to be placed below the high water mark (HWM) is estimated to be 22,800 m³ (*i.e.*, 16,800 m³ structural fill and 6,000 m³ riprap).

The only hazardous materials required for the Project will be modest amounts of fuels, lubricants and other hydrocarbon-based products required for equipment operation and services. Water requirements will be minimal and primarily used for compaction purposes and dust suppression.

Preliminary design drawings of the proposed works are presented in **Appendix A**. Area 1 (west side of the Suncor facility) is presented in drawings SK-001-MOD and SK-002; and Area 2 (east side of the Suncor facility) is presented in SK-002 and SK-003. The Burrard Terminal (Suncor facility) is presented in SK-002.

3.0 Description of Existing Environment

The Project area encompasses primarily foreshore/intertidal habitat as well as some subtidal area. For ease of reference, specific study areas within the project limits were designated as follows: Area 1 – the shoreline and foreshore on the west side of the Burrard Products Terminal; and Area 2 – the shoreline and foreshore between Reed Point Marina and the east side of the Burrard Terminal. A third area (Area 3) of upland habitat affected by the Project occurs between Suncor’s terminal and the CP right-of-way. This narrow strip of land was assessed to characterize its biophysical condition and potential value as fish and wildlife, if any.

3.1 Approach and Information Sources

Existing habitat conditions were documented through desktop review and on-site assessment.

Background habitat, vegetation and species information sources included:

- Habitat Wizard;
- Species at risk online mapping databases;
- iMap BC;
- DFO data;
- BC Marine Conservation Analysis;
- Other publically available resources; and,
- Reports available to Dillon.

Visits to the Project area by Qualified Environmental Professional (QEP) biologists, technicians and planners have occurred on multiple occasions between June 2017 and December 2018 with observations contributing to the assessment of existing biophysical conditions. A summary of the dates of site visits is provided in **Table 2**.

Table 2. Site visit dates to complete habitat assessment

	Site Visit Dates
2017	June 27, July 31
2018	June 12, June 21, June 22, June 26, July 13, Sept 13, Oct 2, Dec 18
2019	Jan 15, Feb 26

Site visits have coincided with a range of tide levels (0.09 m to 5.03 m) and generally clear weather conditions. The site was visited on foot and the assessments focused on areas of foreshore, riparian, and upland habitat within and adjacent to the proposed Project. Observations of dominant physical features, biological communities, and features of regional importance/uniqueness were recorded.

Subtidal surveys were conducted by SCUBA-equipped QEPs with knowledge and experience of the local aquatic biology and targeted the characterization of bottom substrates and the presence, distribution,

and abundance of biota in Areas 1 and 2. These surveys were completed by Foreshore Technologies on June 21, June 22, and December 18, 2018 and provided a biophysical overview of approximately 66,000 m² of subtidal habitat along twenty belt transects and reconnaissance surveys between transects. The abundance levels of selected species or biota groups were based on the criteria adapted from the Fisheries and Oceans Canada's *Coastal/Estuarine Fish Habitat Description and Assessment Manual* (1990). Further details of the subtidal assessment are presented in the sections that follow and **Appendix B**.

3.2 Substrate Characteristics

Substrates of particular interest within the Project Area are those found on the Burrard Inlet foreshore and subtidal zones. There is a narrow strip of terrestrial substrate (i.e., soil) south of the Suncor Burrard Terminal (Area 3) and, of course, the non-native fill materials comprising the embankment of CP ROW. Geotechnical investigations have been completed in upland and foreshore areas to inform the design of the Project.

3.2.1 Foreshore/Subtidal Substrates

The existing CP track ROW embankment is characterized as primarily a steep riprap and crushed rock slope with pockets of soil and organic material originating from the vegetation that has colonized this region.

The morphology of the Area 1 intertidal zone is defined by two large, generally stable and firm bars extending some distance from the shoreline and comprising mixtures of sand, gravel, cobble, shell hash and boulders, as defined by the *Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures* (2001) (see **Appendix C, Photos 1, 2, 3, and 4**). Alluvial deposits along the shoreline represent highly-erodible sedimentary rocks underlying Burnaby Mountain that have been transported to foreshore via steep ephemeral channels of the Mountain's north face (Francioni *et al.*, 2018). The intertidal zone, starting at 2.0 – 3.0 m chart datum (CD), typically comprises cobble (60-75%), gravel (10-20%), sand (10%), boulders (0-10%) and shell hash (0-5%). The subtidal zone, starting at approximately -0.5 m CD, is a transition to sand (55%), mud (35%) and cobble (10%). Beyond -1.2 m CD, the substrate consists primarily of mud (35-80%), sand (20-55%) and scattered pieces of woody debris (0-5%) (see *Drawings 3967-D-03.1 and 4003-D-01.1* in **Appendix B**). The remainder of the subtidal area was characterized as almost entirely mud and sand which likely limits growth and colonization of vegetation and organisms.

To assist in understanding the suitability of substrates for forage fish spawning, lab analysis of substrate samples collected at 0.0 m CD from both ends of Area 1 was undertaken. The veneer of coarse surficial particles was removed from a 1m X 1m quadrat and a composite sample of the top 2cm of substrate collected. This layer contained very low percentages of silt (<2%), clay (<1%) and fine sand (<1%). At grain sizes above this the sand size and gravels present varied across samples. Grain size analysis results for the samples collected in Area 1 are listed in **Table 3**.

Table 3. Grain size analysis results for Area 1 Substrates.

Area	Location	Sediment Type	Percentage	Total Percentage
Area 1 – West Beach 1	49.28845887, -122.9000514	% Gravel (>2mm)	22.3	22.3
		% Sand (2.00mm - 1.00mm)	7.2	77.4
		% Sand (1.00mm - 0.50mm)	27.9	
		% Sand (0.50mm - 0.25mm)	37.8	
		% Sand (0.25mm - 0.125mm)	3.5	
		% Sand (0.125mm - 0.063mm)	<1	<1
		% Silt (0.063mm - 0.0312mm)	<1	
		% Silt (0.0312mm - 0.004mm)	<1	
		% Clay (<4um)	<1	<1
Area 1 – West Beach 2	49.28843311, -122.90155766	% Gravel (>2mm)	58.7	58.7
		% Sand (2.00mm - 1.00mm)	8.8	40.4
		% Sand (1.00mm - 0.50mm)	11.4	
		% Sand (0.50mm - 0.25mm)	17.1	
		% Sand (0.25mm - 0.125mm)	2.1	
		% Sand (0.125mm - 0.063mm)	<1	<1
		% Silt (0.063mm - 0.0312mm)	<1	
		% Silt (0.0312mm - 0.004mm)	<1	
		% Clay (<4um)	<1	<1
Area 1 – Middle Beach 1	49.28934542, -122.89755684	% Gravel (>2mm)	36.2	36.2
		% Sand (0.125mm - 0.063mm)	<1	62.4
		% Sand (0.25mm - 0.125mm)	19.8	
		% Sand (0.50mm - 0.25mm)	26.4	
		% Sand (1.00mm - 0.50mm)	8.5	
		% Sand (2.00mm - 1.00mm)	6.7	<1
		% Silt (0.0312mm - 0.004mm)	<1	
		% Silt (0.063mm - 0.0312mm)	<1	
% Clay (<4um)	<1	<1		
Area 1 – Middle Beach 2	49.28908887, -122.89814075	% Gravel (>2mm)	51.9	51.9
		% Sand (2.00mm - 1.00mm)	9.2	48.6
		% Sand (1.00mm - 0.50mm)	15.7	
		% Sand (0.50mm - 0.25mm)	20.6	
		% Sand (0.25mm - 0.125mm)	2.1	
		% Sand (0.125mm - 0.063mm)	<1	<1
		% Silt (0.063mm - 0.0312mm)	<1	

Area	Location	Sediment Type	Percentage	Total Percentage
		% Silt (0.0312mm - 0.004mm)	<1	
		% Clay (<4um)	<1	<1

The existing CP embankment in Area 2 is also characterized by a steep bank of crushed rock, riprap and boulders. Area 2 is bounded by the floats and buildings of the Reed Point Marina to the north which shelters the shoreline from wind- and vessel-induced wave energy. The morphology of the Area 2 intertidal zone comprises a flat and firm bar gently and uniformly extending north from the toe of the CP track embankment. The intertidal zone is characterized by a mix of substrates dominated by sand with scattered gravel and cobble (see **Appendix C, Photos 9, 10 and 11**). Similar to Area 1, substrates of the upper foreshore are coarser with boulders situated at the toe of slope and the percentage of cobbles and gravel decreasing between 2.0 and 0.0m CD. Through the intertidal zone, the abundance of finer substrates increases toward the sheltered east end of Area 2. The transition to the subtidal zone is characterized by finer substrates of sand (55%) and mud (35%) with a small amount of cobble (10%) at approximately -0.5m CD while substrates at depths beyond -1.2m CD are primarily mud (80%) and sand (20%) (see **Appendix B, Photo 7**). Drawing 3967-D-01.1 *Substrate Conditions East* in **Appendix B** illustrates the distribution of substrates along, and between, transects in Area 2.

An analysis of Area 2 substrates was also completed following the same approach as at Area 1 to assess their suitability to support forage fish spawning. Substrates from across the area at 0.0m CD were dominated by sand and contained low percentages of silt (<2%) and clay (<1%). Grain size analysis results for the samples collected in Area 2 are presented in **Table 4**.

Table 4. Grain size analysis results for Area 2

Area	Location	Sediment Type	Percentage	Total Percentage
Area 2 – East Beach 1	49.29158164, -122.8898848	% Gravel (>2mm)	9.1	9.1
		% Sand (2.00mm - 1.00mm)	5.7	87.9
		% Sand (1.00mm - 0.50mm)	14.8	
		% Sand (0.50mm - 0.25mm)	38.4	
		% Sand (0.25mm - 0.125mm)	25.5	
		% Sand (0.125mm - 0.063mm)	3.5	<2.3
		% Silt (0.063mm - 0.0312mm)	1.3	
		% Silt (0.0312mm - 0.004mm)	<1	
% Clay (<4um)	<1	<1		
Area 2 – East Beach 2	49.291712, -122.89043992	% Gravel (>2mm)	21.7	21.7
		% Sand (2.00mm - 1.00mm)	13.3	75.6
		% Sand (1.00mm - 0.50mm)	17.2	
		% Sand (0.50mm - 0.25mm)	18.5	
		% Sand (0.25mm - 0.125mm)	21.1	
		% Sand (0.125mm - 0.063mm)	5.5	<2.5
		% Silt (0.0312mm - 0.004mm)	<1	
		% Silt (0.063mm - 0.0312mm)	1.5	
		% Clay (<4um)	<1	<1

3.2.2 Soils

Geotechnical sampling along the CP ROW in the vicinity of the proposed project has been ongoing since 2016 to understand underlying soil composition and structure. Two boreholes were drilled in the CP ROW in 2016 by Suncor contractors in the vicinity of Suncor's Burrard Terminal. The strip of land south of Suncor Burrard Terminal within CP ROW has been historically infilled with structural crushed rock fill and modified during development of industry in the region.

In August 2017, geotechnical drilling was conducted by AECOM at four locations along the CP ROW. These studies have confirmed that the subsurface soils at the proposed track expansion site generally consist of fill (e.g., sand, silt, gravel, cobbles, wood debris, boulder) from previous developments underlain by marine deposits (sand, silt, occasional cobbles) over glacially-overridden till-like (Vashon Drift) soils. Fill thickness typically ranged from 2.8 metres to 10.5 metres in depth along the proposed

Project alignment, with glacio-marine deposits encountered between approximately 4.3 metre and 10.5 metre depths for all but two of the westernmost boreholes. Till-like soils were encountered for boreholes drilled in Area 1 (AECOM, 2018). The Geological Map of Canada Plan Detailed borehole logs were previously provided to the VFPA with a Category B Information Support Package submitted in July 2018.

Additional boreholes were drilled in late 2018 to advance the Project Team's understanding of the subsurface conditions and provide information for the detailed design of the proposed capacity expansion project. The 2018 geotechnical investigation proposed a total of eight borehole locations at the intertidal-upland interface. The results of this geotechnical drilling program are currently being confirmed. A Category A Application for the 2018 geotechnical drilling program was submitted to the VFPA on September 11, 2018, and approved under VFPA PER 18-177 on September 28, 2018.

3.3 Aquatic, Riparian and Terrestrial Vegetation

The Project is located within the Coastal Western Hemlock biogeoclimatic zone which is characterized by mild, wet climates supporting coniferous forests that are often complex and highly productive (BC Ministry of Forests, 1999). Vegetation communities of the Project Area are associated with marine (subtidal and intertidal), riparian and upland components of the proposed project and are described independently in the following sections.

3.3.1 Subtidal and Intertidal (Marine) Vegetation

Subtidal vegetation in Area 1 includes sea lettuce (*Ulva* sp.) and Laminarian kelp which were both common, but limited by hard surface attachment points and typically found beyond -1.0m CD (see distribution and photos of intertidal and subtidal vegetation in Area 1 on *Drawing 3967-D-04.1 Biological Conditions West*, *Drawing 4003-D-02.1 Biological Conditions* and *Drawing 3967-D-06.1 Biota Photographs* in **Appendix B** and **Photos 5 and 6** in **Appendix C**). In Area 2, common subtidal vegetation found attached to hard surfaces includes sea lettuce and Laminarian kelp typically beyond -1.0m CD (see distribution and photos of intertidal and subtidal vegetation in Area 2 on *Drawing 3967-D-02.1 Biological Conditions East* and *Drawing 3967-D-06.1 Biota Photographs* in **Appendix B**).

At the upper limits of the intertidal zone of Area 1 there are discrete and scattered pockets of sea milk-wort (*Glaux maritima* ssp. *obtusifolia*), grasses and boulders colonized by rockweed (*Fucus gardneri*) and sugar kelp (*Laminaria saccharina*) along the shoreline. Vegetation attending the Area 2 intertidal zone is an almost homogeneous stand of Lyngbye's sedge (*Carex lynbyei*), sea milk-wort (*Glaux maritima* ssp. *obtusifolia*), and grasses (see **Appendix C, Photo 12**). Boulders and cobbles in the intertidal zone along both sections of shoreline are colonized by rockweed and sugar kelp but are of lower abundance than in Area 1.

3.3.2 Riparian Vegetation

Riparian vegetation along the shoreline of Burrard Inlet in Area 1 is a mixture of flowering plants, ferns, shrubs and large patches of mature deciduous trees (see **Appendix C, Photos 41 and 47**). The approximate areal coverage of riparian vegetation is 4,525 m².

Flowering plants generally associated with ground cover include hawksbeard (*Crepis* sp.), common foxglove (*Digitalis purpurea*), creeping buttercup (*Ranunculus repens*), field bindweed (*Convolvulus arvensis*), policeman's helmet (*Impatiens glandulifera*), wild pea (*Vicia* sp.), reed canary grass (*Phalaris arundinacea*), cutleaf blackberry (*Rubus laciniatus*), and fireweed (*Epilobium angustifolium*). Several unidentified grass species were also present. Other herbaceous species observed were sword fern (*Polystichum munitum*), common horsetail (*Equisetum arvense*), and bracken fern (*Pteridium aquilinum*). The shrub species attending the foreshore of Area 1 are willow (*Salix* sp.), hardhack (*Spiraea douglasii*), Himalayan blackberry (*Rubus armeniacus*), Indian plum (*Oemleria cerasiformis*), red elderberry (*Sambucus racemosa*), red huckleberry (*Vaccinium parvifolium*), salmonberry (*Rubus spectabilis*), thimbleberry (*Rubus parviflorus*), Hooker's willow (*Salix hookeriana*), Nootka rose (*Rosa nutkana*), and Pacific crab-apple (*Malus fusca*) (see **Appendix C, Photo 42**).

The Tsleil-Waututh Nation (TWN) has noted that crab-apple trees have been found in association with archaeological sites. As such, the TWN has requested that archaeological monitoring be conducted in the vicinity of the cluster of Pacific crab-apple if significant ground disturbance is expected. Since the vicinity of the crab-apple will undoubtedly be disturbed by construction of the rail embankment, CP and its Contractors will apply the Archaeological/Cultural Sites Chance Find Guidelines outlined in Section 5 of the Project Construction Environmental Management Plan, as well as the specific Chance Find Procedure developed for the Project.

Mature trees found along the shoreline of Area 1 include red alder (*Alnus rubra*), bigleaf maple (*Acer macrophyllum*), and black cottonwood (*Populus balsamifera*) (see **Appendix C, Photo 43**). Dillon conducted a tree inventory assessment on June 26, 2018. There are 44 trees or tree clusters and one significantly sized willow within Area 1 that will need to be removed for Project construction (**Table 5, Appendix C, Photos 44, 45 and 46**). Tree removals may be subject to changes due to changes in the details of Project design. The tree inventory will be updated as additional Project details are confirmed.

There is a small stand of mature riparian vegetation, including a copse of black cottonwood and red alder, located at the eastern edge of the Suncor Burrard Terminal property. This corresponds with the western-most extent of Area 2 (**Table 5**). Other than this small patch, dominant riparian vegetation over the length of Area 2 comprises flowering plants, ferns and low shrubs. Abundant species include common foxglove, creeping buttercup, field bindweed, wild pea, reed canary grass, fireweed, common horsetail, willow, hardhack, Himalayan blackberry, Indian plum, red elderberry, salmonberry, and thimbleberry (see **Appendix C, Photos 48, 49, and 50**). Other vegetation established in the intertidal

region includes Lyngbye's sedge, sea milk-wort, and unidentified beach grasses (see **Appendix C, Photo 7**).

Table 5 details the trees within the riparian zone of Area 1 and the small patch immediately east of Burrard Terminal in Area 2. This includes the estimated size (diameter-at-breast-height) and number of individual stems within each clump. Trees were identified from the western Project boundary (Area 1) up to the Suncor Trestle at the east side of Suncor's Burrard Terminal (Area 2). There are no trees east of the Suncor Trestle.

Table 5. Description of Riparian Trees in Area 1 and Area 2.

Location	Species	Number of Primary Stems in Clump	Size of Primary Stems (diameter-at-breast-height (dbh))
Area 1	Bigleaf maple	14	2 stems x 8 cm, 12 cm, 18 cm, 2 stems x 25 cm, 30 cm, 2 stems x 35 cm, 40 cm, 45 cm, 70 cm, 2 stems x 77 cm
	Bigleaf maple	5	8 cm, 10 cm, 13 cm, 2 stems x 25 cm
	Bigleaf maple	1	30 cm
	Bigleaf maple	4	20, 25, 30, 55 cm
	Bigleaf maple	3	2 stems x 25 cm, 30cm
	Bigleaf maple	2	10, 30 cm
	Black cottonwood	1	40 cm
	Black cottonwood	1	8 cm
	Black cottonwood	1	65 cm
	Black cottonwood	1	8 cm
	Black cottonwood	1	10 cm
	Black cottonwood	1	30 cm
	Red alder	4	8, 13, 25, 45 cm
	Red alder	1	22 cm
	Red alder	1	30 cm
	Black cottonwood	1	5 cm
	Red alder	3	15, 18, 25 cm
	Red alder	4	15 cm, 20 cm, 2 stems x 22 cm
	Red alder	8	3 cm, 8 cm, 2 stems x 10 cm, 2 stems x 18 cm, 20 cm, 25 cm
	Red alder	3	2 stems x 18 cm, 70 cm
Red alder	5	2 stems x 8 cm, 15 cm, 18 cm, 20 cm	
Red alder	1	20 cm	
Red alder	1	15 cm	
Bigleaf maple	1	80 cm	
Bigleaf maple	1	25 cm	

Location	Species	Number of Primary Stems in Clump	Size of Primary Stems (diameter-at-breast-height (dbh))
Area 1	Red alder	1	23 cm
	Red alder	1	23 cm
	Red alder	1	5 cm
	Red alder	1	5 cm
	Red alder	1	15 cm
	Red alder	1	13 cm
	Bigleaf maple	1	20 cm
	Bigleaf maple	1	8 cm
	Red alder	1	20 cm
	Red alder	1	40 cm
	Red alder	1	20 cm
	Red alder	4	4 stems x 8 cm
	Red alder	1	15 cm
	Bigleaf maple	1	23 cm
	Bigleaf maple	1	8 cm
	Bigleaf maple	1	5 cm
	Red alder	6	3 stems x 8 cm, 2 stems x 10 cm, 20 cm
	Red alder	2	18, 20 cm
	Willow ¹	9	5 cm, 3 stems x 8 cm, 10 cm, 3 stems x 13 cm, 18 cm
Area 2	Black cottonwood	3	2 stems x 10 cm, 15 cm
	Black cottonwood	1	40 cm
	Black cottonwood	1	35 cm
	Black cottonwood	1	35 cm
	Black cottonwood	1	40 cm
	Black cottonwood	1	45 cm
	Black cottonwood	2	20, 50 cm
	Red alder	1	25 cm

¹Not a tree, but of significant size.

3.3.3 Upland Vegetation

There is an area of upland vegetation between the Suncor Burrard Terminal and the north CP rail line that was assessed for connectivity to fish habitat. Within this area, there are several constructed ditches and topographic low areas that collect runoff from the CP ROW, and promote groundwater infiltration. No connectivity or function of this vegetation to marine or freshwater fish habitat was observed. The vegetation in this area is characterized by species typical of wetter soils and low lying areas, such as red alder, black cottonwood, willow sp., horsetail, and cattail (see **Appendix C, Photos 51 and 52**). Project construction necessitates the removal of this vegetation.

Areas adjacent to the Project area south of the CP ROW are densely forested with a mix of mature deciduous and coniferous tree species that provide habitat for an array of wildlife. The upland terrestrial vegetation is dominated by red alder, bigleaf maple, black cottonwood, western red cedar (*Thuja plicata*), and western hemlock (*Tsuga heterophylla*). Shrubs and other plant species present include red huckleberry, salmonberry, red elderberry, Himalayan blackberry, Indian plum, hardhack, common hawthorn (*Crataegus monogyna*), common foxglove, hawksbeard sp., clover (*Trifolium* sp.), cattail, bracken fern, fireweed, devil's club (*Oplopanax horridus*), silverweed, reed canary grass, wild pea, policeman's helmet, field bindweed, creeping buttercup, common horsetail, and unidentified rush and grass species. The terrestrial vegetation south of the CP rail lines and ROW is not anticipated to be impacted during Project construction activities.

3.4 Freshwater Aquatic Habitat

There is very limited freshwater aquatic habitat in the vicinity of the proposed capacity expansion Project. Upslope drainage from forested areas between Barnet Highway and the CP ROW is conveyed via informal drainage pathways to the base of slope where it intersects constructed track-side ditches. Several culverts direct intermittent flow beneath the CP mainline tracks to Burrard Inlet (**Figure 7**). Three of those culverts drain into Area 1 at Mile 118.50, Mile 118.66, and Mile 118.70 (**Table 6**). Four culverts drain into Area 2 at Miles 118.08, Mile 118.10, Mile 118.20 and Mile 118.21 (**Table 6**). One culvert drains within the Suncor Industrial complex at Mile 118.36. Additional culverts have had preliminary mapping completed; however, detailed surveying will be completed if they are determined to fall within the Project impact area. There are culverts beyond the Project area to both the east and west that were not accessed. Drainage pathways and culverts were assessed during a June 2018 and January 2019 site visits to consider their value as fish habitat and the potential for fish passage from Burrard Inlet. Culvert locations are identified on **Figure 7** and the engineering drawings presented in **Appendix A**. Additional information on the culvert assessment is provided below.

Table 6. Summary of Information for Culverts within the Project Area

Station Number	CP Mileage (Cascade Subdivision)	Type	Diameter (mm)	Length (m)	Comments (re: Project Construction)
0+004.31	118.08	CMP	600	18.3	Culvert to be extended
0+035.75	118.10	CMP	1000	18.3	Culvert to be extended
0+236.91	118.20	RCB	300	17.4	Culvert to be relined
0+243.62	118.21	Unknown	Unknown	Unknown	Culvert to be removed/replaced with CSP
0+489.94	118.36	CMP	1220	18.3	-
0+747.79	118.50	CMP	1000	15.2	Culvert to be relined and extended
0+964.01	118.66	CMP	900	15.2	Culvert to be relined and extended
1+039.28	118.70	CMP	600	12.2	Culvert to be relined and extended
191+195.18	118.74	CSP	900		

Station Number	CP Mileage (Cascade Subdivision)	Type	Diameter (mm)	Length (m)	Comments (re: Project Construction)
TBC	118.XX	CSP	650		To be updated following survey and assessment.
TBC	118.XX	CSP	750		To be updated following survey and assessment.
TBC	118.XX	CSP	450		To be updated following survey and assessment.
TBC	119.XX	CSP	900		To be updated following survey and assessment.
TBC	119.XX	CSP	800		To be updated following survey and assessment.

Surface water drainage does not follow a defined path upslope of the culvert at Station 0+004.31 (see **Appendix C, Photos 15, 16, 17, and 18**). Water does pool at the toe of slope/culvert inlet. No flow was observed entering the pool or culvert on the date of the assessment. The culvert outlet to Burrard Inlet is perched approximately 1.6 m above the high tide line, therefore there is no potential for fish to access the culvert or upslope area from the Inlet. Groundwater seepage through the track embankment was observed on the exposed foreshore during field assessments at low tides. Fish habitat value of the drainage pathway upslope of Station 0+004.31 is therefore limited to food/nutrient contribution.

The inlet to the culvert at Station 0+035.75 is a drop structure located at the toe of slope (see **Appendix C, Photos 19, 20, 21, and 22**). There is evidence of a second culvert at this location that may have been historically abandoned. Upslope drainage pathways are undefined across the forested slope. The culvert outlet is perched high (*i.e.*, 1.3 m) above the high tide line and is inaccessible to Burrard Inlet fish. One of the two outlets was buried in riprap. Trickle flow was observed at the outlet to one culvert and groundwater seepage through the track embankment was observed on the exposed foreshore at low tides (see **Appendix C, Photo 23**). Fish habitat value of the drainage pathway(s) upslope of Station 0+035.75 is therefore limited to food/nutrient contribution.

There was an area of intertidal seepage observed between Station 0+035.75 and Station 0+236.91 (10 U 508037 5459855). No culvert was indicated on the engineering drawings and no culvert could be observed (see **Appendix C, Photo 24**).

One defined channel was located during searches of areas upslope of the culvert at Stations 0+236.91 and 0+243.62 (see **Appendix C, Photos 25, 26, 27, and 28**). Trickle flow was audible near the toe of slope, however, and seepage/flow into the inlet of the culvert at 0+236.91 was visible. There is no potential for fish to be present in natural areas south of the CP ROW in the areas draining to these culverts. Fish habitat value of the drainage pathway(s) upslope of Stations 0+236.91 or 0+243.62 is therefore limited to food/nutrient contribution. The watercourse in the east culvert (Station 0+236.91) discharges over rocks down to the intertidal area, approximately 0.8 m above the high tide line. There is no channel downstream for the east watercourse. A small diameter pipe was noted that extends from

the bank above the intertidal area immediately west and is greater than 2 m above the high tide line. Therefore, there is no potential for fish to access the watercourse from Burrard Inlet. There was no access to the downstream section of the watercourse in the west culvert.

The culvert at Station 0+489.94 could only be assessed from the upstream portion, as the outflow in somewhere in the midst of the Suncor industrial area and could not be accessed (see **Appendix C, Photos 29 and 30**). To the south of the tracks, there are swales that discharge to a culvert drop structure from the west and east along the toe of the tracks. There is a very low potential for fish to be present in this watercourse since there is limited habitat potential. Habitat value is limited to a food/nutrient contribution.

The watercourse upstream of the culvert at 0+747.79 is known as Aliceville Creek and extends upstream beyond the Barnet Highway, along the boundary of Burnaby and Port Coquitlam (see **Appendix C, Photos 31, 32, and 33**). Surface water is conveyed down the forested slope north of Barnet Highway via a defined channel having a bankfull width of 2.2 m and bankfull depth of 0.3 m. At the time of the assessment the wetted width ranged from 0.4 to 1.1 m with a wetted depth of 0.1 m. The channel is steep and cascades into the culvert inlet. The outlet is perched approximately 1.0 m above the Burrard Inlet high tide line and cascades to the foreshore via a rock-lined channel. Access to the culvert outlet by fish is considered to be of very low potential and would occur only at the highest tides. Access to habitat in reaches upstream of the culvert is also limited by high gradient and low flow. Fish habitat value of Aliceville Creek upslope of the culvert at Station 0+747.79 is therefore limited to food/nutrient contribution.

The watercourse upstream of the culvert at Station 0+964.01 is known as Cougar Creek (see **Appendix C, Photos 34, 35, 36, and 37**). A reach of the upslope channel is cobble-lined with a bankfull width ranging from 1.2 to 2.4 m and intersects a constructed swale along the toe of the slope which directs flow to the culvert inlet. The channel was observed to be dry at the time of the site visit. The culvert outlet is perched 0.3 to 0.4 m above the high tide line and is highly eroded. It is unlikely that fish can access the culvert outlet and upstream channel from Burrard Inlet due to the perched condition. Fish habitat value of Cougar Creek upslope of the culvert at Station 0+964.01 is therefore limited to food/nutrient contribution.

Surface and ground water upslope of the culvert at Station 1+039.28 is conveyed overland to the toe of slope where it is directed to the culvert (see **Appendix C, Photos 38, 39, and 40**). No flow was observed in the culvert on the date of the assessment. The outlet of this culvert is perched ~2.5 m above the high tide line and is considered to be inaccessible to Burrard Inlet fish. Fish habitat value upslope of this culvert is considered to be minimal and, therefore, the primary value of flows through this drainage path is its contribution of food and nutrients to productive fish habitat in Burrard Inlet.

Overall, there is a very low potential for Burrard Inlet fish to access any of the watercourses/drainage pathways due to the perched elevations of culvert outlets, flow limitations and channel morphology. The potential risk of project development to harm freshwater fish and fish habitat is anticipated to be very low.

3.5 Species Observed or Likely Present

A list of species observed or likely present was compiled through site visits by biologists and environmental professionals and background review of relevant information.

3.5.1 Aquatic Species

Aquatic biotic diversity in Area 1 is low. During shore surveys, acorn barnacle (*Balanus glandula*), thatched barnacle (*Semibalanus cariosus*), blue mussel (*Mytilus trossulus*), shore crabs (*Hemigrapsus* sp.), hermit crabs, and leather (*Dermasterias imbricate*) and ochre (*Pisaster ochraceous*) sea stars were regularly observed within the intertidal zone (**Appendix C, Photo 5**). The shells of butter clam (*Saxidomus gigantean*), dark mahogany clam (*Nuttalia obscurata*), gaper species (*Tresus* sp.), Nuttall's cockle (*Clinocardium nuttallii*), and Pacific oyster (*Crassostrea gigas*) were also abundant across the generally homogeneous intertidal zone. Squirts from large unidentified bivalves were observed at several locations during one visit at very low tide. Other species identified during pedestrian surveys of the Area 1 foreshore were bent-nose macoma (*Macoma nasuta*) and limpet, as well as tidepool sculpin (*Oligocottus maculosus*). Multiple sculpin were observed in the single shallow tidal pool found in Area 1 which was situated on the easterly bar approximately 20 m from the toe of railway embankment (see **Appendix C, Photo 8**).

Similar to Area 1, biotic diversity in Area 2 is low (see **Appendix C, Photos 12, 13, and 14**). Species frequently observed during pedestrian surveys and/or widely distributed across the intertidal zone were acorn barnacle, blue mussel and shore and hermit crabs. Evidence (*i.e.*, shells) of clam, cockle, oyster, and crab species was observed across the intertidal zone as well as specimens of checkeredperiwinkle (*Littorina scutulata*). Other species observed in the intertidal zone during shore surveys were leather (*Dermasterias imbricate*) and ochre (*Pisaster ochraceous*) sea stars and a deceased sea blubber (*Cyanea capillata*).

Table 7 summarizes all species of biota observed along the fourteen transects of Area 1 (transects 7-14.9) and their relative abundance (areal coverage/individuals encountered). Only one species, acorn barnacle, was considered to be common across the full intertidal/subtidal zone of Area 1. The abundance of two crab species, hermit and shore crab, was observed to be "Few" (*i.e.*, 6 to 10 individuals along a transect) and also widely distributed across the intertidal and subtidal zones surveyed. The abundance of all other biota was observed to be "Sparse" or "Rare". Three fish species, English sole (*Parophrys vetulus*), scalyhead sculpin (*Artedius harringtoni*) and C-O sole (*Pleuronichthys coenosus*) were observed during the SCUBA surveys in Area 1. Abundance for all fish species in Area 1 was "Rare". Dive survey results and photographs of biota observed in Area 1 are illustrated in *Drawing*

3967-D-04.1 *Biological Conditions West*, Drawing 3967-D-06.1 *Biota Photographs* and Drawing 4003-D-02.1 *Biological Conditions* in **Appendix B**.

In the Area 2 subtidal zone, the sea star and crab species observed in Area 1, as well as horse clams coincident with the band between -1.2 m and -2.4 m CD, were observed. Three species of fish were observed during dive surveys in Area 2: scaly head sculpin; tube-snout (*Aulorhynchus flavidus*) and English sole. Dive survey results and photographs of biota observed in Area 2 are illustrated in *Drawing 3967-D-02.1 Biological Conditions East* and *Drawing 3967-D-06.1 Biota Photographs* in **Appendix B**. **Table 7** summarizes all species of biota observed along the six transects of Area 2 (transects 1-6) and their relative abundance (areal coverage/individuals encountered) and general location on the foreshore/nearshore at the time of the surveys. Like Area 1, only acorn barnacle was considered to be “Common” while hermit and shore crab was observed to be “Few” in the intertidal/subtidal zone of Area 2. The abundance of all other biota was observed to be “Sparse” or “Rare”. The fish observed during the Area 2 SCUBA surveys were in very low abundance (*i.e.*, one individual along a transect).

During the subtidal survey, a swath of horse clams (*Tresus* spp.) was observed between -1.2m and -2.4m CD. Leather, mottled (*Evasterias troschelii*) and ochre sea stars, red rock (*Cancer productus*) and Dungeness crabs (*Cancer magister*), as well as English sole, were typically observed in subtidal habitats between -1.0m and -4.5m CD (see *Drawing 3967-D-06.1 Biota Photographs* in **Appendix B**).

Table 7. Presence and relative abundance of biota during sub-tidal surveys.

Common Name	Scientific Name	Transect																		Abundance			
		1	2	3	4	5	6	7	8	9	10	11	12	12.3*	12.7*	13	13.3*	13.7*	14	14.5*	14.9*	Amount	Method
Green Algae																							
sea lettuce	<i>Ulva lactuca</i>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓			✓			Sparse	PAC
flat-tube sea lettuce	<i>Ulva linza</i>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓			✓				Sparse	PAC
Brown Algae																							
rockweed	<i>Fucus gardneri</i>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓			✓	✓			Rare	PAC
Sargassum	<i>Sargassum muticum</i>													✓	✓	✓	✓	✓	✓			Rare	PAC
sugar wrack kelp	<i>Laminaria saccharina</i>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	Rare - Sparse	PAC
Agarum	<i>Agarum fimbriatum</i>		✓					✓											✓			Rare	PAC
Red Algae																							
filamentous red	Unidentified											✓	✓	✓			✓			✓		Sparse	PAC
Turkish washcloth	<i>Mastocarpus papillatus</i>																		✓			Rare	PAC
Anemones																							
short plumose	<i>Metridium senile</i>																	✓		✓		Rare	IOT
Worms																							
calcareous tubeworm	Unidentified													✓	✓		✓	✓		✓	✓	Rare	PAC
feather duster	<i>Eudistylia vancouveri</i>																		✓			Rare	PAC
Bivalves/Univalves																							
bay mussel	<i>Mytilus trossulus</i>														✓	✓		✓		✓	✓	Rare	PAC
horse clam	<i>Tresus</i> spp.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓			Rare - Sparse	IOT
limpet	<i>Tectura</i> sp.																		✓		✓	Sparse	IOT
Snails																							
dogwinkle snail	<i>Nucella</i> sp.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							✓			Few	IOT
Crabs																							
Dungeness	<i>Cancer magister</i>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Sparse	IOT
red rock	<i>Cancer productus</i>	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓			Sparse	IOT
Hermit	<i>Pagurus</i> spp.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓			✓			Rare - Few	IOT
shore crab	<i>Hemigrapsus</i> spp.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓				✓			Few	IOT
Barnacles																							
acorn	<i>Balanus glandula</i>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Common	PAC
Echinoderms																							
leather star	<i>Dermasterias imbricata</i>	✓	✓	✓	✓	✓	✓	✓				✓			✓			✓		✓		Rare - Sparse	IOT
mottled star	<i>Evasterias troschelii</i>	✓	✓		✓		✓	✓	✓	✓	✓	✓			✓				✓			Sparse	IOT
ochre star	<i>Pisaster ochraceus</i>	✓	✓	✓		✓	✓	✓	✓			✓	✓				✓	✓	✓		✓	Sparse - Few	IOT
California sea cucumber	<i>Parastichopus californicus</i>																	✓	✓	✓	✓	Sparse	IOT
Fish																							
scalyhead sculpin	<i>Artedius harringtoni</i>	✓	✓															✓				Rare	IOT
tubesnout	<i>Aulorhynchus flavidus</i>		✓																			Rare	IOT
C-O sole	<i>Pleuronichthys coenosus</i>																			✓		Rare	
English sole	<i>Parophrys vetulus</i>					✓						✓			✓				✓			Rare	IOT

*Surveys completed December 2018

A survey of fish using beach seining methods in Port Moody Arm in 2010 and 2011 found eighteen species. Of these, ten species were found at the survey point closest to the Project Area east of Reed Point Marina (City of Port Moody, 2011; **Figure 6**). In 1999, nine sites along Burrard Inlet between West Vancouver and the end of Port Moody Arm and between the north and south shores of the inlet were sampled using beach seining methods and a confirmed 29 species of fish (Haggarty, 2001). The Port Moody Ecological Society compiled a list of species found within Port Moody Arm and streams within a 6-kilometer radius that spend all or part of their life history in those waterbodies (Port Moody Ecological Society, 2001). The species list for Burrard Inlet compiled from our habitat surveys, the historical surveys, and Port Moody Ecological Society's records includes 63 species and is presented in **Table 8**. One species was only identified by the common name and it is unclear which species it refers to.

Table 8. Fish species of Burrard Inlet.

Common Name	Scientific Name	Project Areas (Foreshore Technologies, 2018)	Reed Point Marina (City of Port Moody, 2011)	Port Moody Arm (Port Moody Ecological Society, 2001) ¹	Burrard Inlet (Haggarty, 2001)
arrow goby	<i>Clevelandia ios</i>		✓		✓
bay goby	<i>Lepidogobius lepidus</i>			✓	
bay pipefish	<i>Leptorynchus griseolineatus</i>		✓		✓
big skate	<i>Raja binoculata</i>			✓	
black prickleback	<i>Xiphister atropurpureus</i>			✓	
blackbelly eelpout	<i>Lycodopsis pacifica</i>			✓	
buffalo sculpin	<i>Enophrys bison</i>			✓	✓
butter sole	<i>Isopsetta isolepsis</i>			✓	
Chinook salmon	<i>Oncorhynchus tshawytscha</i>			✓	✓
chum salmon	<i>Oncorhynchus keta</i>			✓	✓
C-O sole	<i>Pleuronichthys coenosus</i>	✓			
cockscorb	<i>Anoplarchus sp.</i>				✓
Coho salmon	<i>Oncorhynchus kisutch</i>			✓	✓
copper rockfish	<i>Sebastes caurinus</i>			✓	
crescent gunnel	<i>Pholis laeta</i>				✓
curlfin sole	<i>Pleuronichthys decurrens</i>			✓	
cutthroat trout	<i>Oncorhynchus clarki clarki</i>		✓	✓	✓

Common Name	Scientific Name	Project Areas (Foreshore Technologies, 2018)	Reed Point Marina (City of Port Moody, 2011)	Port Moody Arm (Port Moody Ecological Society, 2001) ¹	Burrard Inlet (Haggarty, 2001)
Dover sole	<i>Microstomus pacificus</i>			✓	
English sole	<i>Parophrys vetulus</i>	✓		✓	✓
flatfish (juv.)	<i>Pleuronectidae</i>				✓
flathead sole	<i>Hippoglossides elassodon</i>			✓	
fluffy sculpin	<i>Oligocottus snyderi</i>				✓
great sculpin	<i>Myoxocephalus polycanthocephalus</i>			✓	
grunt sculpin	<i>Rhamphocottus richardsoni</i>			✓	
hybrid sole	<i>Inopsetta ischyra</i>			✓	
kelp greenling	<i>Hexagrammos decagrammus</i>			✓	
kelp surfperch	<i>Brachyistius frenatus</i>				✓
lingcod	<i>Ophiodon elongatus</i>				✓
night smelt	<i>Spirinchus starksi</i>			✓	
northern anchovy	<i>Engraulis mordax</i>			✓	
Pacific cod	<i>Gadus macrocephalus</i>			✓	
Pacific hake	<i>Merluccius productus</i>			✓	
Pacific herring	<i>Clupea pallasii</i>			✓	
Pacific lamprey	<i>Lampetra tridentatus</i>			✓	
Pacific sand dab	<i>Citharichthys sordidus</i>			✓	
Pacific staghorn sculpin	<i>Leptocottus armatus</i>		✓	✓	✓
Pacific tomcod	<i>Microgadus proximus</i>			✓	
padded sculpin	<i>Artedius fenestralis</i>				✓
penpoint gunnel	<i>Apodichthys flavidus</i>			✓	✓
petrale sole	<i>Eopsetta jordani</i>			✓	
pile perch	<i>Rhacochilus vacca</i>			✓	
pink salmon	<i>Oncorhynchus gorbuscha</i>			✓	

Common Name	Scientific Name	Project Areas (Foreshore Technologies, 2018)	Reed Point Marina (City of Port Moody, 2011)	Port Moody Arm (Port Moody Ecological Society, 2001) ¹	Burrard Inlet (Haggarty, 2001)
plainfish midshipman	<i>Porichthys notatus</i>			✓	
prickly sculpin	<i>Cottus asper</i>			✓	
quillback rockfish	<i>Sebastes maliger</i>			✓	
river lamprey	<i>Lampetra ayresi</i>			✓	
rock sole	<i>Lepidopsetta bilineata</i>			✓	
roughhead sculpin ²					✓
saddleback gunnel	<i>Pholis ornata</i>		✓		✓
salmon smolt	<i>Oncorhynchus sp.</i>				✓
sand lance	<i>Ammodytes hexapterus</i>			✓	✓
sand sole	<i>Psettichthys melanostictus</i>			✓	
scaly head sculpin	<i>Artedius harringtoni</i>	✓			
sculpin (juv.)	<i>Cottidae</i>				✓
sharpnose sculpin	<i>Clinocottus acuticeps</i>		✓		
shiner perch	<i>Cymatogaster aggregata</i>		✓	✓	✓
slender sole	<i>Lyopsetta exilis</i>			✓	
smoothed sculpin	<i>Artedius lateralis</i>				✓
snailfish	<i>Careprocus sp.</i>			✓	
sockeye salmon	<i>Oncorhynchus nerka</i>			✓	✓
speckled sanddab	<i>Citharichthys stigmaeus</i>			✓	✓
spiny dogfish	<i>Squalus acanthias</i>			✓	
starry flounder	<i>Platichthys stellatus</i>		✓	✓	✓
steelhead/rainbow trout	<i>Oncorhynchus mykiss</i>			✓	
striped seaperch	<i>Embiotoca lateralis</i>			✓	
surf smelt	<i>Hypomesus pretiosus</i>			✓	✓
three-spined stickleback	<i>Gasterosteus aculeatus</i>		✓	✓	✓
tidepool sculpin	<i>Oligocottus maculosus</i>	✓	✓	✓	✓

Common Name	Scientific Name	Project Areas (Foreshore Technologies, 2018)	Reed Point Marina (City of Port Moody, 2011)	Port Moody Arm (Port Moody Ecological Society, 2001) ¹	Burrard Inlet (Haggarty, 2001)
tube-snout	<i>Aulorhynchus flavidus</i>	✓		✓	
walleye pollock	<i>Theragra chalcogramma</i>			✓	

¹Includes freshwater streams confluent with Port Moody Arm

² No scientific name listed; unclear which species this is, possibly scaly head sculpin

3.5.2 Forage Fish Spawning Survey

In October 2018, Dillon collected samples from intertidal locations in Area 1 and Area 2 and a grain size analysis was completed to assess the appropriateness of existing substrates to support forage fish spawning. The analysis confirmed that grain size of existing substrates was appropriate for spawning by Pacific Sand Lance (PSL) and Surf Smelt (SS). A spawning survey was therefore undertaken to assess whether PSL or SS were actively using the intertidal beaches of the Project area for spawning.

The forage fish spawning assessment was undertaken on February 26, 2019. Methods for the assessment followed those found in 'Field Manual for Sampling Forage Fish Spawn in Intertidal Shore Regions' (Moulton & Penttila, 2006). Samples were collected from three transects in 'Area 1' and one transect located west of Area 1 at Chemtrade Beach (**Table 9**). The study was conducted during mid to low tidal period. Visual scans of *insitu* substrates and collected samples for eggs were completed in the field. As well, bulk samples were collected, washed through a series of sieves (6, 2 and 0.5mm) to remove larger substrates, and transported to the lab at 4°C for more detailed examination under a microscope.

No forage fish eggs were detected at any of the locations assessed in the field or more detailed examination in the lab. **Table 9** outlines the data collected for each transect.

Table 9. Data collected during forage fish spawning survey, February 26, 2019

Transect ID	Area	Sample ID	Location	Character of Upper Beach (Substrate)	Impact Level (up to 300m upland)	Width of Potential Spawning Substrate (m)	Length of Beach (m)	Egg Presence
1	Chemtrade Beach	FF01	49.28810678, -122.9041582	2- Fine Gravel with Sand Base	50-74%	3	45	None
2	Area 1	FF02	49.28813805, -122.9031185	2- Fine Gravel with Sand Base	50-74%	3	100	None
3	Area 1	FF03	49.28852731, -122.9012828	5- Cobble with Sand Base	50-74%	24	170	None

Transect ID	Area	Sample ID	Location	Character of Upper Beach (Substrate)	Impact Level (up to 300m upland)	Width of Potential Spawning Substrate (m)	Length of Beach (m)	Egg Presence
4	Area 1	FF04	49.28866858, -122.8994466	5- Cobble with Sand Base	50-74%	15	170	None

Through cursory assessments of Port Moody Arm beaches, De Graff (personal communication, 2018) has indicated that the Area 1 beaches have an appropriate range of substrate sizes to support forage fish spawning. Extensive shading of the foreshore provided by Burnaby Mountain, as well as existing riparian vegetation, further supports the potential for successful forage fish spawning at Area 1. It is anticipated that broader efforts to restore Burrard Inlet habitat and water quality will increase the potential for PSL and SS spawning in the local and regional area.

3.5.3 Terrestrial Species

The primary terrestrial species recorded in the Project area during site visits were avian species. Avian species detected at, or transiting through, the Project site included: American robin (*Turdus migratorius*), bald eagle (*Haliaeetus leucocephalus*), Canada goose (*Branta canadensis*), cedar waxwing (*Bombycilla cedrorum*), chickadee (*Poecile* sp.), European starling (*Sturnus vulgaris*), fox sparrow (*Passerella iliaca*), glaucous-winged gull (*Larus glaucescens*), great blue heron (*Ardea herodias*), northern flicker (*Colaptes auratus*), northwestern crow (*Corvus caurinus*), pelagic cormorant (*Phalacrocorax pelagicus*), red-breasted nuthatch (*Sitta canadensis*), rock pigeon (*Columba livia*), song sparrow (*Melospiza melodia*), Stellar's Jay (*Cyanocitta stelleri*), Swainson's Thrush (*Catharus ustulatus*), and willow flycatcher (*Empidonax traillii*). No bird nests were observed on site. A variety of other avian species have been detected within Burrard Inlet and adjacent to the Project Area (Butler, Couturier, & Dickson, 2015). Surf scoter (*Melanitta perspicillata*), which is Blue-listed in BC, was detected within the Project Area (Butler, Couturier, & Dickson, 2015). The only insect species of note observed was a swallowtail butterfly (*Papilionidae* sp.); however, there is an invertebrate community that contributes to the habitat features, functions and conditions within the Project Area.

The intertidal and subtidal habitat is likely used by North American river otter (*Lontra canadensis*) and raccoon (*Procyon lotor*) which are common along the foreshore and riparian habitat of the Lower Mainland. Many bivalve shells were observed above the HHWM, indicating transport by terrestrial vertebrate species. Vertebrate species that are known to occur in the area (Page, 2012) and may use habitat within or adjacent to the Project area include: coyote (*Canis latrans*), striped skunk (*Mephitis mephitis*), American mink (*Neovison vison*), American black bear (*Ursus americanus*), common muskrat (*Ondatra zibethicus*), Keen's mouse (*Peromyscus keeni*), and deer mouse (*Peromyscus maniculatus*). Nine bat species are known to occur in the Lower Mainland (Community Bay Programs of BC, 2014) and may use the Project area or adjacent areas for aerial feeding or overnight roosting. Of the nine, three bat species of note are Townsend's big-eared bat (*Corynorhinus townsendii*) and Keen's Myotis (*Myotis keenii*) which is Blue-listed in BC; and little brown myotis (*Myotis lucifugus*) which is listed as Endangered under the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

A number of other species may be present adjacent to the Project area (Page, 2012) and use habitat features adjacent to or within the Project area such as: long-tailed vole (*Microtus longicaudus*), creeping vole (*Microtus oregoni*), Townsend's vole (*Microtus townsendii*), bushy-tailed woodrat (*Neotoma cinerea*), Pacific jumping mouse (*Zapus trinotatus*), northern flying squirrel (*Glaucomys sabrinus*), Douglas' Squirrel (*Tamiasciurus douglasii*), common shrew (*Sorex cinereus*), dusky shrew (*Sorex monticolus*), Trowbridge's Shrew (*Sorex trowbridgii*), vagrant shrew (*Sorex vagrans*), shrew-mole (*Neurotrichus gibbsii*), and coast mole (*Scapanus orarius*). Introduced species such as the Norway rat (*Rattus norvegicus*), black rat (*Rattus rattus*), house mouse (*Mus musculus*), eastern grey squirrel (*Sciurus carolinensis*) and North American opossum (*Didelphis virginiana*) are likely common or abundant adjacent to the Project area and may use habitat features within the Project area.

3.6 Species at Risk

The following aquatic species and their status as listed under the *Species at Risk Act* have been considered in the assessment of potential Project effects on fish and fish habitat:

- Leatherback sea turtle (Pacific population) (*Dermochelys coriacea*) – Endangered
- Northern abalone (*Haliotis kamtschatkana*) – Endangered
- Basking shark (Pacific Population) (*Cetorhinus maximus*) – Endangered
- Killer whale (Northeast Pacific Transient Population) (*Orcinus orca*) – Threatened
- Killer whale (Northeast Pacific Southern Resident Population (*Orcinus orca*) – Endangered
- Harbour porpoise (Pacific Ocean population) (*Phocoena phocoena*) – Special Concern
- Humpback whale (North Pacific population) (*Megaptera novaeangliae*) – Special Concern
- Grey whale (Eastern North Pacific population) (*Eschrichtius robustus*) – Special Concern
- Stellar sea lion (*Eumetopias jubatus*) – Special Concern
- Green sturgeon (*Acipenser medirostris*) – Special Concern

The Pacific leatherback sea turtle is rarely observed in Canadian Pacific waters with 142 unique sightings in British Columbia from 1931 to 2018 (DFO unpublished data). The most recent sighting was August 6th, 2018 at Loudon Canyon off SW Vancouver Island (Wilson, 2018). They are a pelagic species thought to inhabit Canadian Pacific waters primarily for feeding on jellyfish and other gelatinous prey species (DFO, 2015).

Basking sharks are a coastal-pelagic shark. They are planktivorous and will follow plankton concentrations virtually anywhere in the water column including close to land and in bays with narrow openings. (*i.e.*, areas of high zooplankton concentration such as areas of converging water masses, headlands/islands with strong tidal flow) (Fisheries and Oceans Canada, 2018). Only six records of basking sharks in the Canadian Pacific have been confirmed over the past twenty years (Fisheries and Oceans Canada, 2018). Habitat assessments indicate that the Project shoreline does not support habitat that is typically favoured by the species.

Northern abalone is a subtidal marine mollusc known to inhabit rocky intertidal habitat with water depths of 10 m or less. They prefer habitats with moderate water exchange such as exposed or semi-exposed coast (Fisheries and Oceans Canada, 2012). BC Columbia Marine Conservation Atlas classified the Project area, and most of Burrard inlet, as Protected (BC Marine Conservation Analysis, 2008) based on information from the BC Shorezone Mapping System. As the Project site is Port Moody Arm of Burrard Inlet, it is not an exposed or semi-exposed site with moderate water exchange and is not expected to occur at the Project site.

Marine mammals such as killer whale, harbour porpoise, humpback whale, grey whale and stellar sea lion have been sighted and occasionally known to occur in Burrard Inlet (Butler, Couturier, & Dickson, 2015; Page, 2012). Burrard Inlet, including Port Moody Arm, falls outside the Critical Habitat for southern resident killer whales (Fisheries and Oceans Canada, 2011) and the Critical Habitat for transient

killer whales has not been fully defined (Fisheries and Oceans Canada, 2007). Grey whales have been observed in English Bay and Indian Arm of Burrard Inlet (Butler, Couturier, & Dickson, 2015). Harbour porpoises have been observed at the entrance to English Bay (Butler, Couturier, & Dickson, 2015). There are unconfirmed reports of stellar sea lions in Port Moody Inlet (Butler, Couturier, & Dickson, 2015).

Green sturgeon is an anadromous fish found in waters less than 110 m off Canada's western coast. Their spawning habitat is primarily found in U.S. waters (Fisheries and Oceans Canada, 2016). Their primary threat in Canada is as bycatch from fishing activities, and their distribution throughout Canadian waters and Burrard Inlet is unknown (Fisheries and Oceans Canada, 2016).

There is a Rockfish Conservation Area in Eastern Burrard Inlet outside of the Project area (approximately 3.5 km west of the proposed Project area). This area was established to protect inshore rockfish species (yelloweye, quillback, copper, China and tiger) from mortality associated with commercial and recreational fisheries. None of the above species at risk have been observed during site visits and species inventory assessments at the site, although rockfish species are known to occur in Burrard Inlet (City of Port Moody, 2011). If any of the species at risk are observed in the Project Area, observations will be recorded from an appropriate, non-disruptive distance, any potentially harmful activities associated with the Project will immediately cease, and the sighting will be reported to DFO. Mitigation measures to reduce potential harm have been incorporated into the CEMP (**Appendix D**).

A search of the species at risk public registry for freshwater fishes in British Columbia identified 21 species (including several species having multiple populations) (Government of Canada, 2018). Given that a review of distribution and habitat requirements of these species, and that on site assessment showed no fish access to the freshwater drainages within the Project area, no listed freshwater fish were considered to potentially inhabit the freshwater drainage channels located south of CP's mainline tracks or pass through the Project area via culverts. No species at risk have been identified for the Project area according to the British Columbia Conservation Data Centre's database of known occurrences (Government of B.C., n.d.).

The great blue heron (*fannini* subspecies) is listed under Schedule 1 under SARA (Species at Risk Public Registry, 2018). Several great blue herons have been observed on the intertidal area during multiple site visits. Their presence at the Project site, however, is considered transitory. No nesting great blue herons were observed in the Project area. Eagle predation, habitat loss and human disturbance are the primary conservation concerns for this subspecies (Butler, Couturier, & Dickson, 2015).

Through a series of surveys and population density analysis, Butler, Couturier, & Dickson (2015) determined areas of primary, secondary and tertiary population density for birds and marine mammals in Burrard Inlet. They determined areas of secondary and tertiary surf scoter (BC Blue-listed species) population clustering east and west of the Project area. Surf scoters were the most abundant species recorded during their survey, and can occur in flocks of several thousand, feeding on mussel and clam

beds and herring spawn. They are particularly sensitive to immediate and long term effects of oiled beaches. Ensuring adequate food, resting places and pollution free habitat is critical to their conservation success (Butler, Couturier, & Dickson, 2015). Butler, Couturier, & Dickson (2015) determined the area between Reed Point Marina (east of the Project Site) and Barnett Marine Park (west of the Project site) to be secondary and tertiary population density for SARA-COSEWIC listed birds and mammals within Burrard Inlet. The bird and mammal species of conservation concern they found regularly occurring in Burrard Inlet and considered in their analysis are listed in **Table 10**. They also found that forage fish specialists and rocky shores specialists had tertiary population density in the area between Reed Point Marina and Barnett Marine Park.

Table 10. Regularly occurring marine bird and mammal species of conservation priority in Burrard Inlet and Indian Arm (Butler, Couturier, & Dickson, 2015)

Common Name	Scientific Name	COSEWIC status ¹	BC CDC Status ²	SARA Status ³
horned grebe	<i>Podiceps auritus</i>	SC	Yellow	No status ⁴ /SC ⁵
western grebe	<i>Aechmophorus occidentalis</i>	SC	Red	No status ⁴ /SC ⁵
double-crested cormorant – Pacific coastal subspecies	<i>Phalacrocorax auritus</i>	Not at risk	Blue	No status
Brandt's cormorant	<i>Phalacrocorax penicillatus</i>	N	Red	
great blue heron – Pacific coast subspecies	<i>Ardea herodias fannini</i>	SC	Blue	SC
long-tailed duck	<i>Clangula hyemalis</i>	N	Blue	
surf scoter	<i>Melanitta perspicillata</i>	N	Blue	
black scoter	<i>Melanitta americana</i>	N	Blue	
peregrine falcon – Pacific subspecies	<i>Falco peregrinus pealei</i>	SC	Blue	SC
California gull	<i>Larus californicus</i>	N	Blue	
common murre	<i>Uria aalge</i>	N	Red	
marbled murrelet	<i>Brachyramphus marmoratus</i>	T	Blue	T
killer whale – southern resident population	<i>Orcinus orca</i> Pop. 5	E	Red	E
killer whale – transient population	<i>Orcinus orca</i> Pop. 3	T	Red	T

Common Name	Scientific Name	COSEWIC status ¹	BC CDC Status ²	SARA Status ³
grey whale	<i>Eschrichtius robustus</i>	SC	Blue	SC
harbour porpoise	<i>Phocoena phocoena</i>	SC	Blue	SC
elephant seal	<i>Mirounga angustirostris</i>	Not at risk	Red	

¹Committee on Species of Endangered Wildlife in Canada listing (www.cosewic.gc.ca): E = Endangered; T= Threatened; SC = Special Concern; N = not assessed

²BC Conservation Data Centre listing (www.env.gov.bc.ca/cdc/): Red is the provincial equivalent of the federal Endangered and Threatened categories; Blue is equivalent to Special Concern; Yellow indicates not at risk.

³Species at Risk Act assessment (http://www.registrelepsararegistry.gc.ca/species/schedules_e.cfm?id=1)

⁴Status reported in Butler, Couturier, & Dickson (2015)

⁵Current status as listed in BC Conservation Data Centre (Government of B.C., n.d.) as of September 26, 2018

3.7 Invasive Species

None of the federally (Fisheries and Oceans Canada, 2018) or provincially (British Columbia Government and Invasive Species Council of BC, 2015; BC Inter-Ministry Invasive Species Working Group) prohibited listed aquatic invasive species have been detected on site. A species of particular note that has not been observed on site, but has been confirmed within Metro Vancouver and Port Moody region of Burrard Inlet is saltmeadow cordgrass (*Spartina patens*) (BC Inter-Ministry Invasive Species Working Group, 2014; Benny, 2018, *personal communication*; MacVicar, 2018, *personal communication*).

Of the provincially and regionally regulated noxious plants (BC Invasive Species Council; BC Inter-Ministry Invasive Species Working Group, 2016), only reed canary grass was detected within the Project Area. Two large clusters of Japanese knotweed (*Fallopia japonica*) were recorded past the east end of Area 2 immediately adjacent to CP's north mainline track, south of Reed Point Marina (49.290880, -122.885750). The reed canary grass is interspersed throughout the site amongst the Marine riparian vegetation.

Unregulated invasive plants of concern in BC that were detected on site include: creeping buttercup, field bindweed and Himalayan blackberry (BC Invasive Species Council). Construction in the Project area necessitates removal of these species.

Guidance on Best Management Practices (BMPs) for invasive species mitigation, monitoring and BMPs and Environmental Monitoring that will occur as part of the Project are detailed in the CEMP in **Appendix D**.

3.8 Habitat features that support fish and wildlife functions

There is limited freshwater aquatic habitat in the vicinity of the proposed capacity expansion Project. Upslope drainage from forested areas between Barnet Highway and the CP ROW is conveyed via informal drainage pathways to the base of slope where it intersects constructed track-side ditches. Eight

culverts within the Project Area direct intermittent flow beneath the CP mainline tracks to Burrard Inlet. Drainage pathways and culverts were assessed during a June 2018 site visit to consider their value as fish habitat and the potential for fish passage from Burrard Inlet. Based on the assessment by professional biologists, the waterbodies draining into the Project Area are inaccessible due to steep gradient from the marine environment due to their location above the HHWM and are therefore unlikely to support fish species as direct fish habitat. In addition, the ephemeral nature of the channels likely precludes the presence of resident fish populations, including trout. The waterbodies likely contribute food and nutrient value (*i.e.*, indirect fish habitat) to the surrounding marine fish and fish habitat. Photos upstream and downstream of the culvert locations can be seen in **Appendix C, Photos 15-40**.

The marine habitat is primarily sand, cobble and small boulders. The primary species supported in this habitat are marine invertebrates such as bivalves, crustaceans, and sea stars. BC Marine Conservation Analysis classified the extent of Area 1 as Important Algal Habitat – Mudflat and Estuarine Shoreline (BC Marine Conservation Analysis, 2009) and the extent of Area 2 as Important Invertebrate Habitat – Sandy Substrate in the Intertidal Zone (BC Marine Conservation Analysis, 2009) which are classification of the 36 different coastal classes derived from the BC Shorezone Mapping System (Howes, Harper, & Owens). The marine habitat within the Project area provides some refugia for juvenile fish and potential, but unconfirmed spawning habitat for adult forage fish such as surf smelt and Pacific sand Lance (deGraaf, 2018, Personal communications). The marine habitat within the Project Area provides refugia and habitat for invertebrate species (bivalves, crustaceans, snails, and sea stars) and food and nutrient contributions to the fish species that are known to inhabit Burrard Inlet.

4.0

Potential Environmental Effects & Proposed Mitigation Measures

The proposed Cascade Capacity Expansion Project will be constructed adjacent to Burrard Inlet (Pacific Ocean) and encroach on to the existing marine foreshore. Existing vegetation within the narrow strip between the existing CP mainline track and the Burrard Inlet foreshore will be removed. Potential project effects to aquatic (marine and freshwater) and terrestrial communities, and the habitats that they provide to fish and wildlife, are anticipated to result. Potential environmental effects may occur through the following pathways:

- Land-based Activities:
 - Excavation and Grading activities;
 - Riparian plantings;
 - Use of industrial equipment; and,
 - Vegetation clearing.
- In-water Activities:
 - Placement of materials below the HWM; and,
 - Use of industrial equipment.

It is expected that project effects will have the potential to impact fish and aquatic life of the marine environment only. Drainage pathways on the south side of the CP ROW convey freshwater (and potential effects) across the ROW to Burrard Inlet, however no work is proposed on the south side of the existing CP ROW and aquatic life within these drainage pathways is very limited (*i.e.*, not fish-bearing). Potential effects on wildlife are primarily associated with the removal of existing vegetation and disturbance from the use of equipment.

Select mitigation measures recommended to address potential effects are identified below. Detailed BMPs, recommended mitigation measures and details of the environmental monitoring to be implemented during the construction period are presented in the attached CEMP (**Appendix D**). The CEMP is a living document and will be updated as additional BMPs or mitigation measures are developed or deemed necessary.

4.1 Potential Effects on Water Quality and Recommended Mitigation Measures

Construction activities associated with each of the primary pathways of effects identified above have the potential to negatively affect local water quality and fish habitat of Burrard Inlet. Potential effects of highest risk on water quality are associated with the potential generation and transport of sediment from construction activities, equipment and materials. Accidental releases of deleterious substances (*i.e.*, spills) from equipment could also occur and negatively affect local water quality.

Direct effects on fish and fish habitat may include habitat loss, reduced reproductive success and fish mortality and injury. Indirect effects of impacted water quality may result in changes in prey abundance or quality, change in habitat function or avoidance behaviour.

To mitigate potential negative impacts on nearshore water quality and fish habitat in Burrard Inlet, the proponent is proposing a suite of general and specific best management practices including scheduling construction with the period of least risk to fish, coordinating activities on the foreshore with low tides, and installing and maintaining temporary silt curtains to isolate the construction area and any and all potential impacts to fish and fish habitat. Silt curtains will be established daily in the vicinity of construction activities on or adjacent to the foreshore. Any fish and aquatic life within the isolated area will be salvaged and relocated outside the isolated area prior to construction on that day. The curtain will be retained in place during the daily construction period, and monitored regularly to ensure effectiveness until all activities below the HWM have been completed and no potential impact to water quality/fish and fish habitat remain. Silt curtains will be removed at the end of each working day.

For all work being conducted below the HHWM, an environmental monitor will be on-site to monitor the effectiveness of these measures and to determine whether additional mitigation and/or monitoring is required.

In addition, the following general mitigation measures will be implemented to minimize potential project impacts to water quality:

- Storage of excavated material and debris will occur above the HWM. All stockpiled material will be covered and secured to minimize risk of surface runoff;
- Areas of disturbed soils will be reseeded with appropriate seed mixes/species;
- The Environmental Monitor will verify that machinery is in good working condition and free of fuel and lubricant leaks.
- Necessary maintenance oils/lubricants will be stored in a separate contained lay-down area removed from Burrard Inlet and any drainage pathways;
- All machinery working in or around water will use marine-grade fluids and lubricants;
- Fueling of machinery will be conducted away from water and at approved fueling location having appropriate spill containment/clean up equipment and materials;
- Spill kits will be maintained in the active construction area and spill-containment kits containing sufficient quantities of absorbent material will be present in the active work area in proximity to working machinery;
- Should barges be required to deliver materials, etc., a floating boom will be placed around barges during offloading of materials that could negatively impair water quality;
- Environmental monitoring will be conducted, as required, during construction works to confirm appropriate mitigation measures are being implemented; and

- Works will be conducted in accordance with applicable Acts, regulations, standards, and guidelines to protect the water quality of the marine habitat.

4.2 Potential Effects on Marine Aquatic Habitat and Recommended Mitigation Measures

Potential direct and indirect effects on marine aquatic habitat of the Project area will be generated by construction activities such as excavation, infilling, and the clearing of vegetation. Effects may include the loss and/or degradation of habitat quality including effects deemed as resulting in serious harm to the commercial, recreational or Aboriginal fishery of Burrard Inlet.

An estimated area of 10,153 m² of intertidal habitat will be permanently removed as a result of the encroachment (infilling) of the expanded embankment on to the Burrard Inlet foreshore. An additional 5,356 m² of intertidal foreshore is estimated to be temporarily impacted by construction needs of the Project. The fish habitat function of affected intertidal habitat areas is primarily rearing habitat for juvenile fish. Beaches at the west end of the Project have substrate sizes that may be suitable for surf smelt and Pacific sand lance however, spawning has not been documented at these specific beaches (deGraaf, 2018, Personal communications).

To minimize potential impacts to marine aquatic life and their habitats, the following mitigation measures are proposed in addition to those presented above for the protection of water quality:

- Where possible, all work below the HWM will occur at low tide;
- As quickly as possible, the new toe of slope will be established at an elevation above the HWM allowing construction activities behind the toe of slope to occur outside of tidal influence; and
- During the repair or replacement of any upland culverts, the affected culvert will be blocked and flow temporarily diverted to the east or west into another culvert.

Some work activities will occur below the HWM of Burrard Inlet and will be scheduled with the annual “window” of least risk to Marine/Estuarine fish and fish habitat for Burrard Inlet (i.e., August 16 – February 28). It is anticipated that all work below the HWM can be completed within this period. As noted above, CP proposes to install, maintain and monitor silt curtains on a daily basis to isolate active construction areas from the intertidal zone. In addition to mitigating potential water quality impacts, the curtain also accomplishes the objective of keeping aquatic life out of the working area during the working period. At the end of each construction day, the isolation measures will be removed and the area will again be available for re-colonization and use as fish habitat. CP believes that the benefits of daily isolation and disruption of habitat in this manner outweighs the temporary unavailability and potential harm to fish in these intertidal habitat areas.

4.3 Potential Effects on Riparian Vegetation

All vegetation situated between CP's north mainline track and the Burrard Inlet shoreline will be removed for construction and the installation of the proposed new service/lead track and its components. In Area 1, riparian vegetation includes patches of mature deciduous trees and shrubs. In Area 2 there is one small group of trees near Suncor's overhead trestle with the remainder of riparian vegetation in Area 2 comprising low shrubs and herbaceous plants. Riparian vegetation provides cover, shade and nutrients to the nearshore areas of Burrard Inlet; however, these contributions are small given the very large surface area, volume, and tidal flushing of the Inlet. Additionally, the steep, forested slopes of Burnaby Mountain to the south of the Project area provides extensive shading of the foreshore.

An estimated area of 6,805 m² of riparian vegetation will be removed for construction of the proposed Project. Removal of the existing riparian vegetation will result in the direct and indirect reduction of habitat quality and function for fish, aquatic life and wildlife.

To minimize potential impacts to riparian vegetation, the following mitigation measures are proposed:

- Where ever possible, riparian vegetation removal/disturbance will be minimized to the greatest extent possible; and
- Where not in conflict with sightlines and operating standards, disturbed areas adjacent to Burrard Inlet will be seeded/planted to re-establish riparian vegetation areas.

4.4 Summary of Anticipated Residual Serious Harm to Fish

An assessment of potential Project effects on the various components of the environment results in the identification of residual impacts when mitigation measures cannot fully address the stressor. While there is an extensive suite of standard BMPs that have been proven to effectively mitigate the range of potential impacts from construction activities similar to those proposed for CP's Capacity Expansion Project, the encroachment of fill below the HWM and the removal of riparian vegetation from the narrow area between the mainline track and Burrard Inlet cannot be mitigated. Residual effects identified for this Project are, therefore, permanent and temporary losses of fish habitat of the Burrard Inlet foreshore, as well as a loss of riparian vegetation attending the shoreline (**Table 11**). DFO has determined that impacts to marine riparian habitat will result in serious harm to fish.

Table 11. Estimates of Permanent and Temporary Residual Project Impacts

Impact Type	Habitat Type	Estimated Area (m²)
Permanent (Footprint)	Intertidal Zone – Area 1	7,197
	Intertidal Zone – Area 2	2,956
	Sub-total	10,153
	Riparian Vegetation Zone – Area 1	4,525*
	Riparian Vegetation Zone – Area 2	2,280*
	Sub-total	6,805*
Temporary Working Zone	Intertidal Zone – Area 1	5,180
	Intertidal Zone – Area 2	176
	Sub-total	5,356
	Riparian Zone – Area 1	0
	Riparian Zone – Area 2	0*
	Sub-total	0*

* denotes estimate of surface areal coverage by vegetation

CP is committed to the concept of habitat offsetting to compensate for serious harm to fish and fish habitat resulting from the proposed Capacity Expansion Project and will work with DFO, potentially affected and interested Indigenous communities, and stakeholders to develop an offsetting plan that contributes to the sustainability and ongoing productivity of Burrard Inlet fisheries.

5.0 Summary and Conclusions

This document has been prepared in support of a Project and Environmental Review application to the VFPA and a Fisheries Authorization application to DFO. A Request for Review has previously been submitted to DFO with their determination that a *Fisheries Act* authorization is required due to the likelihood of serious harm to fish and fish habitat. This document was developed to characterize the habitat features, functions and conditions in and adjacent to the Project Area so that appropriate mitigation and offsetting measures can be put in place during the proposed construction and operation of the Project.

Overall the Project area encompasses existing CP rail track, track fills and armouring, riparian vegetation, freshwater drainage paths, and intertidal and subtidal habitats of Port Moody Arm (Burrard Inlet). Biophysical surveys and assessments of these habitats have identified important ecological values which have been affected by historic development in the local area and in Burrard Inlet. Many of the habitats surveyed were determined to support common species and communities of low diversity and productivity. The Project requires the infilling of an area of intertidal area that primarily serves as rearing habitat for juvenile fish and various invertebrates. Other direct and indirect effects of project construction on existing habitat values may be generated by site excavation and grading, vegetation clearing and the use of industrial equipment. A detailed CEMP has been developed with BMPs and project-specific mitigation measures to be put in place during construction of the Project to avoid, reduce and minimize potential environmental impacts.

Project construction will result in the permanent and temporary alteration and destruction of fish and fish habitat. As a result, a fish habitat offsetting plan is under development and will require approval from DFO to ensure that potential negative project effects on fish habitat productivity in Burrard Inlet are appropriately offset.

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