PRELIMINARY REPORT

Gabriola Island Berth Replacement and Upland Redevelopment
Environmental Impact Assessment

Prepared for:

BC Ferries
Terminal Engineering
British Columbia Ferry Services Inc.
Suite 500 – 1321 Blanshard Street
Victoria, BC V8W 0B7

Project No. 104134-01

January 14, 2020

Prepared by:

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Suite 500 – 1321 Blanshard Street
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Attention: Stephen Mayall, Senior Project Manager

Re: Gabriola Island Berth Replacement and Upland Redevelopment: Environmental Impact Assessment

On behalf of Hemmera we are pleased to provide you with this electronic copy of the preliminary Environmental Impact Assessment for the Gabriola Island Berth.

We appreciate the opportunity to provide this early draft version and look forward to your feedback. Please feel free to contact the undersigned by phone or email regarding any questions or further information that you may require.

This report is based on the preliminary project design. The finalized, detailed design is to follow. Any additional information will be incorporated into the report, as required.

Regards,
Hemmera Envirochem Inc.

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1.0 INTRODUCTION

The proposed Gabriola Island berth replacement and upland redevelopment is a British Columbia Ferry Services Inc. (BC Ferries) project that will upgrade infrastructure, allow docking of larger vessels and increase capacity of vehicle queuing lines. Over the next 25 years, BC Ferries Terminal Network will be optimized for efficient and effective operation. Gabriola Terminal will be developed through a series of initiatives as guided by the Terminal Development Plan. The purpose of the Gabriola Terminal Development Plan is to set out a long-term vision for the future of the terminal, a gateway and route connection between Gabriola Island and Nanaimo Harbour Terminal.

BC Ferries retained Hemmera Envirochem Inc. (Hemmera) to undertake an Environmental Impact Assessment (EIA) and *Fisheries Act* assessment in support of the project (the "Project"). Similar upgrades are proposed at the Nanaimo Harbour ferry terminal.

1.1 Proponent Contact Information

BC Ferries
Terminal Construction
British Columbia Ferry Services Inc.
Suite 500 – 1321 Blanshard Street
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Contact Information:

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1.2 Regulatory Context

The *Fisheries Act* (FA) is the main federal law governing fisheries in Canada. The purpose of the Act (Section 2.1) is to provide a framework for:

a. the proper management and control of fisheries; and,
b. the conservation and protection of fish and fish habitat, including by preventing pollution.

Fish habitat, as defined by the FA under Subsection 2(1) is:

> *"water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas"*

The fish and fish habitat protection provisions apply to all fish and fish habitat throughout Canada.

The Fish and Fish Habitat Protection and Pollution Prevention provisions of the Act include the following:

- a prohibition against causing the death of fish, by means other than fishing (section 34.4)
- a prohibition against causing the Harmful Alteration, Disruption or Destruction of fish habitat (section 35)
- a framework of considerations to guide the Minister's decision-making functions (section 34.1)
- ministerial powers to ensure the free passage of fish or the protection of fish or fish habitat with respect to existing obstructions (section 34.3)

Subsection 34.4(2)(b) and 35(2)(b) qualifies these prohibitions and allows for the authorization of harmful impacts to fish and fish habitat by the Minister of Fisheries and Oceans.

DFO applies a risk-based approach when evaluating the impacts of works, undertakings or activities on fish habitat. Harmful Alteration, Disruption or Destruction (HADD) is defined as any temporary or permanent change to fish habitat that directly or indirectly impairs the habitat's capacity to support one or more life processes of fish.

DFO's Fisheries Protection Policy Statement (http://www.dfo-mpo.gc.ca/pnw-ppe/policy-politique-eng.html) provides direction regarding the FA. The goal of the Fish and Fish Habitat Protection Policy Statement is to provide a framework for the conservation and protection of fish and fish habitat.

Proponents of works, undertakings, or activities taking place in or near water may harmfully impact fish or fish habitat are expected to:

- understand the types of harmful impacts their works, undertakings, or activities are likely to cause
- take measures to avoid harmful impacts, including following relevant standards, codes of practice, or regulations
- request an exception (Authorization Concerning Fish and Fish Habitat Protection Regulations) to the section 34.4 and 35 prohibitions when it is not possible to avoid harmful impacts to fish and fish habitat.

Furthermore, proponents are required to ensure that their actions conform to all other statutory requirements, such as federal, provincial, territorial or Indigenous legislation.

2.0 PROJECT DESCRIPTION

2.1 Location

The Project Site is located at the Gabriola Island Ferry Terminal, at the west end of Gabriola Island in Descanso Bay (**Figure 1**). Surrounding land and water uses includes an emergency services dock, Descanso Bay Regional Park, and residential and commercial properties.

2.2 Key Features of the Project

The proposed Project Activities will include infrastructure upgrades in both the marine and upland environment at the Gabriola Ferry Terminal. A schematic of existing berth infrastructure to be removed and new infrastructure to be installed is shown in **Appendix 1**. Details of project components that impact the marine environment are documented in **Table 1.**

Table 1 Marine structure components to be removed and installed.

Gabriola Island Terminal - Marine Structure Items To Be Removed					
Structural Component	**Quantity**	**Material**	**Dimensions / Volumes / Mass**	**Footprint on Seafloor**	**Shading Footprint**
Abutment:	**1**				
Piles	10	timber	Assumed 10 m long x 300 mm. Dia.	0	0
Concrete Pile Cap		concrete	16.0 m^3	0	0
On Ramp:	**1**		**83 m^2**	**0**	**83 m^2**
Beams	3	timber	0.273 m x 1.41 m x 22.5m long	0	0
Beams	4	timber	0.171 m x 1.295 m x 3.05 m long	0	0
Ramp Decking Material		timber	50 mm x 150 mm x 4.267 m long	0	0
Apron:	**1**	**steel**	**25 m^2**	**0**	**25 m^2**
Tower Supports:					
HP12 x 53 H Piles	24	steel	15.4 m	2.25 m^2	
Concrete Pile Caps:	2	concrete	8.75 m^3	0	17.5 m^2
Structural Bracing		steel	3925 kg	0	
Steel Tower Structures:	2		2 m x 2.2 m x 12.0 m tall	0	
Tower Counter Weights	2	steel	0.91 m x 0.91 m x 1.8 m tall	0	
Wingwalls:	2			0	
Pipe Piles (concrete filled)	6	steel	610 Diam. (Range from 12.0 m to 29.0 m long)	1.75 m^2	
Pipe Piles (concrete filled)	4	steel	457 Diam. (Range from 12.0 m to 19.0 m long)	0.656 m^2	
Wingwall Fender Panels	2	steel	8.0 m x 3.0 m x 0.3 m thk.	0	
Wingwall Fender Panel UHMW	2		8.0 m x 3.0 m x 0.05 m thk.	0	
Floating Pontoon	1	steel	Approx. 107 m^2 x 1.265 m deep	0	107 m^2
Dolphin 6:	1			0	5 m^2
Pipe Piles	10	steel	457 diam. x 24.38 m long	1.64 m^2	
Pipe Piles	5	steel	457 diam. x 27.43 m long	0.82 m^2	
Pipe Piles	3	steel	254 diam. x 22.86 m long	0.15 m^2	
Wales	28	timber	305 mm x 305 mm x 7.315 m long	0	
Dolphin Facing	1	timber	5.486 m x 7.315 m	0	
Dolphin Facing Edges	2	Ekki timber	203 mm x 305 mm x 7.315 m long	0	

Gabriola Island Terminal - Marine Structure Items To Be Installed					
Structural Component	**Quantity**	**Material**	**Dimensions / Volumes / Mass**	**Footprint on Seafloor**	**Shading Footprint**
Floating lead berth guide structures, including:	2				
Floating lead concrete filled backing piles	2	steel	1.5 m diam.	3.53 m^2	
Integral floating pontoon	1	steel	298 m^2		298 m^2
Wingwalls	2	steel	7.5 m long x 3.6 m high x 0.5 m deep		3.7 m^2
Pontoon vertical pipe piles	2	Steel, concrete filled	1.5 m diam.	3.53 m^2	
Central abutment vertical piles	2	Steel, concrete filled	1.5 m diam.	3.53 m^2	
Waiting Room & Bathroom Fill Area:					
Fill on top of existing rip-rap		Fill material	approx. 800 m^3 volume	300 m^2 area	
Rip rap from edge of new fill material @ 1:1 slope		Rip rap	approx. 850 m^3 volume	450 m^2	

Existing piles will be removed using vibro extraction equipment. New piles will be installed by vibratory hammer and in-water drilling.

Proposed Project Activities and upgrades to the upland environment include:

- A vehicle holding compound to accommodate a minimum of 50 vehicles with separated foot passenger walkway on the port side of the ramp. Approximately 850 m^3 of clean fill material will be placed on top of existing rip rap to create an additional 300 m^2 of upland to accommodate vehicle loading and unloading lanes (**Appendix Figure 1**).
- Accommodation for bus parking, short-term parking/staff parking, pick-up/drop-off, bicycle storage, a waiting room/washroom, and three vehicle holding lanes.
- Relocation and adjustment of existing electrical junction boxes and kiosks, as required.
- Connecting existing storm systems to new pipe, as required.
- Modifications as necessary to the existing sanitary and water services from existing washroom facilities to proposed location, as required.
- Relocate existing electrical poles, as needed, to suit the new holding compound layout.

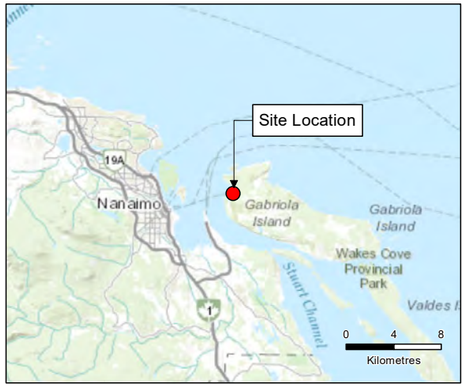
2.3 Objectives

The objectives of this EIA are the following:

- Describe and classify the subtidal, intertidal and backshore environment at the Project Site through a field assessment.
- Assess potential for Project related effects to the aquatic and upland environment.
- Identify mitigation measures to avoid or reduce the potential effects of the Project on fish and their habitat.
- Identify any residual harm that may remain following implementation of recommended mitigation measures and determine whether these effects would result in the harmful alteration, disruption or destruction of fish or fish habitat or result in sub-lethal effects to at-risk species.

Gabriola Island Ferry Terminal
Environmental Impact Assessment
Gabriola Island, BC

Project Site



Legend

Project Site

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Contains information licensed under the Open Government Licence - Government of British Columbia
- Aerial Image: ESRI World Imagery
- Inset Basemap: ESRI World Topographic Map

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Metres

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104134-01	Production Date: Aug 16, 2019	Figure 1

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3.0 METHODS

Field assessments of subtidal, intertidal and surrounding backshore areas were conducted from 11:45 to 15:35 on July 19, 2019 during a low tide of 0.9 m Chart Datum (CD) to classify biophysical characteristics at the Project Site. Transect methodology for the subtidal biophysical survey was adapted from Fisheries and Oceans Canada's (DFO) working draft *Marine Foreshore Environmental Assessment Procedure* document (DFO 2004). Observational surveys of intertidal areas were conducted during the low tide. The geographic scope of the Project Site and the transect locations of the assessment is illustrated in **Figure 2**. Marine life present was identified to the species level, where possible. Substrates were characterized based on a visual assessment of size classes presented in DFO (2004):

- Boulder (> 256 mm)
- Cobble (64 mm to 256 mm)
- Gravel (2 mm to 64 mm)
- Sand (0.0625 mm to 2 mm)
- Silt/Mud/Clay (< 0.0625 mm)

The assessment of upland areas comprised an observation survey and included vegetation and wildlife habitat at the Project Site. Transect locations for the upland observational survey are shown in **Figure 2**.

Information related to the biophysical conditions at the Project Site was obtained from the following sources:

- Review of available ortho-imagery (Google Earth) to determine habitat types and quality;
- Review of known Species at Risk occurrences through iMap BC (iMapBC 2019); and,
- On-line databases:
- BC Conservation Data Centre;
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC);
- Sensitive Habitat Inventory and Mapping database (SHIM 2018);
- BC Species and Ecosystems Explorer database (BC Ministry of Environment 2019); and,
- E-fauna and E-flora BC database (Klinkenberg 2018, 2017).
- Biophysical Inventory – Gabriola Island BC Ferry Terminal Rezoning (Stantec 2019).

Note that this assessment is intended to address Project related effects that may affect fisheries and at-risk species resources protected by the Fisheries Act and the Species at Risk Act respectively. The report also includes a description of existing conditions for wildlife species with potential to occur at the Site.

Gabriola Island Ferry Terminal
Environmental Impact Assessment
Gabriola Island, BC

Transect Locations and Habitat Map

Legend

- Transect by foot
- Underwater Video Transect

Habitat Types

- Boulders and bedrock
- Eelgrass
- Fines (sand, silt, mud)
- Gravels and fines
- Riprap
- Upland

Notes

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4.0 HABITAT DESCRIPTION AND FISH SPECIES PRESENT

4.1 General Characteristics of the Project Site

The Project Site is in the Coastal Douglas Fir moist maritime (CDFmm) biogeoclimatic zone (MFLNRORD 2016). The CDFmm occurs at elevations <150 m above sea level and typically has warm, dry summers and mild, wet winters; mean annual temperature is 9.2 to 10.5°C and mean annual precipitation ranges from 647 to 1263 mm (Nuszorfer et al. 1991).

The Project is situated within the Pacific Maritime climate zone. The highest runoff occurs during the winter months, and lowest runoff generally occurs in late August through September (Ecological Framework of Canada 2016). Weather and climatic conditions for the area are summarized in **Table 2**.

Table 2 Climate Summary

Climate Zone	Pacific Maritime Ecozone
Average Temperature Range	5˚C to 20˚C
Average Total Annual Precipitation	1140 mm, located approximately 5 km west of the Site
Weather Forecasts	www.weather.gc.ca; www.theweathernetwork.com
Weather Phone (Environment Canada)	250.245.8899
Weather Notices (Environment Canada)	https://weather.gc.ca/marine/region_e.html?mapID=02

(Environment Canada 2019)

Descanso Bay lies in Fisheries Management Area 17, subarea 13. Due to the risk of sanitary contamination, bivalve shellfish harvesting is permanently closed within 125 m of the Gabriola Island terminal (DFO 2018). Annual shellfish harvesting closures from April 1 to March 31 are also present at the north and south sides of Descanso Bay (DFO 2018).

Hoggan Lake, located 3.5 km south of the Project Site, has records of cutthroat trout (*Oncorhynchus clarkii)*, rainbow trout (*O. mykiss*), and threespine stickleback (*Gasterosteus aculeatus*) (iMapBC 2019). No other watercourses or waterbodies on Gabriola Island have records of fish presence. The two closest salmon bearing watercourses are the Nanaimo and Millstone Rivers, located 5.6 and 6 km, respectively, across Northumberland Channel in the Nanaimo Harbour. The Nanaimo River supports runs of chinook (*Oncorhynchus tshawytscha*), chum (*O. keta*), coho (*O. kisutch*), and pink (*O. gorbuscha*) salmon as well as cutthroat and rainbow trout, and steelhead. The Millstone River historically supported runs of steelhead and now sustains coho salmon, chum salmon and cutthroat trout (iMapBC 2019).

The Project Site is located within DFO's Northumberland Channel Rockfish Conservation Area (RCA) (**Figure 3**). Within RCAs, inshore rockfish are protected from all mortality associated with recreational and commercial fisheries; no fishing is permitted. Recreational fishing is restricted to hand picking invertebrates, harvesting crab and shrimp by trap, and smelt by gillnet (DFO 2019). Commercial fisheries for shrimp, herring, prawn, and salmon are located within Northumberland Channel, however, none of these ranges extend into Descanso Bay (iMapBC 2019).

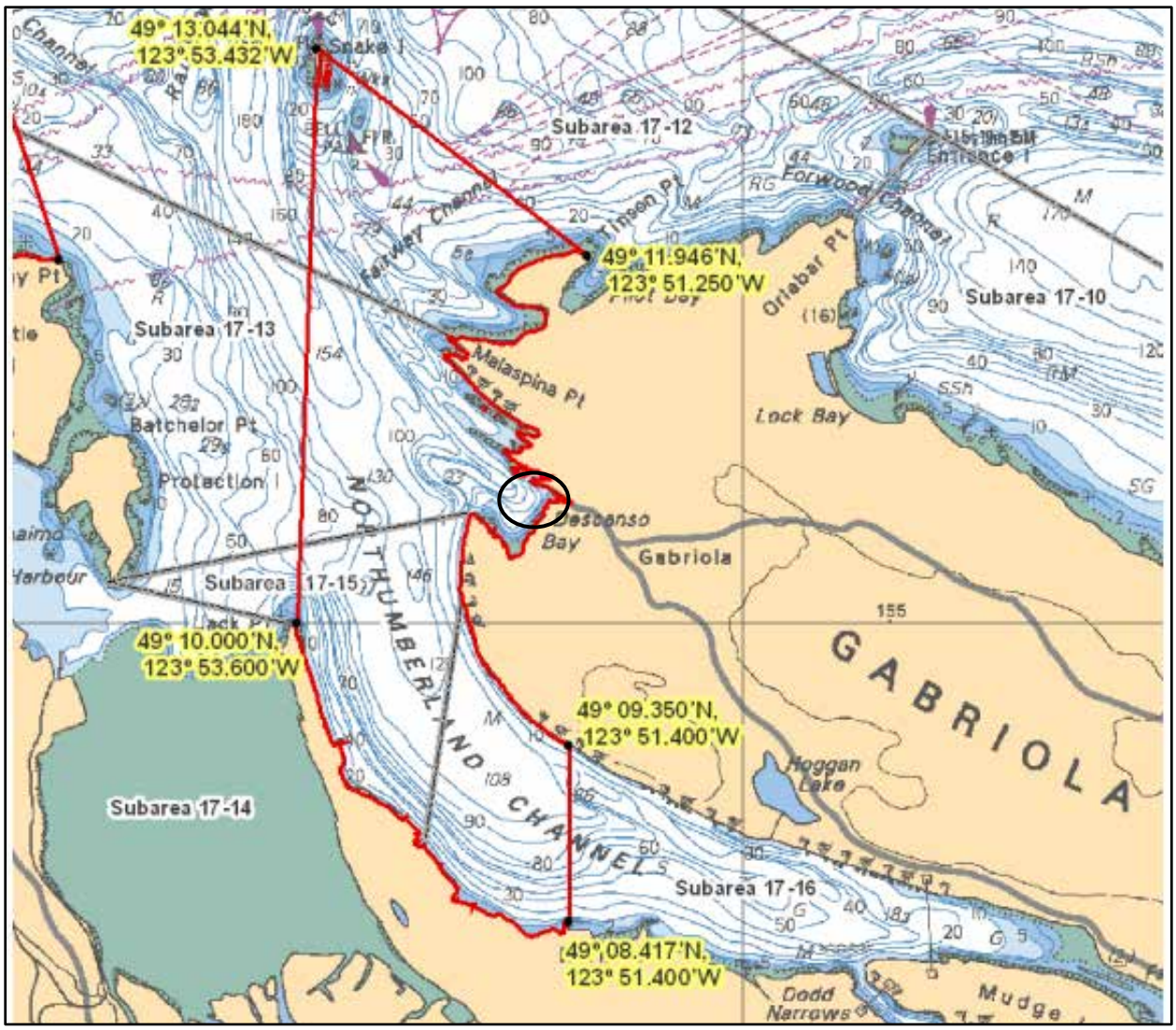

Figure 3 Northumberland Channel Rockfish Conservation Area in relation to Project Site (black circle).

The Project Site is located approximately 4.5 km southeast of a designated Important Bird and Biodiversity Area located between Rainbow and Fairway Channels (IBA Canada 2019, **Figure 4**). Pelagic cormorants (Phalacrocorax pelagicus) and glaucous-winged gulls (Larus glaucescens) are known to nest in the largest numbers on the island, with fewer pairs of black oystercatchers (Haematopus bachmani) and pigeon guillemots (Cepphus columba) (IBA Canada 2019).

Figure 4 Snake Island Important Bird Area (IBA) (orange circle) in relation to Project Site (red circle).

4.2 Detailed Physical Characteristics of the Project Site

The Project Site comprises upland, intertidal, and subtidal habitat at the Gabriola Island Ferry Terminal (**Photo 1A**). The terminal is located in Descanso Bay, adjacent to an inlet that extends northwest-southeast along North Road (**Figure 1; Photo 1B**). An unnamed tributary enters the bay at the head of the intertidal inlet (**Photo 1C**). The tributary is unmapped on iMapBC and has no records of fish presence (iMapBC 2019). An armoured riprap bank stabilizes the south slope along the inlet and extends south of the berth near the terminal parking area (**Photo 1D and Photo 1E**). A dock is located north of the berth for emergency service access to the island (**Photo 1F**).

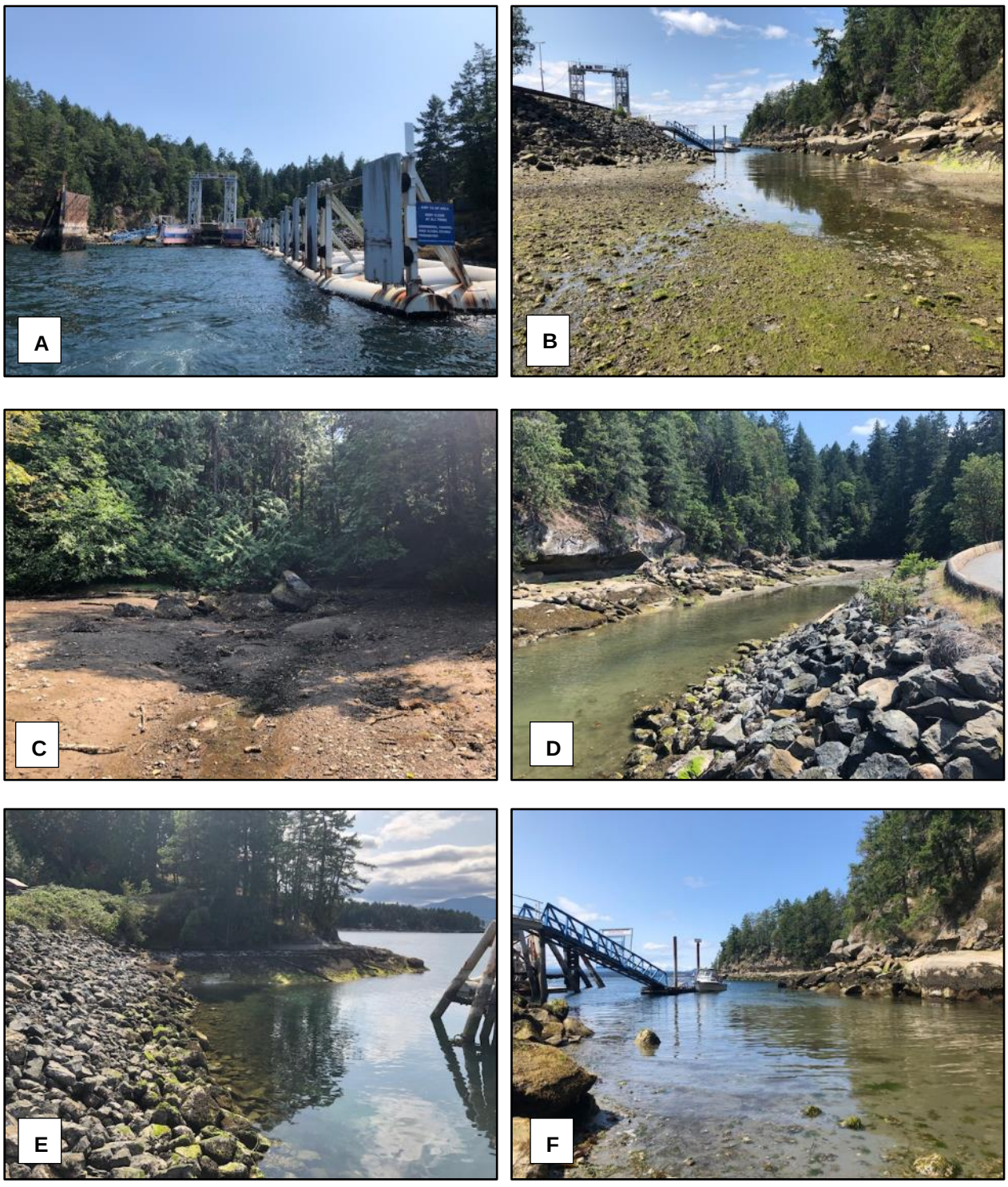

Photo 1 **The Project Site looking (A) east at existing berth infrastructure, B) west from the inlet towards the berth, C) east (upstream) where unnamed tributary enters the inlet, D) east from berth towards inlet, E) south from the berth along riprap, and F) west from the inlet towards the emergency services dock.**

4.3 Detailed Biological Characteristics of the Project Site

A species inventory compiled from the observational and drop camera surveys is summarized in **Table 3** and includes 24 terrestrial vegetation species, two marine vascular plants, 12 marine macroalgae and 1 micoalga, 17 marine invertebrates, and five marine fish, for a total of 61 species at the Project Site.

Table 3 Species inventory at the Project Site.

Common Name	Scientific Name
Upland Vegetation	
Arbutus	*Arbutus menziesii*
Bigleaf maple	*Acer macrophyllum*
Broad-leaved stonecrop	*Sedum spathulifolium*
Bull thistle	*Cirsium vulgare*
Canada thistle	*Cirsium arvense*
Common dandelion	*Taraxacum officinale*
Common horsetail	*Equisetum arvense*
Common snowberry	*Symphoricarpos albus*
Douglas fir	*Pseudotsuga menziesii*
Dull Oregon-grape	*Mahonia nervosa*
Hairy cat's-ear	*Hypochaeris radicata*
Himalayan blackberry	*Rubus armeniacus*
Lady fern	*Athyrium filix-femina*
Oceanspray	*Holodiscus discolor*
Orchard-grass	*Dactylis glomerata*
Oxeye daisy	*Leucanthemum vulgare*
Red alder	*Alnus rubra*
Salal	*Gaulthoria* shallon
Scotch broom	*Cytisus scoparius*
Sword fern	*Polystichum munitum*
Various mosses	unknown
Western dock	*Rumex aquaticus*
Western red cedar	*Thuja plicata*
Wild carrot	*Daucus carota*
Marine Vascular Plants	
American glasswort	*Salicornia pacifica*
Eelgrass	*Zostera marina*
Macroalgae	
Coralline algae (encrusting)	*Pseudolithophyllum* sp.
Nori	*Porphyra* sp.

Common Name	Scientific Name
Red sea-cabbage	*Turnerella mertensiana*
Rockweed	*Fucus gardnerii*
Sea cauliflower	*Leathesia marina*
Sea lace	*Microcladia* sp.
Sea lettuce	*Ulva* sp.
Sea moss	*Acrosiphonia* sp.
Splendid iridescent seaweed	*Mazzaella splendens*
Sugar kelp	*Saccharina latissima*
Turkish washcloth	*Mastocarpus papillatus*
Wireweed	*Sargassum muticum*
Microalgae	
Diatoms	unknown species
Invertebrates	
Acorn barnacle	*Balanus glandula*
Aggregate green anemone	*Anthopleura elegantissima*
Blue mussel	*Mytilus* sp.
Feather star	*Florometra serratissima*
Giant plumose anemone	*Metridium farcimen*
Hydroids	*Abietinaria* spp.
Leather star	*Dermasterias imbricata*
Limpets	*Lottia* sp.
Macoma clam	*Macoma* sp.
Moon jellies	*Aurelia labiata*
Nuttall's cockle	*Clinocardium nuttalli*
Ochre star	*Pisaster ochraceus*
Pacific oyster	*Crassostrea gigas*
Red rock crab	*Cancer productus*
Shore crab	*Hemigrapsus* sp.
Sponges	unknown species
Water jellies	*Aequoreus* sp.
Fish	
Blackeye goby	*Rhinogobiops nicholsii*
Kelp greenling	*Hexagrammos decagrammus*
Pile perch	*Rhacochilus vacca*
Shiner perch	*Cymatogaster aggregata*
Unidentified flatfish	Unknown species

4.3.1 Upland Environment

A narrow strip of vegetation is present along the top of the riprap slope immediately south of the berth and continuing along the south bank of the inlet (**Figure 2, Photo 2A**). The vegetation was dominated by weedy, non-native species typical of a disturbed area, including Himalayan blackberry (*Rubus armeniacus*), wild carrot (*Daucus carota*), orchard-grass (*Dactylis glomerata*), and hairy cat's-ear (*Hypochaeris radicata*).

Other non-native species that occurred in low densities included bull thistle (*Cirsium vulgare*) (**Photo 2C**), Canada thistle (*Cirsium arvense*), common dandelion (*Taraxacum officinale*), and western dock (*Rumex aquaticus*). Native species observed in small densities included oceanspray (*Holodiscus discolor*) and broad-leaved stonecrop (*Sedum spathulifolium*). One arbutus tree (*Arbutus menziesii*) (**Photo 2D**), oxeye daisy (*Leucanthemum vulgare*), and Scotch broom (*Cytisus scoparius*) were also observed. Small (< 1 m^2) patches of dull Oregon grape (*Mahonia nervosa*) (**Photo 2B**) were found throughout and a dense patch of Himalayan blackberry was observed west of the parking area, at the top of the riprap slope.

Photo 2 **A) Himalayan blackberry west of parking area, B) Dull Oregon-grape west of parking area, C) Bull thistle in disturbed upland area, and D) Arbutus at top of riprap along inlet.**

Canada thistle is a provincially regulated noxious plant under the Invasive Species Council of BC (ISC 2019). The *Weed Control Act* requires all land occupiers to control the spread of provincial and/or regional noxious weeds on their lands and premises. Bull thistle, Himalayan blackberry, and Scotch broom are unregulated invasive plants of concern in BC (ISC 2019).

At the east extent of the riprap bordering the inlet, vegetation transitions into coastal upland forest (**Figure 2; Photo 3A, 3B**). Species composition changes from opportunistic, weedy species along the road, to predominantly native species in the less disturbed area. An unnamed tributary flows through a small gully at the southeast end of the Project Site and enters the inlet. Multiple barriers to fish migration are present in the tributary (e.g., depth, large woody debris).

Mature western red cedar (*Thuja plicata*), Douglas fir (*Pseudotsuga menziesii*), bigleaf maple (*Acer macrophyllum*), red alder (*Alnus rubra*), and arbutus occur in the backshore forest. Understory vegetation comprised sword fern (*Polystichum munitum*), lady fern (*Athyrium filix-femina*), salal (*Gaulthoria shallon*), common snowberry (*Symphoricarpos albus*), common horsetail (*Equisetum arvense*), and various mosses. No at-risk plant species were identified during the site assessment.

Photo 3 View southeast A) within the mature Douglas fir, western red cedar dominated forest, and B) from the inlet toward the upland forest.

4.3.2 Intertidal Environment

The intertidal area comprised three main habitat types, fines (sand/silt/mud), boulder and bedrock, and rip rap (**Figure 2;**). The inlet comprised a gently sloped intertidal area with steeper sloped rock and boulder habitat along the shorelines (**Figure 2; Photo 4A**). Armoured riprap is located along a portion of the south bank of the inlet, adjacent to North Road, and extends south of the terminal along the parking area. Riprap size varies from approximately 0.2 to 0.8 m in diameter. In the upper intertidal area, dominant species were acorn barnacles (*Balanus glandula*) and rockweed (*Fucus gardnerii*), comprising ~50% cover (**Photo 4B**). Riprap in the lower intertidal hosted higher species diversity but lower cover. Species included sea moss (*Acrosiphonia* sp.), sea lace (*Microcladia* sp.), acorn barnacles, rockweed, blue mussels (*Mytilus* sp.) and small amounts of sponges and sea cauliflower (*Leathesia marina*). Small patches of Pacific oysters (*Crassostrea gigas*) were observed attached to the riprap in the lower intertidal zone.

Substrate in the gently sloping intertidal inlet varied from predominantly fines (sand/silt/mud, <0.0625 mm) with small amounts of gravel in places (2 to 64 mm), to gravel and fines with small amounts of cobble (64 to 256 mm). Shell fragments were observed throughout. Substrate at the mouth of the inlet was predominantly fines; substrate coarseness increased closer to the shorelines and farther up the inlet (east). Shore crabs (*Hemigrapsus* sp.), carapaces of red rock crab (*Cancer productus*) (**Photo 4E**), and empty bivalve shells (Nuttall's cockle (*Clinocardium nuttalli*), clam (*Macoma* sp.), and Pacific oyster) were observed throughout the intertidal inlet.

The north extent of the intertidal area comprised sandstone bedrock and boulders (**Figure 2; Photo 4C**). Dominant species colonizing this habitat were rockweed, sea moss, and sea lettuce (*Ulva* sp.), with smaller patches of blue mussels, Turkish washcloth (*Mastocarpus papillatus*), and nori (*Porphyra* sp.). Dense polycultures of American glasswort (*Salicornia pacifica*) were observed along the north shore of the inlet on the bedrock shelf (**Photo 4D**).

Near the emergency services dock, at the toe of the rip rap slope substrates transitioned to fines. Splendid iridescent seaweed (*Mazzaella splendens*), sea lettuce, and non-native wireweed (*Sargassum muticum*) were the dominant macroalgal species, comprising approximately 40% cover. Leather stars (*Dermasterias imbricata*) were observed in this area (n = 5).

Four distinct patches of native eelgrass (*Zostera marina*) were observed within the Project Site at the mouth of the inlet, one patch in the intertidal and three patches in the shallow subtidal zone (**Figure 2; Photo 4F**). The patch in the intertidal area was approximately 6 m^2, with approximately 10-15 shoots/m^2. Eelgrass is important because it provides a number of important ecosystem functions, including foraging areas and shelter to young fish and invertebrates, food for migratory waterfowl, and spawning surfaces for species such as the Pacific herring (*Clupea pallasii*). Eelgrass beds also reduce coastal erosion by trapping sediment, stabilizing the substrate, and reducing the force of wave energy (Islands Trust 2013).

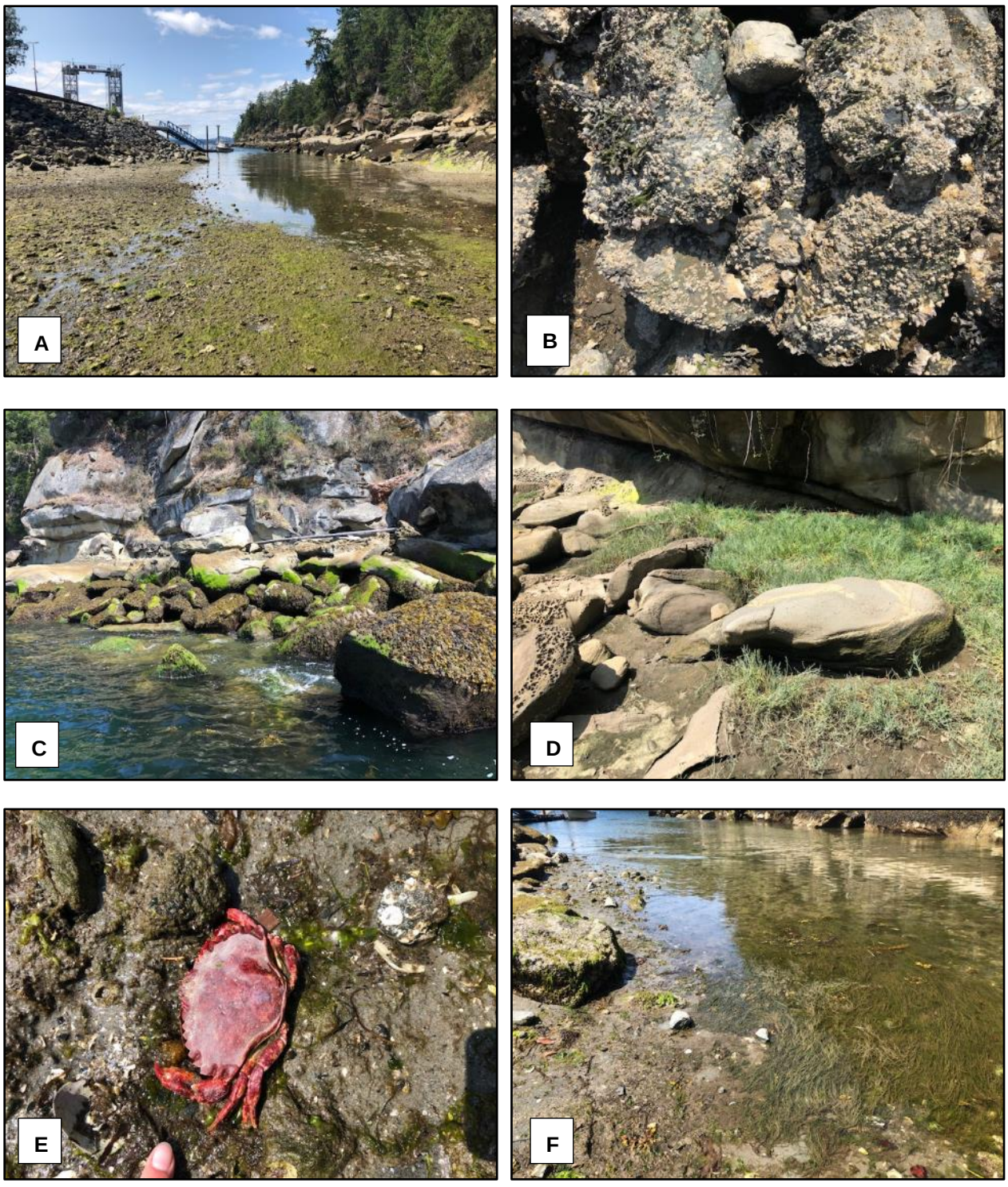

Photo 4 **A) View northwest of intertidal area, B) intertidal riprap habitat, C) boulder and bedrock habitat, D) American glasswort along the north shore of the inlet, E) carapace of red rock crab, and F) patch of eelgrass in intertidal area.**

4.3.3 Subtidal Environment

Subtidal habitat at the Project Site included gravel and fines, fine substrates (sand/silt/mud), and eelgrass (*Zostera marina*) beds (**Figure 2**).

Under the berth, substrate was predominantly gravel interspersed with fines, shell fragments and small amounts of cobble (**Figure 2, Photo 5A**). Larger substrate in this area was colonized by acorn barnacles. Small, dispersed patches of sugar kelp (*Saccharina latissima*), wireweed, sea lettuce, and red sea-cabbage (*Turnerella mertensiana*) provided habitat for small fish, including blackeye goby (*Rhinogobiops nicholsii*) (**Photo 5B**) and juvenile kelp greenling (*Hexagrammos decagrammus*).

The majority of the subtidal area in the Project Site comprised predominately fine substrates (**Figure 2**). In the shallow subtidal area north of the berth, three patches of eelgrass were identified at the mouth of the inlet, comprising an area of approximately 163 m^2 (**Figure 2; Photo 5C, D**). A small (<20) school of shiner perch (*Cymatogaster aggregata*) were observed in the eelgrass. The soft, fine substrates are preferred habitat for crab species. Burrows were evident at the Site but only two Dungeness crabs (*Metacarcinus magister*) were observed during the subtidal survey (**Photo 5D**). An unidentified flatfish was also observed. Water jellies (*Aequoreus* sp.) and moon jellies (*Aurelia labiata*) were abundant in the subtidal water column during the subtidal survey.

Bedrock and boulder habitat armouring the shorelines in the Project Site (**Figure 2**) supported occasional small patches of feather stars (*Florometra serratissima*) (**Photo 5E**). Overall, organismal diversity in the subtidal area was low.

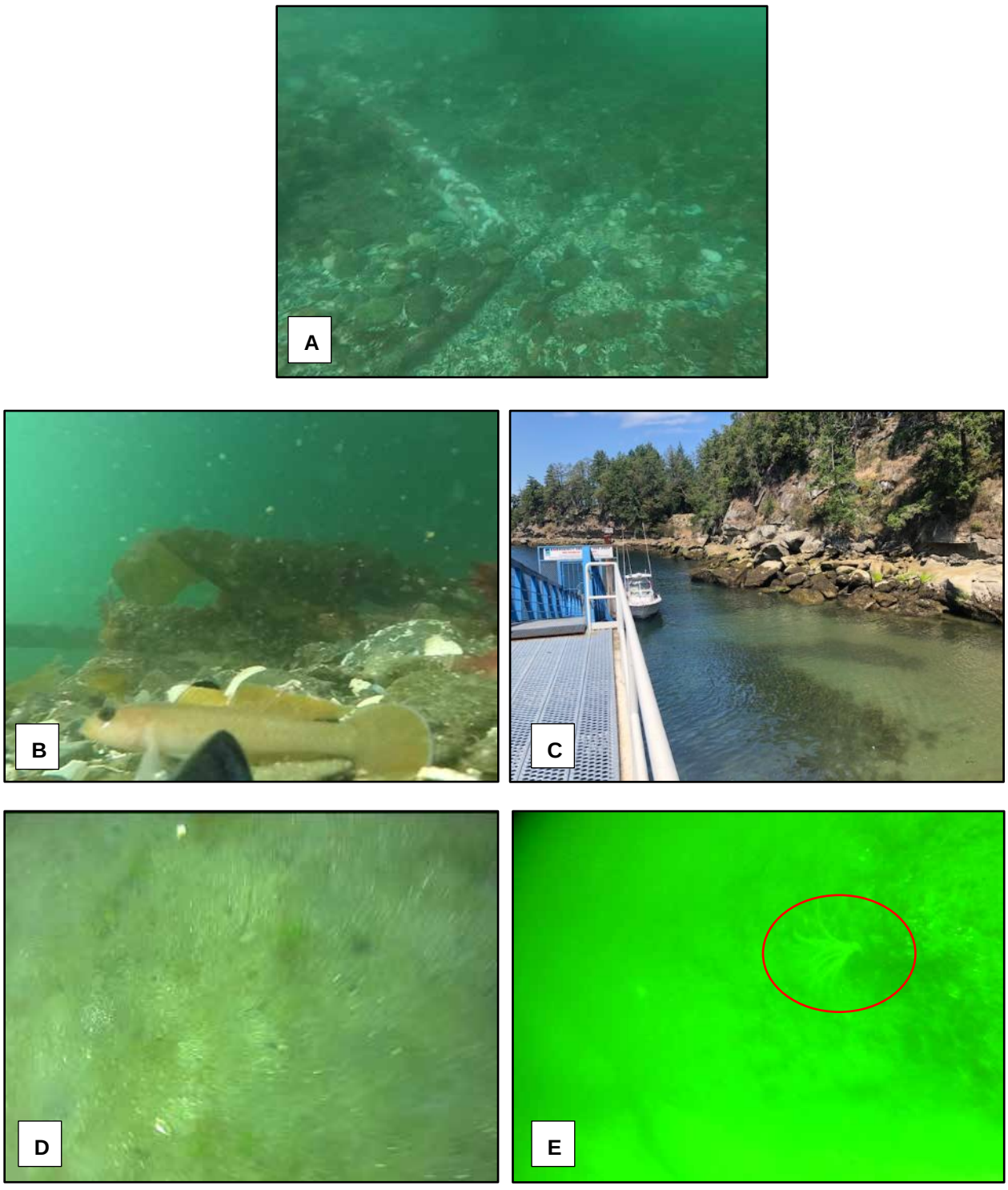

Photo 5 **(A) gravel and fines beneath berth infrastructure, B) blackeye goby beneath berth infrastructure, C) patches of shallow subtidal eelgrass, D) soft substrate in subtidal zone, and E) feather star on hard substrate in subtidal zone.**

4.3.4 Berth Infrastructure

Hard structures installed for the berth were colonized by encrusting species and provided well-functioning fish habitat (**Photo 6A, 6B**). Large schools of pile and shiner perch, and individual kelp greenling and blackeye goby were observed during the survey. Other species were likely present but were not able to be identified.

Acorn barnacles, blue mussels, limpets (*Lottia* sp.), coralline algae, and various sponges colonized berth infrastructure. Giant plumose anemones (*Metridium farcimen*) and aggregate green anemones (*Anthopleura elegantissima*) were abundant with fewer numbers of ochre stars (*Pisaster ochraceus*). Hydroids were found in the largest quantities on chains and aprons, but were still present on pilings.

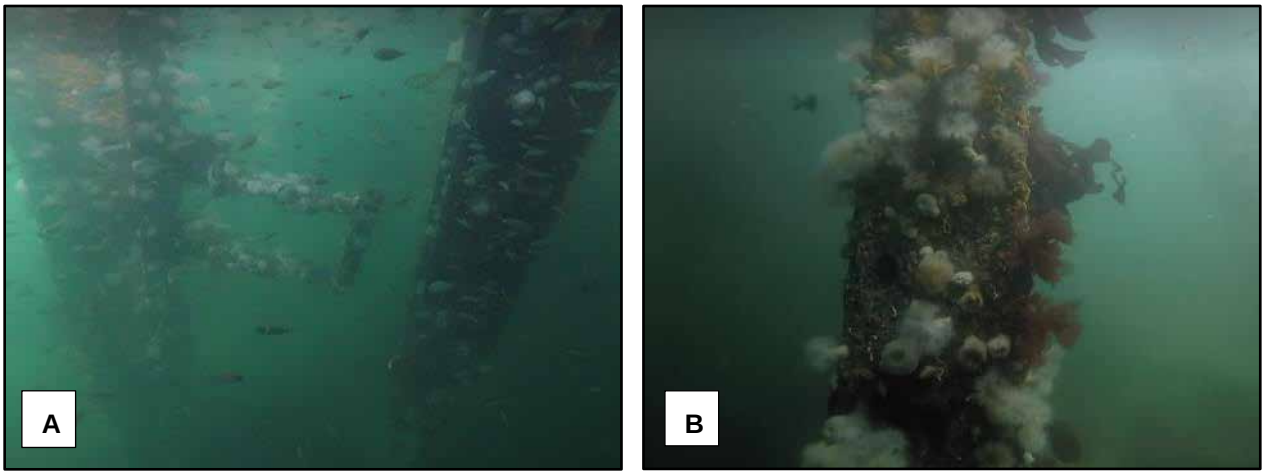

Photo 6 A) Productive fish habitat observed around berth infrastructure, B) encrusting species on pilings.

4.3.5 At-Risk Marine Species and Habitats

The Conservation Data Centre (CDC) assesses the level that BC species or ecological communities are at risk of being lost. Based on that, the CDC assigns a provincial Conservation Status Rank that can be used to set conservation priorities. Based on their conservation status rank, each species and ecosystem is assigned to the red, blue or yellow list to help set conservation priorities and provide a simplified view of the status of BC's species and ecosystems.

The Red list includes species that have been legally designated as Endangered or Threatened under the *Wildlife Act*, are extirpated, or are candidates for such designation. The Blue List includes species not immediately threatened, but of concern because of characteristics that make them particularly sensitive to human activities or natural events. The Yellow List includes uncommon, common, declining and increasing species (BC CDC 2002).

A search of the BC Conservation Data Centre (BC CDC 2019) identified at-risk marine species with potential to occur near the Project Site. Given the Project Site characteristics, this list was refined based on professional judgment to 17 species that are possible to occur: six mammals, six birds, three fish, and two invertebrates **(**Table 4**)**. Of the species identified, 15 are federally listed under the *Species at Risk Act* (SARA).

Table 4 At-Risk Marine Species that May Occur at or near the Project Site

Common Name	Scientific Name	SARA	BC List[1]
Marine Mammals			
Grey Whale	*Eschrichtius robustus*	Special Concern	Blue
Harbour Porpoise	*Phocoena*	Threatened	Blue
Humpback Whale	*Megaptera novaeangliae*	Threatened	Blue
Killer Whale (southern resident population)	*Orcinus orca* pop. 5	Endangered	Red
Killer Whale (west coast transient population)	*Orcinus orca* pop. 3	Threatened	Red
Steller Sea Lion	*Eumetopias jubatus*	Special Concern	Blue
Birds			
Northern Goshawk	*Accipiter gentilis laingi*	Threatened	Red
Marbled Murrelet	*Brachyramphus marmoratus*	Threatened	Blue
Ancient Murrelet	*Synthliboramphus antiquus*	Special Concern	Blue
Double-crested Cormorant	*Phalacrocorax auritus*	None	Blue
Great blue heron (*fannini* subspecies)	*Ardea herodias fannini*	Special Concern	Blue
Peregrine Falcon (*anatum* subspecies)	*Falco peregrinus anatum*	None	Red
Fish			
Green Sturgeon	*Acipenser medirostris*	Special Concern	Red
Rougheye Rockfish	*Sebastes aleutianus*	Special Concern	None
Yelloweye Rockfish	*Sebastes ruberrimus*	Special Concern	None
Invertebrates			
Northern Abalone	*Haliotis kamtschatkana*	Endangered	Red
Olympia Oyster	*Ostrea conchaphila*	Special Concern	Blue

Notes:

[1] BC List: Red = Species that are extirpated, endangered, or threatened; Blue = Species of special concern; Yellow = species and ecological communities that are secure.

The Project Site does not overlap with Critical Habitat that has been defined under SARA for the species identified. Gabriola Island waters currently do not comprise critical habitat for Southern Resident Killer Whales under the SARA but are within draft critical habitat for West Coast Transient Killer Whales and is pending formally designation by DFO (Government of Canada 2017). While killer whales are not expected to occur at the Site, both Southern Resident Killer Whales and West Coast Transient Killer Whales populations could both occur in the vicinity of the Project (i.e., within Fisheries Management Area 17). Olympia oyster (*Ostrea conchaphila*), listed as a species of Special Concern on Schedule 1 of SARA, has the potential to occur at the Site, but are not historically known from the Site (Gillespie 1999).

4.3.6 Birds

Glaucous-winged gulls (*Larus glaucescens*) and a turkey vulture (*Cathartes aura*) were observed during the site assessment. The Site may provide roosting habitat for marine/intertidal foraging species, as well as foraging habitat for insectivorous birds. The upland forest provides nesting habitat for a range of bird species. No stick or cavity nests were observed during the assessment. The general nesting period that covers most federally protected migratory bird species typically extends from late-March and to mid-August (Environment and Climate Change Canada 2018). The Site does not overlap an Important Bird Area or Critical Habitat.

4.3.7 Wildlife

No wildlife was observed at the Project Site during the assessment. The riparian backshore may provide potential habitat for species that forage in intertidal areas. Possible species include mink (*Mustela vison*) and raccoon (*Procyon lotor*). The Site does not overlap any Wildlife Habitat Areas or Critical Habitat (iMapBC 2019).

4.3.8 At-Risk Terrestrial Species

A search of the BC Conservation Data Centre (CDC) (BC CDC 2018) identified at-risk terrestrial species with potential to occur near the Project Site. Given the Project Site characteristics, this list was refined based on professional judgement to 32 species that are possible to occur: 16 birds, six mammals, one amphibian, and nine plants (**Table 5**). Of the species identified, 17 are federally listed under the *Species at Risk Act* (SARA).

Table 5 At-Risk Terrestrial Species that May Occur at or near the Project Site

Scientific Name	English Name	BC List[1]	SARA
BIRDS			
Short-billed Dowitcher	Limnodromus griseus	Blue	None
Northern Goshawk	*Accipiter gentilis laingi*	Red	Threatened
Great Blue Heron	*Ardea herodias fannini*	Blue	Special Concern
Short-eared Owl	*Asio flammeus*	Blue	Special Concern
Rough-legged Hawk	*Buteo lagopus*	Blue	None
Common nighthawk	*Chordeiles minor*	Yellow	Threatened
Olive-sided Flycatcher	*Contopus cooperi*	Blue	Threatened
Black Swift	*Cypseloides niger*	Blue	None
Northern Pygmy-Owl	*Glaucidium gnoma swarthi*	Blue	None
Barn Swallow	*Hirundo rustica*	Blue	None
Western Screech-Owl	*Megascops kennicottii*	Blue	Special Concern
Band-tailed Pigeon	*Patagioenas fasciata*	Blue	Special Concern
Vesper Sparrow	*Pooecetes gramineus affinis*	Red	Endangered
Purple Martin	*Progne subis*	Blue	None

Scientific Name	English Name	BC List[1]	SARA
Western Meadowlark (Georgia Depression population)	*Sturnella neglecta*	Red	None
Barn Owl	*Tyto alba*	Red	None
WILDLIFE			
Mammals			
Townsend's Big-eared Bat	*Corynorhinus townsendii*	Blue	None
Vancouver Island Marmot	*Marmota vancouverensis*	Red	None
Ermine	*Mustela erminea anguinae*	Blue	None
Keen's Myotis	*Myotis keenii*	Blue	None
Little Brown Myotis	*Myotis lucifugus*	Yellow	Endangered
American Water Shrew, *brooksi* subspecies	*Sorex navigator brooksi*	Blue	None
Reptiles and Amphibians			
Northern Red-legged Frog	*Rana aurora*	Blue	Special Concern
VEGETATION			
Slimleaf onion	*Allium amplectens*	Blue	None
Vancouver Island beggarticks	*Bidens amplissima*	Blue	Special Concern
Coastal wood fern	*Dryopteris arguta*	Blue	Special Concern
Dense spike-primrose	*Epilobium densiflorum*	Red	Endangered
Heterocodon	*Heterocodon rariflorum*	Blue	None
Macoun's meadow-foam	*Limnanthes macounii*	Red	Threatened
Coast microseris	*Microseris bigelovii*	Red	Endangered
White-top aster	*Sericocarpus rigidus*	Blue	Special Concern
Lindley's microseris	*Uropappus lindleyi*	Red	Endangered

Notes:

[1] BC List: Red = Species that are extirpated, endangered, or threatened; Blue = Species of special concern; Yellow = species and ecological communities that are secure.

The Project Site does not overlap with Critical Habitat as defined under SARA for the species identified. Based on data available from iMap BC, eFauna, and eFlora, no known occurrences of species at-risk are found within the search radius of 1 km of the Project Site.

5.0 PROJECT COMPONENTS AND MECHANISMS WITH POTENTIAL TO AFFECT FISH AND FISH HABITAT

Project Activities that have the potential to impact fish or fish habitat, including listed aquatic at-risk species, include the removal and installation of in-water infrastructure including floating leads, wingwalls, pilings, and installation of rip rap armouring. The mechanisms by which these activities could cause HADD, either through the death of fish or through the destruction or permanent alteration of fish habitat, are detailed below.

5.1 Potential Impacts of Removal Activities

- Alteration of 7.3 m^2 seabed through the removal of 52 existing piles from the marine environment.
- Removal of existing ramp, apron, pile caps, floating pontoons and dolphins with an overwater shading footprint of approximately 237.5 m^2.

5.2 Potential Impacts of Installation Activities

5.2.1 Mechanisms with the potential to impact fish:

- Crushing, burial or stranding of fish species and permanent alteration to fish habitat may occur through:
  - Installation of six vertical piles in soft bottom marine habitat (10.59 m^2)
  - Infilling on existing intertidal rip rap fish habitat (300 m^2); and,
  - Installation of armouring rip rap on soft bottom marine habitat (450 m^2).
- Asphyxiation of mobile marine organisms such as fish and sessile organisms:
  - Temporary increase in total suspended solids from pile extraction and installation, infilling works and upland trenching, resulting in increased turbidity. Increased suspended sediments may disrupt fish swimming, feeding and/or predator avoidance.
  - Erosion/sedimentation events from upland activities.
- Barotrauma and avoidance of near shore habitat by marine fish, mobile invertebrates and marine mammals due to acoustic impacts of Project Activities:
  - Vibratory pile driving is expected to be required for installation of the piles. This poses a risk of mortality from barotrauma injuries caused by exposure to underwater noise involving impulsive sounds generated by the vibratory hammer (Halvorsen et al. 2012a,b). While all species of fish are susceptible to barotrauma; hearing-specialist species use swim-bladders for hearing (e.g., Pacific herring) and are therefore most susceptible to injury from high underwater sound pressure waves.
- Disturbance of interstitial organisms inhabiting soft bottom substrates.

5.2.2 Mechanisms with the potential to impact fish habitat:

- Installation of six vertical piles in soft bottom marine habitat (10.59 m^2)
- Infilling on existing intertidal rip rap fish habitat (300 m^2); and,
- Installation of armouring rip rap on soft bottom marine habitat (450 m^2).
- Indirect impacts to eelgrass beds due to close proximity of in-water construction.

- Water quality impacts through:
  - Suspension of bottom sediments resulting in increased turbidity and re-suspension of contaminants.
  - Increased contaminants entering the marine environment from Project-related activities such as drilling, increased vessel traffic on Site, and pile install and backfilling.

5.2.3 Mechanisms with the potential to impact upland habitat and wildlife species:

- Disturbance of wildlife through vegetation clearing.
- Impacts to marine water quality through run off and particulates from trenching, stock piling, paving and general construction activities.

6.0 MITIGATION MEASURES

The recommended mitigation measures below are intended to address and mitigate potential adverse effects of the proposed Project on fish and fish habitat at the Project Site identified in **Section 5.1**. Hemmera recommends that a qualified environmental professional (QEP) be on-site daily during in-water drilling and pile driving and weekly at other times.

6.1 Timing Windows

Through consideration of the seasonal distribution and abundance of fish and the timing of their sensitive life stages and processes (e.g., reproductive periods, migration of Pacific salmon), DFO identifies periods of lower (least) risk for the timing of in-water and near-water works. Generally, in-water Project Activities should be timed to occur within DFO's least risk work windows, to avoid or limit possible adverse effects on fish and aquatic species during sensitive life history stages. The Project Site lies within DFO Fisheries Management Area 17-13. Timing windows of least risk for this area are:

- Summer Window: **June 1 - September 1**
- Winter Window: **December 1 - February 15**

6.2 Impacts to Fish and Fish Habitat, and Marine Mammals

6.2.1 Fish and Fish Habitat

Death of sessile and slow-moving species such as crabs and sea urchins may result from crushing or burial during pile extraction and installation or fish stranding within the proposed fill area. Fish mortality is expected to be effectively mitigated through pre-construction species salvage prior to removal of existing infrastructure and a visual survey of the proposed fill area. Incidental mortalities are expected to be of low magnitude and are not anticipated to measurably harm the sustainability or productivity of local fisheries.

The potential presence of rearing salmonids and spawning and rearing Pacific herring is expected to be mitigated through use of DFO least risk timing windows, onsite environmental monitoring and, if required, site isolation. The overall magnitude of the effect is anticipated to be low and not result in a localized effect at the population level for any given finfish species. The following measures should be followed to mitigate impacts of Project Activities to fish:

- Disturbance to riparian vegetation adjacent to the work site will be kept to a minimum. During clearing and grubbing, shrubs will be close cut to allow for regrowth if possible or will be salvaged with root ball intact for replanting after works are completed.
- An exclusion device such as protective netting or geotextile material (e.g., silt curtains) should be onsite and, if required, suspended in the water column around the work area to prevent access to fish and other marine fauna and to contain turbidity resulting from suspension of fine substrates.
- Pile extraction and installation will be guided by the Best Management Practices for Pile Driving and Related Operations (BC Marine and Pile Driving Contractors Association and DFO 2003).
- Hydroacoustic monitoring should be undertaken during pile installation and drilling activities (**Section 6.2.1.3**).
- A bubble curtain should be deployed on-site should hydro-acoustic monitoring (see **Section 6.2.1.3**) indicate an exceedance of noise thresholds for fish or marine mammals.
- Key sessile marine species colonizing in-water infrastructure will be manually removed and relocated within the Project Site during the removal of berth infrastructure.
- Barges should not rest on bottom substrates or spud near or in eelgrass or other sensitive habitats.
- Propeller scour of subtidal habitats should be avoided.

6.2.2 Marine Mammals

- A 30-minute visual assessment will be conducted by the onsite Environmental Monitor prior to initiation of drilling to ensure that no cetaceans are within 1000 m, or pinnipeds within 250 m of Project Activities.
- Project Activities will be ceased if any marine mammal is observed within the exclusion zone, such that there is a risk of physical harm from direct contact, and only resumed once the animal has left the exclusion zone or have not been re-sighted for 30 minutes.

6.2.3 Hydroacoustic Impacts

The intensity and extent of underwater sound and pressure from pile installation will be limited by the preferential use of the vibratory method as opposed to the impact method, which has been shown to reduce sound pressure levels by up to 25 decibels (dB) (BC Marine and Pile Driving Contractors Association and DFO 2003). Environmental monitoring of underwater noise levels will be undertaken to ensure levels potentially harmful to fish or marine mammals are not occurring. Mitigation should, at the direction of Fisheries and Oceans, include the following measures to prevent acoustic impacts to fish and disturbance effects to marine mammals (including cetaceans and pinnipeds) during pile installation and drilling:

- **Fish:** Underwater sound levels that do not exceed 206 dB at a reference pressure of 1 µPa and a $SEL_{cumulative}$ of 187 dB at a reference pressure of μPa^2s with acoustic monitoring within 10 m of the noise source.
- If underwater sound levels exceed the threshold of 206 dB at a reference pressure of 1 µPa, the work must be halted. Work can resume only after additional mitigation measures have been implemented.

- **Marine Mammals:** A marine mammal monitoring program will be implemented to enforce a detection zone of 1000 m around the work area for cetaceans and 250 m for pinnipeds.
- A disturbance threshold of 160 dB at a reference point of 1 µPa is to be used to define the marine mammal detection zone.
- If monitoring indicates underwater sound levels in excess of 160 dB at the edge of the marine mammal exclusion zone, the activity will cease, and the Proponent will notify DFO. The activity will only resume after additional mitigation measures are implemented.
- Pile installation that results in underwater sound levels above 160 dB referenced to 1 µPa should be completed during daylight hours only.

If the Harmful Alteration, Disruption or Destruction of fish or fish habitat is observed, the proponent is required to report to DFO immediately through the DFO-Pacific Observe, Record and Report phone line (toll free) at 1.800.465.4336.

6.2.4 Wildlife

The following mitigation measures will be implemented to limit environmental impacts from vegetation clearing and grubbing to wildlife:

- If clearing and grubbing activities occur between March 31 and August 12, a breeding bird survey will be completed as per the *Migratory Bird Convention Act* to ensure breeding birds are not disturbed.
- Where appropriate, clearing and grubbing works will be phased to limit the area and duration of exposed soil.
- Clearing and grubbing will be limited to the extent possible to minimize the disturbance footprint.
- Clearing boundaries will be identified and flagged in the field.
- Disturbance to banks and riparian vegetation in the vicinity of the work area will be minimized.
- Clearing and grubbing activities will avoid damaging vegetation outside of the designated work site limits; except for danger trees, which will be removed with minimal disturbance of surrounding vegetation.
- Temporary clearing and grubbing stockpiles will be situated in an appropriate location above the top of the bank, where they will not impact existing vegetation or enter fish habitat. All cleared timber, brush, stumps and organic material are to be promptly end-hauled and buried in a location approved by the Ministry Representative within 1.0 km of the Site.

For clearing of Noxious Weed and Invasive Plants:

In accordance with the BC *Weed Control Act* all land occupiers are required to control noxious and invasive weeds. To ensure that weeds are not transferred to the Project Site, personnel entering the Site will comply with the following:

- Vehicle and equipment access will be limited to established roads on the work site, where possible.
- Parking will be limited to a defined laydown area that is confirmed to be free of noxious weeds and invasive plant species.

If an at-risk plant species or ecological community of concern is discovered, the plant or ecological community will be assessed based on the following criteria:

- The position of the plant species or ecological community of concern in relation to the Project Site;
- The potential impact of the Project on the species;
- The habitat preferences of the plant species or ecological community of concern; and
- The local abundance of the plant species or ecological community of concern.

In the event a plant species or ecological community of concern is discovered, a mitigation plan will be developed in consultation with the Ministry Representative, MFLNRORD, and the EM. Mitigation measures may include, but are not limited to:

- Protecting the area by staking, flagging and/or fencing;
- Narrowing or realigning the work area, if possible;
- Temporarily covering the site with geotextile pads or matting; and
- Implementing access restrictions in the vicinity of the area.

6.3 Impacts to Water Quality

Project Activities in the upland, including vegetation clearing, use of heavy equipment, bank stabilization, trenching, paving, and general construction activities, have the potential to impact marine water quality through run off and particulates entering the marine environment. The recommendations below are guidance to protect water quality and should be implemented as applicable: Although Descanso Bay can experience high background levels and variability in water turbidity, chronic, long-term increased sedimentation resulting from in-water and near-water works can have sub-lethal and lethal effects on sensitive fish species including rearing juvenile salmonids and forage fish. Sediment deposition can be particularly harmful at times of the year when fish are spawning as the sediment can smother incubating eggs causing suffocation and lead to egg die-offs.

The use of equipment in and near water can result in impacts to water quality such as accidental contaminant spills and fuel leaks from activities such as drilling, vehicle traffic, and pile backfilling.

- Drill cuttings will be pumped to the surface for deposit into containment skiffs or scows for land disposal when unsuitable for return to the environment.
- Building material (e.g., concrete or grouts) used in water works must be handled and treated in a manner to prevent the release or leaching of deleterious substances into the water.
- Any concrete or grouting work should follow the “Guide to the Code of Practice for the BC Concrete and Concrete Products Industry – Version 6”, particularly Chapter 7 – Authorized Discharge: Effluent and Surface and Marine Water Quality (Millennium EMS Solutions Ltd. 1993).

When cleaning out pipe piles (i.e., air lifting), the following Best Management Practices (BMPs) will be employed to minimize/prevent impacts to water quality:

- Sediment contained in the pipe will be pumped to the surface and processed through an approved containment system, then;
- Dispose offsite, or,
- Pump the sediment through a discharge tube redirecting it back to the base of the pile and allowed it to settle in the immediate area within a silt curtain to contain the sediment.

When placing concrete or grout in form work over or in water, the following Best Management Practices will be employed to minimize/prevent the impacts to water quality:

Pouring concrete and grout

- Spills: Prevent spills of fresh concrete or grout. Concrete and grout are toxic to fish due to high pH. If concrete or grout is being placed with a pump, all hose and pipe connections must be sealed and locked properly to ensure the lines will not leak or uncouple. Crews will ensure that forms are not filled to overflowing.
- Sealing forms: All concrete forms will be constructed in a manner which will prevent fresh concrete or cement-laden water from leaking into the surrounding water.

Curing concrete and grout

- When fresh water is used to cure concrete or grout, the runoff must be monitored for acceptable pH levels. If the pH levels are outside the allowable limits then the run-off water must be contained and neutralized.

Washing hand tools, pumps and transit mixer

- All tools, pumps, pipes, hoses and trucks used for finishing, placing or transporting fresh concrete or grout must be washed off in such a way as to prevent the wash water and excess material from entering the marine environment. The wash water will be contained and disposed of upland in an environmentally acceptable manner.

Erosion and Sediment Control

- At the Project start-up meeting, prior to Project construction, erosion and sediment control measures for the works will be confirmed.
- The Contractor will be responsible for ensuring that sediment and erosion control features are in place, are functional, are maintained throughout the Project and removed following Project works and Site stabilization.
- Preventing erosion will take precedent over measures to prevent sedimentation.
- Work will be phased to limit the extent of soil exposed at any one time.
- Work will be conducted in a manner which prevents the release of silt, sediment, sediment-laden water, or any other deleterious substances into the water (e.g., gauge the speed of work to reduce suspension of sediments), and will be pursued to completion as quickly as possible once started.

- The Contractor will have erosion and sediment control materials and supplies readily available, including, but not limited to, pre-staked silt fencing (or other sediment barrier), polyethylene sheeting, and sandbags, for the duration of the Project. Construction team members will be trained in the installation and use of the erosion and sediment control materials and will be ready to quickly erect measures to prevent sediment entry into watercourses or waterbodies.
- The Contractor will establish all permanent control features (e.g., silt fences) onsite prior to ground disturbance, and will be prepared to install temporary control as needed (e.g., have supplies readily available and team members trained to install them).
- The limits of construction will be identified and flagged prior to starting work. Equipment and machinery will not be operated outside the identified area. When planning the layout for clearing:
  - Minimize vegetation removal and grubbing to maintain roots.
  - Stage clearing and site preparation: do not disturb an area until it is necessary to proceed with construction to minimize exposed soil.
  - Unnecessary activity outside of designated access corridors and temporary workspaces will be prohibited.
- The Contractor will control surface water runoff to prevent sediment-laden runoff from entering fish habitat by installing barriers or water diversion measures to re-direct drainage (e.g., silt fence, drainage berms, and/or swales, armouring). Drainage structures will be maintained for the duration of the Project to prevent surface erosion and introduction of sediment laden runoff into fish habitat. Turbidity will be monitored downstream of the site to ensure drainage structures are functioning as intended.
- Work should be scheduled for dry weather whenever possible. The EM and Contractor will monitor local weather to determine if precipitation is forecast.
- Sumps/berms will be constructed, if required, to prevent sediment laden runoff from excavated surfaces from entering watercourses.
- Temporarily exposed steep surfaces of erodible materials will be covered (e.g., with polyethylene sheeting or other suitable material). Sheeting will be examined, maintained, and will be sufficiently anchored to prevent displacement.
- Structural materials and equipment entering the water will be free of silt, debris, or other deleterious substances.
- Any exposed soils will be stabilized as soon as possible using measures such as erosion control blankets, hydroseeding, hand grass seeding, silt fencing, polyethylene sheeting, and installation of long-term vegetation.
- The EM will be present for work activities with elevated erosion and sediment risks.
- Prior to any prolonged shut-down of the job site, the EM will confirm site control measures are in place, as appropriate to maintain site stability.
- If a mitigation feature is inadequate the EM will be notified, and a new mitigation strategy will be implemented in consultation with the EM and based on specific site requirements.

Whenever there is the possibility of contaminants entering water, the contractor or environmental monitor will monitor pH levels to ensure acceptable levels. With the implementation of recommended avoidance (e.g., least risk construction windows) and mitigation measures (e.g., site isolation as required, monitoring of background and work zone suspended sediment/turbidity) suspended sediments are not anticipated to result in effects to fish.

6.4 Impacts of General Construction

- Heavy equipment working in the marine environment should be clean, in good working order, and if practicable, use biodegradable lubrication and hydraulic fluids.
- Contractors will ensure that all attachments (hydraulic connections and couplings) are in good operating order and inspected prior to the start of every day.
- Drill cuttings will be pumped to the surface for deposit into containment skiffs or scows for land disposal when unsuitable for return to the environment.
- Construction materials should meet or exceed currently accepted environmental standards.
- The work Site and equipment (e.g., hammer, barge) must have emergency spill kits available (pads, sorbent booms, etc.). The kits shall be suitable for the quantities and types of material stored at the Site and shall contain sufficient materials to contain any leaks from cables that are accidentally damaged or cut. Site personnel will be trained in the proper use of the kits in case of a spill. All spills to ground and water will be contained and reported to relevant environmental agencies.
- Use secondary containment for all machinery containing fuel and fuel containers (e.g., jerry cans).
- Conduct refueling with absorbent pads present and performed in such a way that contaminants do not enter any drainage, groundwater or water bodies.
- Maintain all vessels and equipment in clean working order to reduce risk of spills and leaks into the marine environment.
- Plan activities near water so that materials such as paint, primers, blasting abrasives, rust solvents, degreasers, grout, poured concrete or other chemicals do not enter the waterbody.
- All debris and deleterious substances associated with the Project Activities shall be appropriately contained in the immediate work area, collected, and disposed of in accordance with all applicable legislations, guidelines and best management practices.

7.0 EFFECTS ASSESSMENT

7.1 Assessment Approach for Residual Effects

The *Fisheries Act* prohibits the death of fish by means other than fishing and sub-lethal effects to fish and aquatic species at risk. In managing the fish habitat resource, DFO interprets the harmful alteration, disruption or destruction of fish habitat as;

> "*Any temporary or permanent change to fish habitat that directly or indirectly impairs the habitat's capacity to support one or more life history processes of fish*."

Temporary or permanent changes to fish habitat resulting from a project can directly or indirectly impair the capacity of habitat to support one or more life history processes of fish. Mitigation designed to reduce the potential risk of a project to fish habitat will ensure that fish and fish habitat are conserved and protected.

Residual effects to fish and habitat resulting from the interaction between Project Activities and fish and fish habitat, following the implementation of avoidance and mitigation measures, will be assessed using the criteria defined in **Table 6**. This assessment relies on available scientific literature and field studies, the experience and professional judgment of the assessment team, and follows the guidance provided by DFO's Fish and Fish Habitat Protection Policy Statement (DFO 2019).This assessment will consider effects to fish and the magnitude of effects to habitat by considering;

- The habitat components being affected;
- The spatial extent of the area affected by the project relative to the habitat components in the area;
- The sensitivity of the habitat being affected; and,
- The expected persistence of the effects.

The evaluation will be undertaken in the context of the aquatic ecosystem, considering the habitat components (e.g. substrate, aquatic vegetation, water depth, oxygen etc.) that support habitat functions (i.e. spawning, rearing, nursing, feeding, migrating) of the relevant fish and will depend on the nature of the affected habitat, the fish species present, their life history and related habitat requirements. The following will be taken into consideration for this assessment of residual harm:

Identification of habitat components: the structural features that support the requisite habitat functions required to meet the life history processes of fish (e.g., spawning, rearing, etc.). Habitat components are used as a proxy for habitat functions. Habitat components (**Section 4.0**) affected by the project will be identified and the most significant species use will be considered. If multiple components are significant to a species, there may be a need to assess multiple habitat components.

Spatial extent: the overlap of the area affected by the project with the habitat component. The affected area is the areas within which all project related activities are likely to occur either directly or indirectly. Once the primary habitat component(s) is selected, a rough estimate of its geographical extent (i.e., area) will be made to approximate the percentage located within the affected area.

The scale considered will include site, local and widespread. They are described below in **Table 6**.

Table 6 Spatial Extent of Effects

Site	Local	Widespread
The affected area overlaps with the habitat component by up to 5% of the area occupied by the habitat component	The affected area overlaps with the habitat component between 5 and 50% of the area occupied by the habitat component.	The affected area overlaps with the habitat component by between 50 and 100% of the area occupied by the habitat component
The affected area overlaps a minor or negligible portion of the habitat component	The affected area overlaps a portion of the area occupied by the habitat component.	The affected area overlaps much of the area occupied by the habitat component.

Habitat sensitivity: habitat and species sensitivity are critical elements when assessing the risk of temporary or permanent change to fish habitat resulting from the project are likely to directly or indirectly impair a habitats capacity to support one or more life processes of fish. The assessment will determine whether affected habitat is of low, moderate or high sensitivity. A determination matrix is presented in **Table 7**.

Table 7 Habitat Sensitivity

	Low Sensitivity	Moderate Sensitivity	High Sensitivity
Species Resiliency	Species present are resilient to change and perturbation	Species present are moderately resilient to change and perturbation	Species present are highly sensitive to perturbations
Species Dependence on Habitat	Habitat not used by fish for any life stage except occasionally transiting through or feeding in the area	Habitat is suitable and may be used as migratory corridor, rearing or spawning habitat. Habitat characteristics used in a variable way by fish.	Habitat is limited and the fish are dependent on it for survival of the species (e.g., groundwater upwelling zone supporting spawning habitat or deep pools providing the only overwintering habitat). Habitat characteristics used in a specific way by fish.
Habitat Rarity	Habitat is prevalent and widespread with many areas that are similar in features	Habitat is neither widespread or unique, rare or distinct.	Habitat is unique, rare and distinct.
Habitat Resiliency	The habitat is robust, resistant to perturbation or rapidly recovers	The habitat is neither robust nor sensitive, is somewhat resistant to perturbation and recovers at a moderate rate.	The habitat is highly sensitive, easily perturbed, and slow to recover.
Aggregation	Habitat does not support a specific function; fish densities are typically low.	Habitat supports a minimum of one function; fish densities periodically high.	Habitat supports more than one function; fish densities frequently high.
Habitat contribution to Fisheries Productivity	Habitats contribution to fisheries productivity is low. Large amounts of change to the affected species or habitat is expected to have relatively low impacts on fisheries productivity	Habitats contribution to fisheries productivity is moderate. Amount of change to the affected species or habitat is proportional to impacts on fisheries productivity (small change/small impacts; large	Habitats contribution to fisheries productivity is high. Small amounts of change to the species or habitat is expected to have relatively large impacts on fisheries productivity

	Low Sensitivity	Moderate Sensitivity	High Sensitivity
		change/large impacts)	
Abiotic and Biotic Suitability of Habitat	No key structure-providing species (abiotic) in area of WUA.	Key structure providing species is present in location of the WUA but is not a limiting component	Key structure providing species present in location of WUA and is a limiting component
Species at Risk	Not within distribution area of a listed aquatic species at risk.	Within distribution area of an aquatic species at risk, but not in critical habitat. Non-critical habitat of aquatic species at risk that supports their lifecycle functions within their distribution area.	Critical Habitat and/or residence of aquatic species at risk identified in the proposed or final Recovery Strategy or Action Plan. Habitat supporting species of special concern.

Persistence of effects: the length of time needed for an effect to disappear. Assessment is based on three categories;

- Low - weeks
- Moderate – months; and,
- High – more than 1 year.

7.2 Destruction and Permanent Alteration of Fish Habitat

Post application of mitigation measures, project related works, undertakings and activities will result in the direct harmful alteration, disruption or destruction of approximately 753.3 m^2 marine habitat (**Table 8**). Indirect impacts (through shading of berth infrastructure) will increase at the Project Site by 64.2 m^2 (**Table 8**). Residual effects to fish and habitat resulting from the interaction between Project Activities and fish and fish habitat are presented in **Table 9.**

Table 8 Summary of Affected Fish Habitats

Component	Habitat Type	Area of Directly Affected Fish Habitat (footprint)	Area of Indirectly Affected Fish Habitat (shading)
Existing infrastructure removal	Subtidal benthic soft sediment	7.3 m^2	237.5 m^2
	Habitat gain	7.3 m^2	237.5 m^2
New infrastructure installation	Subtidal benthic soft sediment	10.6 m^2	301.7 m^2
Infill	Low intertidal rip rap	300 m^2	--
Rip rap armoring	Subtidal benthic soft sediment	450 m^2	--
	Habitat loss	760.6 m^2	301.7 m^2
	Net habitat loss	**753.3 m^2**	**64.2 m^2**

Table 9 Effects Matrix of Project Components with the Residual Effects

Habitat Zone	Description of Pre-Construction Habitat	Existing Habitat Area (m^2)*	Effect Type	Area of Habitat Affected (m^2)	Description of Post-Construction Habitat	Spatial extent of effects	Species Resiliency	Species Dependence on Habitat	Habitat rarity	Habitat Resilience	Aggregation	Habitat Contribution to Fish Productivity	Species at-Risk	Persistent Effects
Low Intertidal	Rip rap	1,783	Destruction	300	Upland	Local	Low	Low	Low	Low	Low	Low	Low	High
Subtidal	Fines	29,890	Harmful Alteration	10.6	Artificial hard substrate	Site	Low	Moderate	Low	Low	Low	Low	Low	High
Subtidal	Fines		Alteration (shading)	301.7	Artificial hard substrate	Site	Low	Moderate	Low	Low	Low	Low	Low	High
Subtidal	Fines		Harmful Alteration	450	Rip rap	Site	Low	Moderate	Low	Low	Low	Low	Low	High

* within defined Project Site (Figure 1,2).

7.3 Assessment Summary

Project Activities that may result in impacts to fish and fish habitat include the removal and installation of in-water berth infrastructure; pile extraction and installation; concrete and grout work in and near water, infilling of existing rip rap habitat to create additional upland, placement of rip rap in the shallow subtidal and general construction activities. Measures to mitigate these potential effects are provided in **Section 6.0.**

After incorporation of measures to avoid and mitigate effects to fish and fish habitat, it is expected that some works, undertakings, and activities required by the Project will result in a HADD to fish habitat including approximately 760.6 m^2 of marine habitat:

- Alteration of 450 m^2 of benthic soft sediments to rip rap fish habitat;
- Harmful alteration of 10.6 m^2 of benthic soft sediments that support Dungeness and red rock crab, flat fish, sea pens, anemones, gobies, bivalve species and potentially forage fish such as sand lance (*Ammodytidae* sp.); and,
- Harmful alteration (through infilling) of 300 m^2 of intertidal rip rap that potentially support sculpins, juvenile salmon in the spring during out migration, bivalves, and possibly surf perch (*Embiotocidae* sp.) and shiner perch (*Cymatogaster aggregata*).

Within the defined Project Site (~42,542.7 m^2), benthic soft sediments are the dominant habitat type, comprising 70.3 % of marine habitat (29,890 m^2) (**Figure 2**). 7.3 m^2 of the HADD impact of 760.6 m^2 would be offset by alteration of existing artificial substrate back to benthic soft sediments with removal of existing berth infrastructure (**Table 8**).

Of the 10.6 m^2 of harmful alteration of benthic soft sediments associated with new berth installation (**Table 8**), artificial habitat will be created, adding vertical complexity and providing hard substrate for fouling communities, thereby increasing productivity at the Project Site.

The habitat that will be impacted by the proposed berth upgrades is widespread at the Project Site. Anticipated impacts to fish habitat are largely offset through onsite habitat creation in the form of berth infrastructure and rip rap reef. Impacts of the proposed Project are expected to be small and local (confined to the Project Site). Permanent change to fish habitat that directly or indirectly impairs the habitat's capacity to support one or more life processes of fish are not expected.

8.0 CLOSURE

This report was prepared by Hemmera for sole benefit and use by BC Ferries. In performing this work, Hemmera has relied in good faith on information provided by others and has assumed that the information provided by those individuals is complete and accurate. This work was performed to current industry standard practice for similar environmental work, in the jurisdiction. The findings presented herein should be considered within the context of the scope of work and Project terms of reference. The conclusions and recommendations contained in this report are based upon the applicable guidelines, regulations, and legislation existing at the time the report was produced; any changes in the regulatory regime may alter the conclusions and/or recommendations.

We sincerely appreciate the opportunity to have assisted you with this project and if there are any questions, please do not hesitate to contact the undersigned by phone at 604.669.0424.

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APPENDIX A
Design Drawing

PROPOSED NEW WATER LOT BOUNDARY

BACKING PILES

BERTH CENTERLINE AZIMUTH 292°30'01"

NEW FLOATING LEAD BERTH GUIDE STRUCTURE

NEW INTEGRAL PONTOON AND WINGWALLS

EXISTING WATER TAXI DOCK

EXISTING WINGWALLS

DESCANSO BAY

POTENTIAL FUTURE ELECTRIFICATION ON PILE AND DECK STRUCTURE

PROPOSED NEW WATER LOT BOUNDARY

RELOCATE EXISTING FLOATING LEADS

NEW RAMP AND JUMP SPAN

EXISTING WATER LOT BOUNDARY

KISS & RIDE DROP-OFF

COMMUNITY BUS

MIC PARKING

SURVEY CONTROL

MONUMENT 4002

	LOCAL	UTM
N	10000	5447581.263
E	5000	437441.172

PLAN - BERTH LAYOUT

SCALE: 1:400 (FLOATING LEADS SHOWN)

PRELIMINARY
NOT FOR CONSTRUCTION

NOTES

1. SEE 30-190-G001 FOR GENERAL NOTES.

1:400 0 30 m

E				K			
D	PRELM DESIGN WITH REVIEW COMMENTS	'19.12.02	AG	J			
C	FOR REVIEW - FLOATING LEAD GUIDE	'19.10.21	AG	H			
B	ISSUED FOR PRELIMINARY DESIGN	'19.10.14	AG	G			
A	ISSUED FOR REVIEW	'19.09.27	AG	F			
	REVISIONS	Y/M/D	BY		REVISIONS	Y/M/D	BY

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REVIEWED FOR USE IN CONSTRUCTION

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BCFerries
British Columbia Ferry Services Inc.

GABRIOLA ISLAND FERRY TERMINAL

91099

BERTH REPLACMENT
GENERAL ARRANGEMENT

BERTH LAYOUT

DRAWING No.: 30-190-G011 D

CANCEL PRINTS BEARING EARLIER REVISION