35 YEARS

Keystone Environmental

Knowledge-Driven Results

1988 - 2023

MARINE FISH AND FISH HABITAT MANAGEMENT AND MONITORING PLAN

Woodfibre LNG
Woodfibre, BC

Prepared For: Woodfibre LNG Limited

October 2023

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LIST OF ACRONYMS

AEA	Aquatic Effects Assessment
AIS	Aquatic Invasive Species
AMP	Adaptive Management Plan
AVS	Acid Volatile Sulphides
BC	British Columbia
BCER	British Columbia Energy Regulator
BCFLNRORD	British Columbia Ministry of Forests, Lands, Natural Resource Operations & Rural Development
BMP	Best Management Practice
CD	Chart Datum
CEMP	Construction Environmental Management Plan
CofC	Certificate of Compliance
COSWEIC	Committee on the Status of Endangered Wildlife in Canada
CPA	Certified Project Area
CSA	*Canada Shipping Act*
DFO	Fisheries and Oceans Canada
EA	Environmental Assessment
EAC	Environmental Assessment Certificate (as amended July 2019)
EAO	Environmental Assessment Office
EM	Environmental Monitor
EPP	Environmental Protection Plan
ESCP	Erosion Sediment Control Plan
FA	*Fisheries Act*
FAA	Fisheries Authorization Act
FDS	Federal Decision Statement (as amended 2018)
FST	Floating Storage Tanks
FSO	Floating Storage and Offloading (used in conjunction with FST)
GD	Geodetic Datum
GPS	Global Positioning System
HADD	Harmful Alteration Disruption or Destruction
HDPE	High Density Polyethylene
HEPH	High Extractable Petroleum Hydrocarbon
HHWL	Higher High Water Line
HWL	High Water Line

LIST OF ACRONYMS (CONT'D)

ISMP	Invasive Species Management Plan
ISQG	Interim Sediment Quality Guidelines
LEPH	Light Extractable Petroleum Hydrocarbon
LGA	*Local Government Act*
LNG	Liquefied Natural Gas
MAD	Mean Annual Discharge
MCV	Marine Construction Vessels
MFFHMMP	Marine Fish and Fish Habitat Management and Monitoring Plan
MLRW	Marine Least Risk Window
MMMMP	Marine Mammal Management and Monitoring Plan
MMO	Marine Mammal Observer
MoECCS	Ministry of Environment and Climate Change Strategy
MOF	Marine Offloading Area
MWQMMP	Marine Water Quality Management and Monitoring Plan
OGAA	*Oil and Gas Activities Act*
OGC	Oil and Gas Commission
PAH	Polyaromatic Hydrocarbon
PCB	Polychlorinated Biphenyls
PoD	Point of Diversion
Project	Woodfibre LNG Project
QEP	Qualified Environmental Professional
QP	Qualified Professional
Ro-Ro	Roll-on and Roll-off
SARA	*Species at Risk Act*
SCUBA	Self-Contained Underwater Breathing Apparatus
SEM	Simultaneously Extracted Metals
SNEAA	Squamish Nation Environmental Assessment Agreement
SPLRMS	Sound Pressure Level Root Mean Square
TOC	Total Organic Carbon
TWN	Tsleil-Waututh Nation
WDP	Water Discharge Permit
Woodfibre LNG	Woodfibre LNG Limited
WQG	Water Quality Guidelines
WSA	*Water Sustainability Act*

SYMBOLS AND UNITS OF MEASUREMENT

cfu	colony forming unit
km	kilometre
m	metre

PREAMBLE

The Woodfibre Liquified Natural Gas Project (the Project) is a liquefied natural gas export facility being constructed on the former Woodfibre Pulp and Paper Mill site (the Project) in Nexwnéwu7ts Átlḵ'a7tsem (Howe Sound), approximately seven kilometres south of Sḵwx̱wú7mesh (Squamish). The Project is on the historical location of a Skwxwú7mesh Úxwumixw (Squamish Nation) village known as Swiy̓át. Swiy̓át and Nexwnéwu7ts Átlḵ'a7tsem (Howe Sound) are tied to the cultural well-being of Skwxwú7mesh Úxwumixw (Squamish Nation) members, their ancestors, and their descendants, and to other Indigenous groups as defined in the Project's Environmental Assessment Certificates. Woodfibre LNG Limited recognizes the importance of these areas to the Skwxwú7mesh stélmexw (Squamish People), and other Indigenous groups. Woodfibre LNG Limited seeks to construct and operate the Project in a manner that is respectful of Indigenous values. This Marine Water Quality Management and Monitoring Plan is primarily written in English with important place names, species, phrases, and passages provided in the Skwxwú7mesh (Squamish) language.

Temíxwiy̓iḵw chet wa naantem chet ti temíxw Swiy̓át
Chet wa sméṅhemswit kwis ns7éyx̱nitas chet ti temíxw
We7ú chet kwis t'íchimwit iy íẇas chet eḵ' I tti.

Our ancient ancestors named this place Swiy̓át
We, as their descendants safeguard these temíxw (lands)
We will continue to swim and Sts'úkwi7 (fish) in these clear staḵw (waters).

Tsleil-Waututh Nation - Woodfibre LNG understands that it is operating within the traditional, ancestral, and unceded territory of the səlilwətaɬ (Tsleil-Waututh) Nation.

1. BACKGROUND

Woodfibre LNG Limited (Woodfibre LNG) is proposing to construct and operate a liquefied natural gas (LNG) export facility (the Project) on the former Woodfibre Pulp Mill site (the Site) in Nexwnéwu7ts Átlk̲'a7tsem (Howe Sound), approximately seven kilometres south of Skwxwú7mesh (Squamish). The Project is on the historical location of a Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) village known as Swiẏát. Swiẏát and Nexwnéwu7ts Átlk̲'a7tsem (Howe Sound) are tied to the cultural well-being of Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) members, their ancestors, and their descendants. Woodfibre LNG Limited recognizes the importance of these areas to the Sḵwx̲wú7mesh stélmexw (Squamish People) and seeks to construct and operate the LNG facility and export terminal in a manner that is respectful of Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) values.

The Project area is located at the former Woodfibre Pulp Mill site; a fee simple, industrially zoned brownfield site with more than 100 years of industrial use and deep-water marine access. The community of Shisháyu7ay (Britannia Beach) is approximately 5.5 km southeast of the Project area; Kwtsá7tsutsin (Darrell Bay) is approximately 6.2 km to the east; and K̲'ík̲'elxn (Port Mellon) is approximately 22 km southwest. K̲'emk̲'emeláy (Vancouver) is situated approximately 50 km southeast of the Project area.

The Project location and Certified Project Area (CPA) are shown on **Figure 1-1.** and the Project layout is shown on **Figure 3-1**.

This Marine Fish and Fish Habitat Management and ínexwantas (Monitoring) Plan (MFFHMMP or the Plan) is primarily written in English with important place names, species, phrases, and passages provided in Sḵwx̲wú7mesh Sníchim (Squamish language) and English. This Plan is consistent with the Woodfibre LNG Environmental Policy which includes meeting compliance requirements, implementing best industry practices and continuous improvement in environmental performance.

Woodfibre LNG is committed to maximizing positive benefits and mitigating impacts of the Project for the community of Skwxwú7mesh (Squamish) and Indigenous Groups. This includes employment, training, business, procurement, and community / social investment opportunities, as well as environmental benefits and ensuring mitigation of greenhouse gas emissions. During construction, Woodfibre LNG will employ approximately 700 people, and create an additional 500 indirect and 400 induced jobs in B.C. and 200 indirect and 150 induced jobs for other Canadians. During operations, Woodfibre LNG will provide approximately 100 long-term jobs. Woodfibre LNG is working with governments, local Indigenous Groups, and community stakeholders to develop employment and training opportunities, ensure diversity, equity, and inclusion and promote gender and cultural safety of its workforce and the local community. Woodfibre LNG represents a $5.1 billion investment in the economy that will generate revenues for the federal, provincial and municipal government to reinvest in public services that British Columbians depend on.

1.1 Purpose

The purpose of this Plan is to guide the implementation of mitigation measures and Ínexwantas (monitoring) to manage potential Project related effects to marine sts'úk̲wi7 (fish) and fish habitat during Project construction and operations, consistent with regulatory and legislative requirements.

1.2 Objective

The objectives of this MFFHMMP are to provide guidance that fulfills conditions of the Federal Decision Statement (FDS), the Provincial Environmental Assessment Certificate (EAC), and the Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) Environmental Assessment Agreement (SNEAA), and outline mitigation measures and best management practices for the Project in relation to the protection of marine fish and fish habitat.

The MFFHMMP also:

- Identifies and sets out the means by which regulatory and legislative requirements are met with respect to marine fish and fish habitat, including Table 22-1 of the EA application;
- Outlines mitigation measures to reduce or eliminate environmental effects to fish and fish habitat as described in the EAC and FDS during the Project;
- Describes compliance and verification Ínexwantas (monitoring) programs to verify the accuracy of the predicted Project effects outlined in the EA application, assess the effectiveness of mitigation measures, particularly as they apply to fish migration, fish rearing and spawning, habitat quality, and aquatic invasive species;
- Outlines an adaptive management plan to implement and monitor the effectiveness of additional mitigation measures that may be required, as informed by effectiveness Ínexwantas (monitoring), whether the extent of effects predicted in the EA application may not have been captured or predicted accurately or mitigation measures are found not to be effective; and
- Where design and mitigations are not sufficient to avoid harmful alteration, disruption, or destruction of fish habitat, describes offsetting plans for residual Project effects.

To support FDS sections 3.11, 3.12 and 3.13 regarding the development and implementation of fish and fish habitat offsetting plans, WLNG submitted an application for a *Fisheries Act* Authorization (FAA) to DFO on October 25, 2022 and a FAA was issued by DFO to Woodfibre LNG on October 6, 2023 (DFO No.: 22-HPAC-01346). The FAA includes a detailed Aquatic Effects Assessment and details supporting the subsequent offsetting commitments which are duplicated in this Plan, which will ultimately guide the implementation of the FAA and compliance with the FDS 3.14 and EAC 8. As stated in Section 9 of this Plan, a stand-alone detailed Offset Effectiveness Monitoring Plan will be developed in Q1 of 2024 that will describe in detail how the offsetting will be implemented and how monitoring of the effectiveness of the offset habitats will be undertaken.

Please refer to the marine mammal ínexwantas (monitoring) and management plan that addresses FDS conditions 3.8, 3.9 and 3.10 along with EAC section 8.

To achieve the MFFHMMP objectives, this plan is structured as follows:

- **Section 2** describes consultation and plan development;
- **Section 3** describes the Project and activities;
- **Section 4** provides an overview of the regulatory framework for the Project including applicable Acts, Regulations, and guidelines for the protection of marine fish and fish habitat;
- **Section 5** outlines the Project roles and responsibilities as they relate to this Plan;
- **Section 7** reviews baseline environmental conditions;

- **Section 8** summarizes environmental effects of the Project and prescribes mitigation measures regarding general marine works management including avoidance measures, marine timing windows, marine shading and lighting, underwater noise (Kwémi7), fish exclusion and salvage, concrete works, creosote pile removal, ballast water management, offsetting and offsetting measures, and upland mitigations that may impact marine fish including erosion and sediment control (ESC), stormwater management, and waste management;
- **Section 8** outlines fish and fish habitat Ínexwantas (monitoring) including: (i) verifying the accuracy of the EA regarding of juvenile salmon (Cháyilhen) migration, slhawt' (herring) (Slhawt') spawning, and aquatic invasive species, (ii) determining the effectiveness of offsetting measures, and (iii) outlining adaptive management;
- **Section 9** describes Habitat Offsetting Effectiveness Performance Objectives, ínexwantas (Monitoring), and Adaptive Management;
- **Section 10** describes reporting and communications; and
- **Section 11** describes information management.

skwxwú7mesh Úxwumixw (Squamish Nation) conducted an independent review of the Application for an EAC under its own environmental assessment process and on October 14, 2015, skwxwú7mesh Úxwumixw (Squamish Nation) issued an Environmental Certificate for the Project that included conditions to be met by Woodfibre LNG. As a part of the conditions, skwxwú7mesh Úxwumixw (Squamish Nation) collaborated on early scoping of this document, and Woodfibre LNG requires written approval from skwxwú7mesh Úxwumixw (Squamish Nation) on the final version of this Plan prior to construction.

Woodfibre LNG is committed to ongoing engagement and information sharing with Indigenous groups on the development and implementation of this Plan. A working group has been convened with Squamish Nation to collaboratively develop monitoring protocols based on agreed upon objectives, performance indices, and methodologies.

Primary proposed objectives for the monitoring protocol working group are:

1. To develop an enhanced Baseline Existing Conditions Summary Report.
2. To develop a detailed Marine Fish and Fish Habitat (MFFH) Environmental Effects Monitoring Protocol.
3. To develop a detailed Offset Effectiveness Monitoring Protocol.
4. To review construction phase monitoring information and recommend adaptive management actions as necessary.

The proposed objectives of the MFFH Environmental Effects Monitoring Protocol are:

1. To assess changes in herring spawning habitat use and trends in herring spawn in the CPA from pre-construction, construction and into operational phases.
2. To assess changes in salmon habitat use and trends (spawning, rearing, migration) in the CPA from pre-construction, construction and into operational phases.

The proposed objectives of the Offset Effectiveness Monitoring Protocol are:

1. To expand existing intertidal/ shallow subtidal hard substrate to promote marine vegetation, thereby increasing areas for herring spawning and juvenile salmonid rearing, while also enhancing their migration route.
2. To improve sediment health through addition of: (i) a sand layer over existing sediments determined to be unproductive or of poor health to enhance the biologically active zone (i.e., upper 0.3 m to 0.5 of sediment), and (ii) a sparse surficial cobble blanket to promote kelp and algal growth, but spaced to allow infaunal access (e.g. clams, worms) to the sand layer (bivalves to protrude, invertebrates to migrate).
3. To add rock reefs that will: (i) increase cover/structure for fish species such as juvenile salmonids, rockfish and lingcod; spawning areas for fish such as herring and demersal fish; and (ii) marine structure/ cover to enhance invertebrate diversity (e.g., sea cucumbers, sea urchins, crabs). Shallow reefs would be expected to support kelp growth, while deeper reefs would be primarily for fish and invertebrate cover.
4. To restore degraded riparian areas focusing on the marine shoreline, lower Woodfibre Creek, and lower East Creek. Restoration of Mill Creek Green Zone will also be completed in partnership with Squamish Nation as agreed upon in the SNEAA and without additional offsetting credit.

1.3 Scope

The scope of the MFFHMMP applies to construction and operational phases of the Project, within the Certified Project Area (CPA) and adjacent locations identified for baseline and reference data collection.

For the purposes of defining Construction, the MFFHMMP will use the amended definition from EAC Amendment 2 #E15-02 granted July 19, 2019. The definition is as follows:

> ***"Construction – The phase of the Project during which physical activities in connection with site preparation, building or installation of any component of the Project occurs. For purposes of this Schedule B, Construction does not include the following: (i) any activities conducted solely for investigative purposes under a valid permit or authorization, (ii) the demolition and removal or onsite remediation of existing structures and facilities associated with the former Woodfibre Pulp Mill, (iii) the closure of the existing pulp mill landfill, and (iv) ongoing maintenance or upgrades to the existing work or infrastructure to address safety, environment or regulatory compliance."***

The Project schedule for Construction is anticipated to occur over approximately three years. With proposed mitigation measures, upland works are not anticipated to impact the marine environment and are expected to begin in September 2023.

The marine least risk fisheries window for the Project is August 16 through January 31 (DFO Area 28 – Howe Sound). Intertidal and subtidal construction works will begin in the fall of 2023, within the marine least risk window (MLRW) The operational life of the Project is expected to be 25 years post-Construction.

For the purpose. of defining 'Fish' and 'Fish Habitat', the MFFHMMP will use the definitions from the FDS as follows:

"Fish – as defined in subsection 2(1) of the *Fisheries Act;*" and

"Fish habitat – as defined in subsection 2(1) of the *Fisheries Act.*"

In the *Fisheries Act*, "fish" means: (a) parts of fish; (b) shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans, or marine animals; and (c) the eggs, sperm spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals.

In the *Fisheries Act*, "fish habitat" means spawning grounds and any other areas, including nursery, rearing, food supply and migration areas, on which fish depend directly or indirectly in order to carry out their life processes.

The spatial area that the MFFHMMP will cover includes marine portions of the CPA and off-site proximal locations (i.e., habitat offsetting reference sites) in Howe Sound (Nexwnéwu7ts Átlḵ'a7tsem) outside the CPA.

The MFFHMMP should be reviewed in conjunction with the following linked management plans:

- Marine Mammal Management and Ínexwantas (monitoring) Plan (MMMMP) that describes measures to manage potential Project related effects on marine mammals during Construction and operations;
- Marine Water Quality Management and Ínexwantas (monitoring) Plan (MWQMMP) that describes measures and Ínexwantas (monitoring) to manage potential Project related effects to marine water quality and inform Human Health Risk Assessment (a separate MWQMMP for construction and operations phases);
- Construction/Operations Environmental Management Plan(s) (CEMP and OEMP) that describes measures to manage potential Project related terrestrial effects during construction and operations.

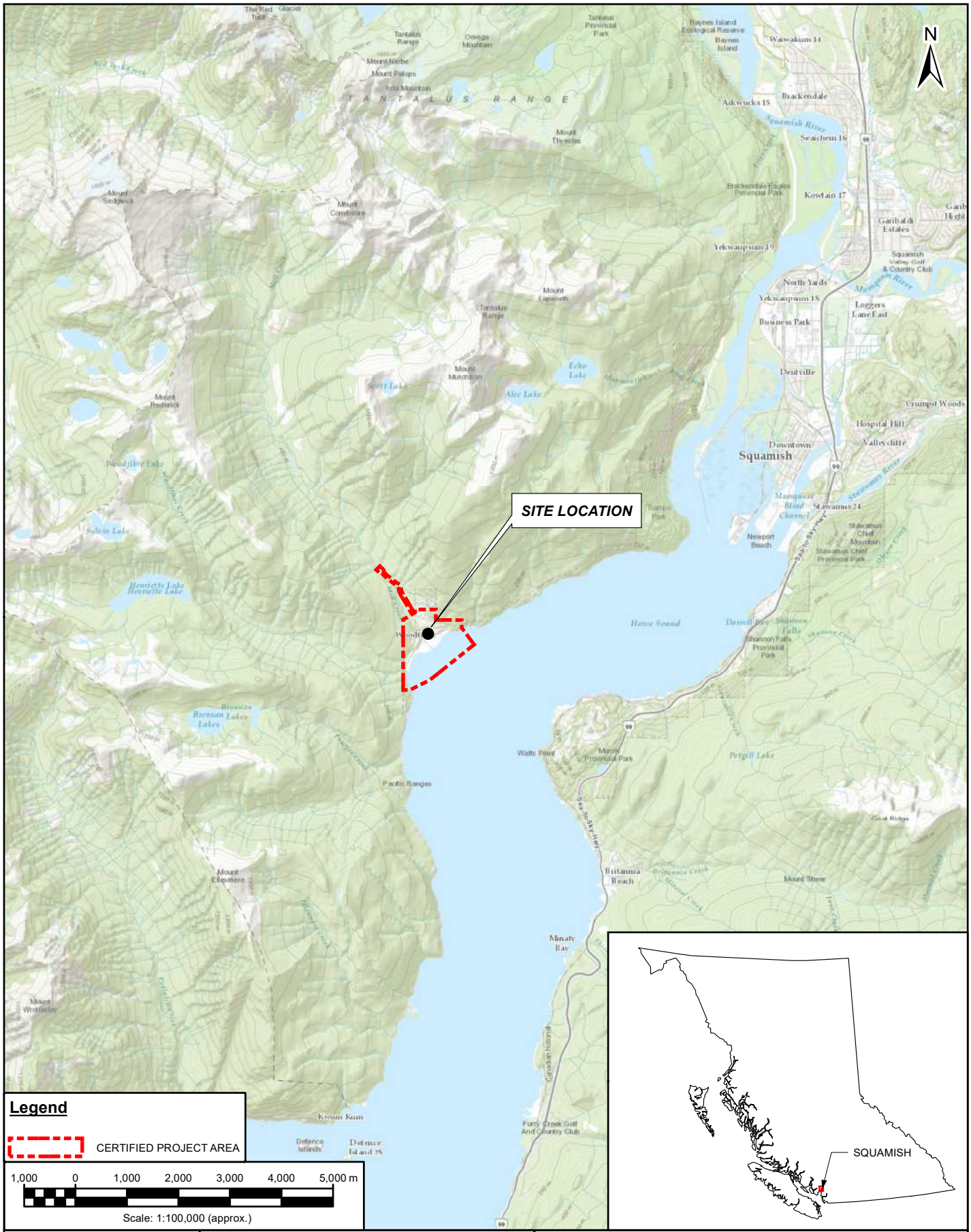
While linked to these other management plans, the Plan has been developed as a standalone document.

1.4 Project Description and Activities

1.4.1 Project Location

The Project is located at the former Woodfibre Pulp Mill, approximately seven (7) kilometres (km) southwest of Skwxwú7mesh (Squamish), British Columbia (BC) within the District of Skwxwú7mesh (Squamish) municipal boundaries (the Site) and within the CPA (**Figure 1-1**). Currently, there is no road access to the Site, only marine access via Howe Sound. The community of Shisháyu7ay (Britannia Beach) is approximately 5.5 km southeast of the Project area; Kwtsá7tsutsin (Darrell Bay) is approximately 6.2 km to the east; and K'ík'elxn (Port Mellon) is approximately 22 km southwest. K'emk'emeláy (Vancouver) is situated approximately 50 km southeast of the Project area.

The Project layout is shown in **Figure 3-1**. The Universal Transverse Mercator (UTM) coordinates for the centre area CPA are: Zone 10 U 481642 m E 5501570 m N. In addition to the CPA, the Project will use Kwtsá7tsutsin (Darrell Bay), Skwxwú7mesh (Squamish) BC to transfer workers to and from the Woodfibre Site. A direct transfer option for workers from K'emk'emeláy (Vancouver) will also be implemented.



Keystone Environmental

Woodfibre
Squamish, B C
Woodfibre LNG Limited

REVISION No.	DATE	PROJECT No.
00	Jul. 2023	17227-100

Figure 1-1
Location Plan

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1.4.2 Site History

The Site is historically a sḵwx̱wú7mesh Úxwumixw (Squamish Nation) Village named Swiy̓át. The original pulp mill was built on Mill Creek in 1908 and destroyed in a washout in the 1930s. A second mill operated at the north end of the Site under various owners until its decommissioning by Western Forest Products in 2006. From 1917 until 1973, the townsite of Woodfibre was present, where mill staff and their families resided. Boat traffic was present in the Woodfibre water lot during active mill operations, with both ships associated with Woodfibre's operations and ferry traffic from Skwxwú7mesh (Squamish) to Woodfibre accessing the waterpot.

The property is a fee simple, industrially zoned brownfield site with deep-water marine access and a history of more than 100 years of industrial use. Woodfibre LNG took ownership of the Site from Western Forest Products on February 6, 2015. Prior to the land transfer in 2015, Western Forest Products received two Certificates of Compliance (CofC, land and water lots) from the BC Ministry of Environment, which were a condition of the sale agreement. At the time of purchase by Woodfibre LNG, Site infrastructure included an active landfill, a leachate treatment system, a wastewater treatment system, a dam at the outlet of Henriette Lake, an operational small hydro project, and failing infrastructure and buildings associated with the pulp mill. In 2018 and 2019, Woodfibre LNG began decommissioning much of the old infrastructure including removal of over 3,000 creosote timber piles, the deep-sea dock, ferry dock, timber wharf, hog fuel unloading dock, buildings and large concrete slabs.

Current access to Site that will continue throughout the Project is the transfer of personnel from the Skwxwú7mesh (Squamish) area. In addition, project materials, equipment and workers will be transported to and from the CPA by water. The primary Project marine access routes that will be used for marine transportation during construction are:

- Skwxwú7mesh (Squamish) harbour route: passage through Mamquam Blind Channel and Skwxwú7mesh (Squamish) Harbour to the CPA.
- Kwtsá7tsutsin (Darrell Bay) Route: passage from Kwtsá7tsutsin (Darrell Bay), or a suitable alternative, through Skwxwú7mesh (Squamish) Harbour to the CPA.
- K'emk'emeláy (Vancouver) Route: passage through Howe Sound, including Queen Charlotte Channel, Passage Island between Point Cowan and Point Atkinson to Pam Rocks, Montagu Channel east of Anvil Island, continuing northeast of Defence Islands to the CPA.

Further details regarding marine transportation can be found in the Marine Transportation Management Plan for construction.

1.4.3 Project Overview

The Project includes the construction of both upland and marine infrastructure to facilitate the storage, loading and offloading, and transport of liquefied natural gas (**Figure 1-1, Figure 3-1**). Infrastructure relating to marine fish and fish habitat includes:

1. Construction of a marine terminal with floating storage tanks (FSTs), including upland blasting to create an upland road and concrete foundation for an FST mooring structure;

2. Construction of a materials offloading facility (MOF);
3. Construction of an offloading platform;
4. Construction of temporary floating worker accommodations on Site (the Floatel);
5. Repair and upgrades to shoreline armour, including excavation of existing shoreline materials to key in rock and place new riprap. Includes covering riprap with native beach material in some locations;
6. Repair and upgrades to the roll-on and roll-off facility (Ro-Ro);
7. Installation of two clear span bridges across Mill Creek;
8. Installation of culverts and outfalls within the shoreline of Howe Sound and Mill Creek;
9. East Creek hydraulic modifications;
10. Water withdrawals from an existing instream water intake in Mill Creek and installation of a supplemental intake in Woodfibre Creek including water withdrawals; and
11. Construction and Ínexwantas (monitoring) of Habitat Offsetting.

Minor additional works are anticipated to support marine construction and installation vessels maneuvering and anchoring around the Project. Potential minor effects to fish and fish habitat that may result from marine construction vessels are proposed to be accounted for through a 25% uncertainty factor applied to the required habitat offsetting. The Habitat Offsetting Plan is described in **Section 8** and its effectiveness Ínexwantas (monitoring) and adaptive management plan is described in **Section 9**. Further regarding the habitat offsetting is described in **Section 9.1** of the *Fisheries Act* Authorization application Aquatic Effects Assessment (AEA) (Keystone Environmental 2023).

2. CONSULTATION AND PLAN DEVELOPMENT

The plan has been developed by qualified professionals, as defined in the EAC and FDS, as listed in **Table 2-1.**

Table 2-1 Qualified Professionals

Name	Qualifications
Mr. Warren Appleton	B.Sc., RP.Bio.
Mr. Duncan Clark	B.Sc., RP.Bio.
Mr. James Slogan	Ph.D., RP.Bio.

This plan is being developed in consultation with Indigenous Groups as defined in the FDS including Skwxwú7mesh Úxwumixw (Squamish Nation) and Tsleil-Waututh Nation. Groups, Agencies or Parties identified in **Table 2-2** were provided copies of the Plan and were invited to comment on the Plan. Where views or information were received regarding the Plan, written response was provided as to how it was/was not considered and addressed. As per Condition 2 of the EAC, records of the comments and how each were addressed are available upon request by the BC Environmental Assessment Office (EAO) or the relevant party.

The Plan is considered a Regulated Plan under the SNEAA and must be approved by the Skwxwú7mesh Úxwumixw (Squamish Nation) representative of the Woodfibre Environmental Working Group (the Working Group) prior to construction commencing. Skwxwú7mesh Úxwumixw (Squamish Nation) participation in implementation of the MFFHMMP will occur in accordance with the SNEAA and through contractual opportunities for Skwxwú7mesh Úxwumixw (Squamish Nation) members or businesses in accordance with the Impact Benefit Agreement.

In respect of promoting open, without-prejudice collaborative discussions on applications for permits and authorizations, the specifics of those discussions are not outlined in detail. Requests to Indigenous Groups may be made by Woodfibre LNG to disclose specifics deemed necessary to progress regulatory process.

Table 2-2 Indigenous Groups, Government, Public and Other Parties Engaged

Indigenous Group/ Agency/Party	Date	Action
Squamish Nation	2019 to 2023	Between 2019 and 2023, Squamish Nation and Woodfibre LNG exchanged written materials and directly discussed the Plan on numerous occasions
Tsleil-Waututh Nation	December 19, 2019	Review comments on draft
Fisheries and Oceans Canada (DFO)	November 3, 2020	Review of Project, fisheries studies and offsetting plan
Tsleil-Waututh Nation	August 2, 2022	*Fisheries Act* Authorization (FAA) provided for comment
Tsleil-Waututh Nation Working Group	August 20, 2022	Technical Working Group meeting. Preliminary draft FAA discussed.

Once finalized, this Plan will be provided to EAO, DFO, OGC, skwxwú7mesh Úxwumixw (Squamish Nation) and Tsleil-Waututh Nation no less than 30 days prior to the planned date to commence construction.

2.1.1 Tsleil-Waututh Nation Summary

A Technical Working Group meeting was held on August 20, 2022, including Tsleil-Waututh Nation (TWN) and Woodfibre LNG, where the preliminary draft of the FAA (August 2, 2022) was discussed. Formal comments from TWN were received on the February 14, 2023, version of the FAA report on April 24, 2023, with Woodfibre LNG responding on May 18, 2023. Further meetings have been convened with TWN as part of the technical working group where further FAA related discussion has continued to progress. Woodfibre LNG is committed to ongoing engagement and information sharing pertaining to the FAA with TWN through the regulatory review period, offset implementation, and performance Ínexwantas (monitoring) phases of the offsetting project. Additional meetings have also occurred as indicated in **Table 2-2**.

2.1.2 Squamish Nation Summary

Woodfibre LNG and skwxwú7mesh Úxwumixw (Squamish Nation) established a technical forum for this Plan through a bilateral Environmental Working Group and have exchanged information and respective priorities for this Plan iteratively between 2019 and 2023. Through subsequent arrangements via the Environmental Working Group, Woodfibre LNG continues to develop further refinements to this Plan for finalization in 2024.

2.1.3 Musqueam Indian Band

Technical meeting was held with Musqueam Indian Band representatives on March 16, 2023, where an FAA overview was presented, and an open discussion held based on the February 15, 2023, version of the report and April 28, 2023 comments received from Musqueam were reviewed for clarification. Formal responses to those comments were provided to Musqueam on May 24, 2023. Woodfibre LNG is committed to ongoing engagement and information sharing with Musqueam on the FAA in tandem with formal Crown consultation and regulatory review, and through all phases of the offset project including performance Ínexwantas (monitoring).

2.1.4 Additional Indigenous Groups

At the time of the original FAA submission to DFO (October 25, 2022), notification to all Indigenous Groups was provided requesting formal comments and offering a meeting to provide an overview of the submission and to explore avenues for further dialogue and information sharing with each Indigenous Group. Notification was again provided for this subsequent submission. All Indigenous groups of been provided notification of subsequent submissions, including this final version.

2.2 Best Management Practices and Standards

Examples of Best Management Practices reviewed to inform the MFFHMMP are provided in **Table 2-3**. The specific applications and methods that will be used are discussed in **Section 7**.

Table 2-3 Examples of Best Management Practices Reviewed

Best Management Practice	Description
Best Management Practices for Pile Driving and Related Operations (BCMPDCA and DFO 2003)	Marine Fish Protection
Guidelines to Protect Fish and Fish Habitat from Treated Wood Used in Aquatic Environments in the Pacific Region (Hutton and Samis 2000)	Water quality and Marine Fish Protection
Measures to Protect Fish and Fish Habitat for Projects near Water (DFO, 2019)	Marine Fish and Habitat Protection
DFO Code of Practice: Clear Span Bridges (DFO, 2023)	Conditions and Measures to Protect Fish and Fish Habitat
Environmental Protection and Management Guideline (BC OGC 2021)	Water Quality

2.3 Management of Change

This Plan is intended to be a live document and requires updating to maintain regulatory compliance and incorporate results of the adaptive management process. Revisions will be made, as required, in response to additional information as it becomes available. Newly available information may come through the progression of detailed design, legislative changes, the issuance of permit/permit conditions, feedback from the Contractor, Indigenous Groups as defined in the FDS, regulatory agencies or the public, the results of Ínexwantas (monitoring), and recommendations of the Qualified Environmental Professional (QEP) implementing the Plan.

Once this Plan is approved, if changes or further approval is required, this Plan will continue to be implemented unless advised to the contrary by the EAO in accordance with EAC Condition 3.

Table 2-4 lists the history of revisions and report version of the plan, as well as the date, distribution, and purpose.

Table 2-4 Report Version History

Version	Date Issued	Distribution	Purpose
0.1	September 2019	Squamish Nation Tsleil-Waututh Nation Fisheries and Oceans Canada BC Energy Regulator	Draft for comment
0.2	December 2020	Squamish Nation Tsleil-Waututh Nation Fisheries and Oceans Canada Indigenous Groups as defined by FDS section 1.1	Draft for comment responding to Squamish Nation comments from September 2019 and Tsleil-Waututh Nation comments received December 2019 Document updated to include mitigation measures associated with the EA amendment #3 (floating worker accommodation)

Version	Date Issued	Distribution	Purpose
0.3	August 2022	Squamish Nation Tsleil-Waututh Nation Fisheries and Oceans Canada Indigenous Groups as defined by FDS section 1.1	Draft for comment responding to Squamish Nation comments from May and September 2019 and Tsleil-Waututh Nation comments received December 2019 Document updated to include mitigation measures associated with the EA amendment #3 (floating worker accommodation)

3. PRIMARY INFRASTRUCTURE

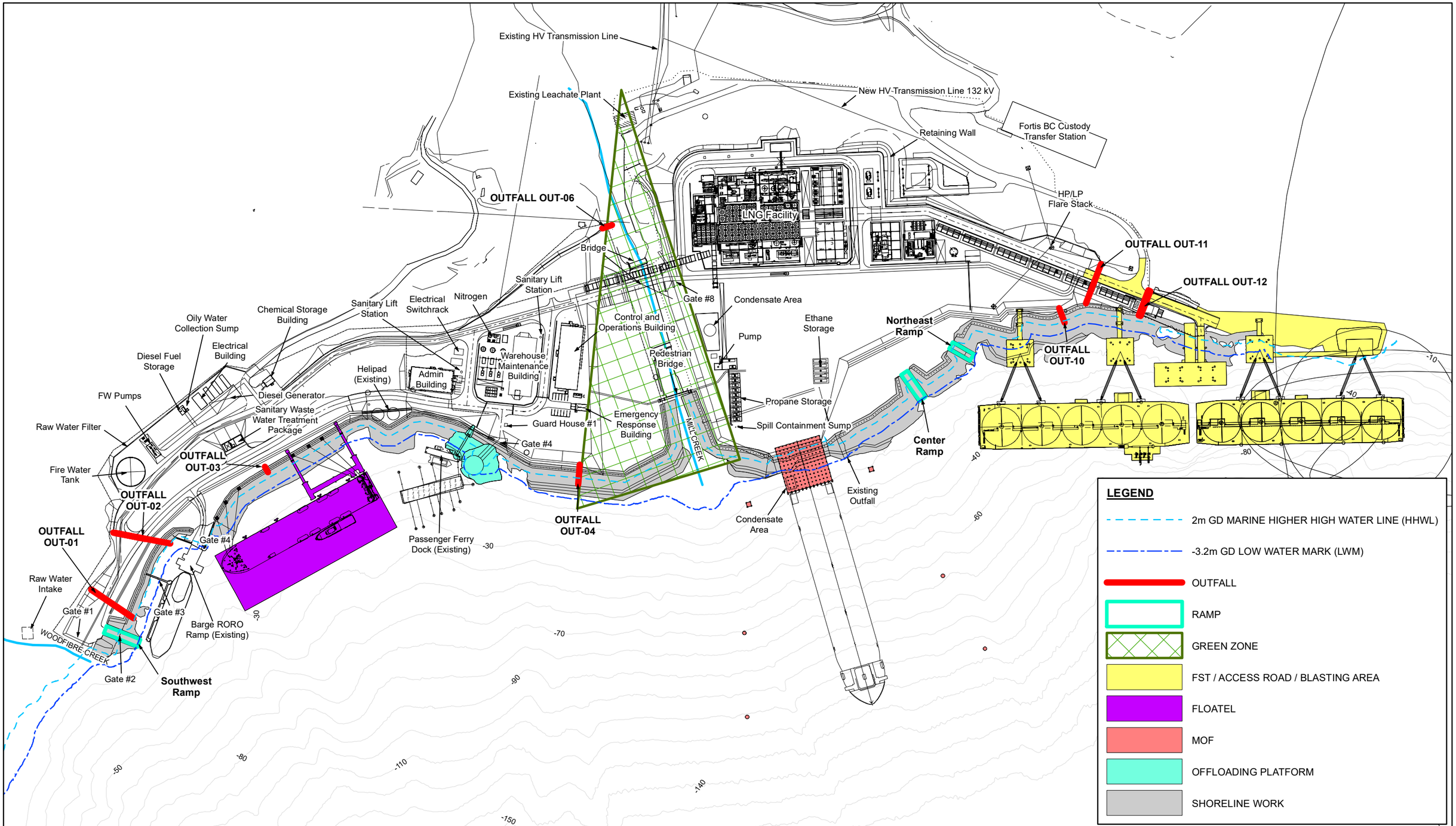
An overview of infrastructure included in the Project is shown in **Table 3-1** and **Figure 3-1**. Details regarding the individual work activities are provided in **Section 3.1** through **Section 3.8.** For additional detail on project components and areas, refer to the *Fisheries Act* Authorization and AEA for Construction (Keystone Environmental 2023).

Table 3-1 List of Project Components, Area, and Location

Project Component	Total Area[a] (m^2)	Impact Area[b] (m^2)	Location	Comments
Marine FST Terminal	24,808 m^2	1,448 m^2	49.6677992 -123.2470597	Total Area includes substrate under floating structures or raised platforms with no shading impacts as well as areas with no change in habitat value. These are not included in the Impact Area.
MOF	2,201 m^2	1,791 m^2	49.6653513 -123.2512062	Total Area includes substrate under floating structures or raised platforms with no shading impacts as well as areas with no change in habitat value. These are not included in the Impact Area.
Offloading Platform	1, 776 m^2	1, 565 m^2	49.6643043 -123.2552212	Total Area includes substrate under floating structures or raised platforms with no shading impacts as well as areas increasing in habitat value. These are not included in the Impact Area.
Floatel	11,198 m^2	87 m^2	49.6632422 -123.2570407	Total Area includes substrate under floating structures or raised platforms with no shading impacts, which are not included in the Impact Area.
Road/ Blasting Area/FST	5,115 m^2	5,115 m^2	49.668542 -123.245019	
Shoreline Armour[c]	29,652 m^2	18, 712 m^2	**Western Point** 49.6615847 -123.258646 **Eastern Point** 49.6679829 -123.2466843	

Project Component	Total Area[a] (m^2)	Impact Area[b] (m^2)	Location	Comments
Ro-Ro	942 m^2	0 m^2	49.662360 -123.258172	Project works are limited to repair of an existing structure. No Impact Area.
Clear Span Bridges	398 m^2	0 m2	49.666543 -123.254328	Bridges will be designed and installed to meet the requirements of the BC Water Sustainability Regulation resulting in no Impact Area.
Culverts and Outfalls	505 m^2	0 m^2	Within Shoreline Armour Footprint	Stormwater outfall culverts will be installed above the high high water level (HHWL) in areas of existing man-made structures and are not anticipated to have a negative impact on fish habitat.
Hydraulic Modifications	865 m^2	0 m^2	49.668733 -123.248452	Hydraulic Modifications to mitigate flood and erosion in non-fish bearing watercourse resulting in no Impact Area.
Water Withdrawals	344 m^2	0 m^2	Woodfibre Creek: 49.661286 -123.259931 Mill Creek: 49.679102 -123.266845	Mill Creek – an existing intake will be used. Woodfibre Creek – small, temporary intake footprint minimal relocation of rocks by hand resulting in no Impact Area.
Marine Aquatic Habitat Offsetting	22,120[e]	-	Multiple areas – see Table 9-3	Described in Section 9
Marine Riparian Habitat Offsetting	16,183[d e]	-	Multiple areas – see Table 9-4	Described in Section 9

[a] Total Area is the total plan view area of a project component.
[b] Impact areas are the portion of the Total Area for each Project Component with potential impacts to fish habitat.
[c] Total Area and Impact Area for the Shoreline Armour Project Component do not include here areas of overlap with other Project Components. In areas of overlap, Shoreline Armour areas are included within the other Project Components.
[d] Includes 10% for time lag per year.
[e] Includes 25% uncertainty factor.



Woodfibre LNG

HATCH Keystone Environmental

NOTES:
1. *THIS DRAWING IS FOR GENERAL INFORMATION ONLY. LOT BOUNDARIES AND FEATURES ARE APPROXIMATE.*
2. *DATE OF AERIAL PHOTO IS 2016.*

Data collected from:
- *Keystone Environmental Ltd. 2019 Dive Surveys at Woodfibre, Squamish, BC. Data Collected for Woodfibre. May 2019*
- *Hemmera. 2016. Figure 1 - Benthic Habitat Survey Summary Report. Prepared for Woodfibre LNG. September 2015*
- *Golder Associates Ltd. 2014. Marine Resources Baseline Study. Prepared for Woodfibre LNG. October 2014*

20 0 100 m

SCALE: 1:0 (approx.)

Woodfibre
Squamish, B C
Woodfibre LNG Limited

REVISION No.	DATE	PROJECT No.
00	Jun. 2023	17227-100

Figure 3-1
Overview Drawing

DRAWN BY: CS Document Path: C:\Users\lesk77688\OneDrive - Hatch Ltd\Projects\Woodfibre\Project_MXD\Updated_Figures\Fig3-1-Overview_Drawing.mxd

3.1 Marine FST Terminal

The Marine Floating Storage Tank (FST) Terminal consists of the following:

- Thirty-two substructure installation support piles;
- Twenty-nine permanent substructure piles;
- FST Transfer Platform Module M05;
- FST Permanent Mooring Structure 01;
- FST Permanent Mooring Structure 02;
- FST Permanent Mooring Structure 03;
- FST Permanent Mooring Structure 04;
- FST Permanent Mooring Structure 04 Access Road;
- Piping trestle Module M07;
- Roadway trestle Module M14; and
- Floating Storage Tanks (FSTs).

Habitat within the remaining footprint of the Marine FST Terminal (offshore of impact areas) will not be impacted as it will be located underneath floating structures (e.g., FSTs) or underneath raised platforms (e.g., Module M05). Piles used to support raised platforms have been included in the Impact Area for the Marine FST Terminal.

3.1.1 Substructure Installation Support Piles

A total of thirty-two, uncoated steel pipe piles will be installed into the bedrock, supporting the infrastructure needed to anchor the marine terminal. The support piles will be 1,067 mm outside diameter for a total footprint area of 33 m^2. The following installation, the piles will be fully submerged with the top of the piles approximately 0 m to 2 m above the mudline. These will be installed during the least risk window using a marine vessel with a crawler crane to complete the required pile driving and drilling work. To reduce the unintentional deposition of materials into the marine environment during pile installation, the sediment and rock materials will be removed from inside the pile and physically isolated from the surrounding environment. If needed, piles will also be rock socketed (grouted) to the adjacent bedrock.

3.1.2 FST Transfer Platform Module M05

Once the substructure installation support piles are placed, the FST transfer platform Module M05 will be constructed. Briefly, the topside platform structure, (approximately 72 m long, 30 m wide, and 9 m high) will be supported by two prefabricated lower assemblies (each approximately 16 m long, 14 m wide, and 25 m high). The westernmost substructure will also support the piping trestle Module M07 and the roadway trestle Module M14. Prefabricated, modular components made from structural steel and preassembled offsite, will be used for this portion of the project. All work requiring placement of structures in the marine environment will be completed using a marine vessel equipped with the necessary equipment such as a crawler crane for pile installation, or welding equipment onboard. A corrosion resistant coating will be applied to the transfer platform structures and components.

A portion of the lower assemblies could contact the seafloor once installed, the area of potential contact is estimated to be 130 m^2.

Eleven permanent steel pipe piles (1,372 mm outside diameter) to support the platform and substructures will be installed through the vertical tubular members (i.e., the legs) using the same methods used in establishing the substructure support piles. The piles will be installed during the marine least risk window (MLRW) and will also be rock socketed (grouted) to bedrock, and either grouted or welded to the substructure tubular members.

Once these have been installed, the Module M05 Topsides will be set in place and welded to the two substructures by a heavy lift marine vessel with a crane and welding equipment onboard. After the Module M05 topside structure is installed, a portion of the deck will have cast-in-place concrete installed within solid, sealed formwork isolated from the marine environment. Concrete will be supplied using onshore concrete pump trucks and all concrete work will be fully isolated from the marine environment.

A steel plate top deck will be installed on a portion of the top of the FST Transfer Platform, creating a fixed surface that is impermeable to light. The remainder of the top of the platform will be open grid steel grating, permeable to light transfer.

3.1.3 FST Permanent Mooring Structures

A permanent mooring system, consisting of four separate subsystems, (FST Permanent Mooring Structures 01, 02, 03 and 04) will be installed to anchor the FST Transfer Platform in place. FST Permanent Mooring Structures 01, 02 and 03 will have maintenance walkways connecting to the shoreline. One maintenance walkway will connect Permanent Mooring Structure 03 to Permanent Mooring Structure 04. Three of the subsystems will be constructed using preassembled steel components, treated with corrosion resistant coating, anchored by permanent steel piles set into the bedrock through each structure's vertical tubular members, with a topside set and welded to the substructure once placed. Two strut arms will be connected to the topside dampening system at a later stage once the FSTs are on site. Portions of two permanent mooring substructures, (numbers 01 and 02) bottom framing will each have potential to contact approximately 150 m^2 of seafloor once installed at site. FST Permanent Mooring Structures 01, 02 and 03 will each have six permanent piles of 1,372 mm outside diameter. All marine piles will be installed during the MLRW.

FST Permanent Mooring Structure 04 consists of a concrete topside structure (approximately 26 m long, 26 m wide, and 3 m high). The mooring structure will consist of a concrete abutment to be installed within an existing onshore rock outcrop, which will require upland blasting and removal of rock. Additionally, an access road will be required to support mooring structure work, which also require removal of overburden and upland blasting, and the construction of a retaining wall on the shoreline side to accommodate loaded rock trucks. The proposed access road will be 8 metres wide, to allow for two-way traffic of 30-tonne rock trucks. Additionally, a 0.5-metre-wide ditch will be included on the up-slope side of the road. An engineering drawing for access road was not available, therefore the footprint of access road was calculated with road linear distance and road width.

A total of thirty solid steel rock anchors (100 mm outside diameter or smaller) will be installed into the rockface to support the installation of concrete foundation. After the rock anchors are installed, the concrete abutment will be set in place. Similar to the first three mooring structures, the fourth will have two strut arms connected to the topsides dampening system at a later stage once the FSTs are on site. Prior to the construction of Permanent Mooring Structure 04, the existing rock outcrop will be cut away to prepare for the foundation and the access road. The estimated overburden and rock volume to be removed are 1,369 m^3 and 2,646 m^3 for the road. The rock volume to be removed for mooring structure abutment is 15,000 m^3. This is a preliminary estimate of the rock cut area, as the design engineering of the structure is still underway and is subject to change as the design progresses. All blasting for mooring structure 04 will be conducted during the MLRW.

For the removal of the bedrock in the immediate vicinity of mooring structure 04, two blasting approaches have been proposed. The first approach is smooth-wall long-hole blasting where majority of the slope will be blasted using one or two substantial blasts, and the second approach is a benched method where blasting will begin on top of the slope and work its way down. The first approach, however, is less likely to be used in this project because the used and staging of equipment such as large drill rig are required at the top of the steep mountainside. It would be difficult to get equipment and explosives to the location relatively high up and removed prior to blasting. Additionally, the perimeter holes would be difficult to layout and achieve the proper alignment and orientation while drilling. A sequenced timing starting nearest to the water and working the back and up from the water is less than desirable for drilling and loading.

The thirty (30) rock anchors will be installed after completion of blasting. The rock anchors consist of solid steel rod anchors, 100mm outside diameter or smaller. The rock anchors will be installed by a marine vessel with a crane onboard. It is anticipated that the rock anchors will be installed utilizing pile drilling equipment to embed the anchors and rock socket (grout) into the bedrock.

The concrete abutment will be constructed of cast-in-place concrete installed within solid, sealed formwork and secured to the rock anchors. The concrete will be installed by a marine vessel with a crane, welding equipment, and concrete pump trucks onboard.

Permanent Mooring Structures 01, 02, 03 and 04 and Permanent Mooring Tie-Back Structures 01 and 02 will be comprised of surfaces that are impermeable to light.

3.1.4 Piping Trestle Module M07 and Roadway Trestle Module M14

Two trestle modules will be installed to connect the FST Transfer Platform M05 to the onshore facilities. Module 07 consists of a steel framework structure (approximately 36 m long, 11 m wide, and 6 m high) with the interior of the structure tightly packed with various piping and electrical works, which will create an impermeable surface to light. Module 14 consists of a steel framework structure (approximately 31 m long, 7 m wide, and 7 m high) with a steel grating top deck, which will allow light penetration. Modules 07 and 14 will be preassembled offsite and painted for corrosion protection. Prior to the installation of the FST Transfer Platform topsides, the two trestles will be set in place and welded to the westernmost FST Transfer Platform substructure by a marine crane.

3.1.5 Floating Storage Tanks (FSTs)

Two floating storage tanks (FSTs) will be permanently moored at the Marine Terminal. The FSTs (each approximately 208 m long, 65 m wide, and 25 m high) are existing LNG tanker ships that will be modified offsite to convert from shipping vessels to stationary storage vessels for LNG. During Marine Terminal operations, the LNG processed by the onshore facilities will be transferred to the FSTs through jumper arms from Module M05. The two FSTs will be permanently moored using the permanent mooring structures described in the previous sections. The elevations of the FSTs will vary due to tidal fluctuations and variations on LNG loading, but a minimum clearance of 3 m above the seabed will be maintained.

The two FSTs will be towed to the site using barges or tugs and secured to the permanent mooring structures using strut arms installed using a barge mounted crane. The strut arms consist of a steel frame structure that will allow light penetration.

3.2 Material Offloading Facility (MOF)

A Material Offloading Facility (MOF) will be installed on the shoreline on the east side of the facility. The platform will be used for material transfer onsite from barges during the construction phase. The platform will create a permanent surface impermeable to light. Four mooring buoys will be installed (2 along each side of the MOF). The buoys will be connected by mooring chains and/or wire rope to dead-man anchors which will be placed on the seabed. Two mooring dolphin structures supported by piles will be installed (1 on each side of the MOF).

The MOF will be a concrete deck wharf structure extending approximately 40 m over the water from the existing shoreline. The MOF will be supported by 169 piles of 36" (914 mm) diameter with the top of piles at elevation +1.8 m geodetic datum (GD). These piles will cover a total of 112 m^2 in area. The piles will be pre-coated at the pile fabricator facility with a marine-rated coating system prior to delivery and installation. The MOF deck surface will be 45.5 m width and 46 m length, covering an area of 2,093 m^2.

The steel pipe piles will be installed by rotary drill method, which will apply little to no vibration into the soil and will not displace soil during installation. Where currently present, existing large boulders or riprap material will be moved from the location of individual piles with an excavator before pile placement. The piles will be initially set in their location on the seabed and allowed to embed by self-weight prior to the start of rotary drilling. Piles below the current high-water mark will be installed from a marine piling barge, and piles above the current high-water mark will be installed from an onshore piling rig.

After piles are installed, shoreline enhancement work will be performed in the intertidal area between the piles, in areas of the shoreline lower than the bottom of the MOF deck. Shoreline enhancement details are further discussed in **Section 3.5**. A prefabricated steel tubular cap (pre-coated with a marine-rated coating system) will be bolted or welded onto the top of each pile. Steel beams (W14 x 61 or similar size, pre-coated with a marine-rated coating system) will be bolted to the connection tabs to form a grid between the piles, which will support the concrete deck. Installation of the caps, connection tabs, and steel framing will be performed from a barge.

Pre-cast concrete panels (12”/305 mm thick) will be placed on top of the steel framing using onshore cranes. Temporary formwork will be installed around the entire perimeter of the concrete deck, extending above the finished top of concrete surface. All gaps between the precast panels and/or formwork will be sealed. After the panels and formwork are placed and the sealant has cured, a 30” (762 mm) thick fully reinforced concrete topping slab will be poured atop the panels using onshore concrete pump trucks. After the concrete has cured, the formwork will be removed. Two mooring bollards will be installed on the top of the concrete deck with cast-in-place anchor bolts. Marine fenders will be installed on the outward (southern) face of the concrete deck from a marine vessel.

The lowest top surface of the concrete MOF deck will be at elevation +3.5 m GD. The lowest bottom of the precast concrete panels will be at elevation +2.3 m, with an air gap of approximately 0.3 m above the higher-high water level (HHWL) of +2.0 m GD. The bottom of the lowest steel framing will be at elevation +1.6 m, approximately 0.4 m below the HHWL.

The four (4) mooring buoys will be 12-foot (3650 mm) outside diameter, composed of rigid foam and urethane shell over a steel frame. Steel mooring chains (2.5” / 64 mm links) and/or wire rope (35 mm diameter) will be connected between the mooring buoys and dead-man anchors prior to installation. The dead-man anchors will be precast concrete with 10 tonne or smaller nominal size (2.5 m long, 2.0 m wide, 1.0 m high or smaller), which will be lowered to the seabed from a barge.

The two (2) mooring dolphin structures will each consist of four (4) steel pipe piles (the same piles as described for the MOF structure) supporting a concrete pile cap with a 100-tonne mooring dolphin. Piles will be driven into the seabed from a marine piling barge using rotary drill method to a depth of 42 m or less into the seafloor. The top of steel for the mooring dolphin structure will be at elevation +3.5 m GD and will be decked with serrated grating.

After completion of construction, the MOF, mooring buoys, and mooring piles will remain in place.

Installation of all piles and mooring structures will occur during the MLRW, thereby supporting topside work outside of the MLRW. After completion of construction, the MOF, mooring buoys, and mooring piles will remain in place.

3.3 Offloading Platform

A light material offloading platform (MOF) will be permanently installed adjacent to the current small craft dock on the west side of the CPA. A permanent access ramp will be constructed using infill between the shore and the offloading platform. As part of the proposed shoreline works, the areas of shore next to the platform and ramp will be armoured with riprap, that will connect to the shoreline repair works discussed below. The platform will facilitate the offloading of light materials from vessels during the operations phase of the LNG facility. The platform will be impermeable to light and will require infilling of the tidal and sub-tidal portions of the associated marine habitat.

The offloading platform will be constructed using a vertical wall (e.g., sheet pile), riprap and fill. The wall extending along the outer perimeter of the structure will be installed from a marine piling barge. Where possible, the driving of sheet piles will be completed using a vibratory hammer. If necessary, an impact

hammer may be used to drive piles to their final design elevation. If sheet pile cannot be completed alternate wall materials like lock blocks, gabion baskets, or related features may be required if deemed necessary by the project engineers. After the area is enclosed with the wall and dewatered, it will be infilled. Infilling will take place from onshore and will use cranes or excavators to fill the area with clean, graded, base material. Infill will be isolated from marine waters within the wall. The fill will gradually be compacted as it is applied and finished with a graded and compacted top layer of high fines surfacing aggregate using excavators, bulldozers, and compactors.

The access ramp will be constructed from on shore using excavators, rollers, and compactors to install fill rock and graded base material. This will infill the shore leading to the platform. It will also be finished with a high fine surfacing aggregate that is compacted and graded. Shore armour in the form of riprap will be incorporated to protect the ramp from erosion and will be applied as discussed in the section on shoreline repairs. After the completion of the offloading platform, the site access dock gangway ramp will be moved from its existing temporary connection point to shore and connected to the offloading platform.

3.4 Temporary Floating Worker Accommodations (Floatel)

A Floatel is required to temporarily (during construction) house workers on-Site and is planned in response to community feedback on worker accommodations. The Floatel will be moored and will be able to house approximately 600 workers. The Floatel will be removed from the Site following the completion of all major construction at the facility, including terrestrial works. The exact size and configuration are to be finalized, however, the total area of the Floatel is not to exceed 8,600 m^2. The components of the Floatel that will be within the CPA for most of the construction phase include:

- A walkway connecting the floating barge(s) to shore, supported by approximately twelve 508 mm (3 m^2 total footprint) diameter steel pipe piles;
- Two gangway ramps connecting the walkway to the floating barges;
- Four breasting dolphins comprised of eight steel pipe piles of 1,219 mm diameter (10 m^2 total footprint) for berthing/ mooring of the Floatel;
- Six onshore mooring structures to secure the Floatel in place.

Fixed walkways and gangways will support electrical conduits for power supply and steel piping for potable water supply from onshore areas. The Floatel will be self-contained and service vessels will remove solid waste and sewage from the Floatel for disposal at a licensed offsite facility. The Floatel will be brought to site and connected to mooring and breasting dolphins. A minimum of 2 m clearance between the Floatel and the seabed will be maintained at the lowest low tide.

All piles will consist of steel pipe, painted for corrosion protection. A metal mooring dolphin and berthing fender will be installed by a marine vessel atop the five breasting dolphins for berthing of the Floatel. A metal mooring dolphin will be installed by a marine vessel atop the remaining four mooring piles. All elements of dolphins and fenders will be located above the HHWL.

The fixed walkways and moving gangways will be constructed of metal beam framing with metal grating and handrails. Walkway platforms will be 4 m wide or less. The walkways and gangways will be supported

by metal frames installed on top of the supporting piles. The support frames will be constructed of metal beam framing including 660 mm outside diameter or smaller sleeves that will be installed on top of the piles.

Piles will be installed from a marine spud barge using a vibratory hammer and an impact hammer to achieve the required design penetration if required. If the piles are rock-socketed, then sediment and rock materials will be removed from inside the pile and isolated from the marine environment.

Pile installation supporting the above water Floatel infrastructure (e.g., gangways and walkways) are scheduled be completed prior to the end of the 2023-2024 MLRW, as the Floatel is scheduled to arrive on site in December 2023. While currently scheduled within the MLRW, installation of the supporting Floatel piles may extend into January 2024 depending on Authorization timing and subsequent construction start date, as worker accommodation is a critical component needed to facilitate onshore and offshore construction activity. Considering the importance of Floatel operation, Woodfibre LNG is currently anticipating that Floatel berthing, and hook-up may extend past the 2023 MLRW, although this activity is deemed low risk to marine fish and fish habitat.

Where final pile installation works are required within the MLRW, effects Ínexwantas (monitoring) will be conducted, and adaptive management employed as outlined in the Aquatic Effects Assessment for Construction Works (Keystone Environmental 2023). Resulting effects to the marine environment are not anticipated.

Support frames will be installed on support piles using an onshore crane, with support from a marine vessel as required for alignment and connections. Walkways and gangways will then be set onto support frames by an onshore crane.

Upon demobilization of the Floatel from the facility, the walkways, gangways, conduit, utility piping, and support frames will be removed using similar methods as the installation. All piles will remain permanently in place.

3.5 Shoreline Repair

The following components are part of the shoreline works:

- Removal of debris and excavation activities east and west of Mill Creek and at the south barge landing to create more gradual slope;
- Reconstruction of riprap armoured shoreline and extension up to the existing first bridge on Mill Creek;
- Construction or modification of three barge landing areas along shore;
- Installation of a sheet pile wall above the HHWL;
- Toe of riprap may extend further into marine environment to create more gradual slope (i.e., fill) to approximately -1 m CD;

The existing shoreline armouring requires repair and upgrades to: (1) meet future coastal design requirements (i.e., sea level rise); (2) repair damage from recent winter storms, and (3) protect newly exposed

shoreline from erosion after removal of the old timber wharfs and docks. The shoreline work will enhance the protection from erosion for approximately 1,300 m linear length of shoreline in the CPA. To begin shoreline repairs, excavation is required to extend the toe of the armoured slope in specific areas along the shoreline. This work will include the modification of two existing barge landings along shore to the southwest and northeast. An additional landing called centre ramp will be constructed as part of the eastern shoreline to accommodate future access constraints from proposed infrastructure. Excavation will take place at the existing south barge landing as well as the areas adjacent east and west of Mill Creek. The excavation activities east of Mill Creek will extend up to FST Permanent Mooring Structure 01 (**Table 3-2**). The purpose of the excavation will be debris and legacy structure removal as well as repositioning of the existing riprap slope along with the placement of new riprap.

Table 3-2 Shoreline Works – Excavation Volumes Below HHWL

Area	Excavation Volume Estimate (m^3)	Description
West of Mill Creek		
Area 1	1,134	• Existing bollard structure will be removed • Repositioning of existing and new riprap along ~170 m of shoreline towards existing Ro-Ro • Existing SW barge ramp upgrades
Area 2	0	• Remove debris – timber and concrete abutment • Reposition of existing and new riprap along ~260m of shoreline • No excavation required
Area 3	0	• Remove debris (timber, asphalt) • Reposition of existing and new riprap along ~210m of shoreline • Shoreline tie-in to offloading platform • No excavation required
Area 4	6,206	• Remove debris (timber, asphalt, 2 concrete abutments) • Excavate and grade to install new riprap along ~140 m shoreline • Existing offshore riprap will remain in place
Area 5 (west)	0	• Remove debris (timber, trees, concrete, asphalt, steel, etc.) • After debris removal, install new riprap along ~50m reach of Mill Creek to the existing pedestrian bridge • No excavation required
East of Mill Creek		
Area 5 (east)	0	• Works will be same as Area 5 (west)
Area 6	3,325	• Remove debris (timber, concrete, steel, etc.) • Grade and excavate to prepare for reposition of existing and install new riprap along ~80m of shoreline; tie-in to MOF

Area	Excavation Volume Estimate (m^3)	Description
Area 7	1,067	• Numerous concrete structures and debris to be removed. • Excavate / grade for reposition of existing and install new riprap along ~130m of shoreline; tie-in to MOF • Excavate / grade for ramp stone install at existing Center Ramp
Area 8	795	• Selective demolition of bulkhead for install of new riprap slope • Excavate / grade for reposition of existing and install of new riprap along ~210m of shoreline • Excavate / grade for ramp stone install at existing NE Barge Ramp
Area 9	0	• Remove debris (timber, trees, concrete, asphalt, steel, etc.) – 4 existing concrete structures remain. • Reposition of existing and install of new riprap along ~110m of shoreline • No excavation is required. • Area of bedrock outcropping (~60m in length)
GRAND TOTAL	**12,527**	

A sheet pile wall approximately 60 m long will be installed near the eastern end of the shoreline in an area above the HHWL. The areas upslope of the sheet pile wall will be backfilled. The area downslope of the sheet pile wall will be protected with riprap armouring that will be part of the planned shoreline repair. Sheet piles will be driven into the existing surface from a land-based piling rig using vibratory pile driving methods and impact pile driving to seat piles to finish elevation if required. After sheet piles are installed, the upslope area will be infilled from onshore with graded base material using excavators and/or cranes. Infill material will be isolated from the marine environment behind the sheet pile wall.

Shoreline works include excavation and riprap placement. Excavation works are expected to be conducted with a crane or excavator with a clamshell bucket; both of which would operate from a floating barge utilizing spuds or anchors to remain in position. The excavated material will likely be loaded onto a separate scow barge with side walls. A portion of the sediment will be placed back on top of the riprap where indicated on the design drawings to bury the toe rock and maintain a beach similar to the existing contours in select locations chosen by the design engineers. The remaining material will be loaded onto a barge and taken offsite for disposal.

Riprap placement will be conducted from onshore using a long arm excavator or clam shell on a crane. Existing riprap that has been colonized by algae is intended to be reused and will be stockpiled in the tidal zone, away from the shoreline works in an area approved by the Qualified Environmental Professional (QEP) and Operations Manager. New riprap will be incorporated to replace degraded or unsuitable material that cannot be reused. Barge landings will be constructed by removing rock and substrate and grading the area to meet the design slope for the landings. Where this work occurs in the intertidal zone, the work will be timed for low tide. Compacted gravel will then be used to stabilize areas after material removal to mitigate erosion effects and sedimentation.

Near-shore sheet pile installation located near the marine jetty is scheduled during the MLRW. Minor works may extend beyond the MLRW, such as final placement of riprap or final infilling to grade in areas previously isolated from the marine environment. In-water works related to shoreline demolition are not anticipated outside of the MLRW, such as removal of existing subtidal riprap or the removal of existing concrete structures. Minor low risk works may extend beyond the MLRW, such as final placement of riprap above the subtidal zone or final infilling and grading in areas previously isolated from the marine environment. Where final low risk works are required to finalize shoreline protection efforts, effects Ínexwantas (monitoring) will be conducted, and adaptive management employed as outlined in the Aquatic Effects Assessment for Construction Works (Keystone Environmental 2023). Effects to the marine environment are not anticipated.

Shoreline protection work (i.e., installation of riprap) and demolition work will be sequentially conducted in discrete sections of shoreline and will progress along the length of the shoreline in a parallel effort to promote efficient equipment utilization, and to avoid extensive lengths of shoreline being exposed to erosion risk for extended disruptive weather events.

In-water marine activities that have the potential to harm fish are scheduled to occur during the MLRW over a 2-year period, including shoreline demolition and initial riprap placement to support subsequent riprap placement within and above the intertidal zone during lower tide. As the end of the MLRW approaches, shoreline protection work will be paused until the following least risk window commences, with shoreline stabilization for this extended period being prioritized.

3.6 Ro-Ro Ramp Dock & Dolphin Refurbishments (Existing Industrial Infrastructure)

An existing roll-on / roll-off (Ro-Ro) ramp dock at the south end of the facility will be repaired for continued use as a combined rail and road dock for the facility. The ramp was originally constructed around 1984 and has not been in operation since 2006. The repairs will be contained within the existing footprint of the Ro-Ro.

Refurbishment and repair work below the high-water mark are expected to consist of localized repair / recoating of steel sheet piles and replacement of existing timber piles with painted timber piles. Repairs to the sheet piles (including recoating and potential partial replacement of areas damaged by corrosion) will be completed from onshore. Pile replacement will be completed from a marine piling barge. Damaged existing creosote piles will be pulled using vibration and replaced with painted timber piles. If existing damaged timber piles cannot be pulled or are broken, piles will be cut at the mudline.

3.7 Bridges Over Mill Creek

Two permanent clear span bridges will be built parallel to each other over the lower reach of Mill Creek to allow for access between the East and West areas of the LNG facility. One road bridge for light vehicle traffic and one pipe bridge supporting piping, electrical conduits/cables and instrumentation will be constructed. The bridges will be installed as modular structures with support piles and piers for the bridges located outside the top of bank boundary for Mill Creek within existing cleared areas devoid of riparian vegetation. The bridges have been designed to account for severe flooding and the increased likelihood of severe floods due to climate change in terms of their design height and structure. Once the new bridges are in place, the existing old bridges will be demolished and the road will be regraded; however, no excavation is anticipated for the removal of footings of the old bridges. Additional freeboard has been allowed in anticipation of any debris that may be carried downstream by a severe flooding event.

Helical or driven steel piles will be used as the primary supports and they have been designed to avoid any requirements for additional support elements installed within the banks of the creek. The bridges will be connected directly to the support piles via welding or bolting to the pile caps.

With the exception of the use of steel foundation piles, which will be located outside of the top of bank of Mill Creek, planned installation methods will follow DFO's Code of Practice for clear span bridges.

A cast-in-place concrete abutment will be installed upslope of the piles on each end of the road bridge which will then be supported by clean, compacted fill to support the road approach slabs. The road bridge will have an impermeable concrete surface while the pipe bridge will be a permeable open steel truss structure. Both bridges will be pre-assembled and then lifted into place on the foundations/pilings using a crane.

3.8 Culvert Outfalls

Seven drainage culvert outfalls will be installed in the shoreline for controlled drainage of treated and non-contact water from the site for discharge into Howe Sound and one into Mill Creek. Three new outfalls will be constructed and five will be refurbished culvert outfalls that currently exist but need repairs or modification. Two of the outfalls will incorporate control structures consisting of precast concrete boxes with manually operated frame gates and weirs. The two controlled outfalls will be associated with the West and East sedimentation ponds. Drainage pipes on the upstream and downstream sides of the outfall control structures will be elevated above the HHWL such that they are inaccessible to fish from Howe Sound. The riprap slope has been designed to account for sea level rise.

Outfalls will either be precast concrete, high-density polyethylene (HDPE) or steel pipe depending on the functional drainage requirements at each location. An onshore crane will lift the outfalls into place along the shore, all outfalls will be protected by riprap as part of the shoreline works. The riprap layer for the outfalls will be underlain with geotextile. The outfalls for East Creek will include two parallel culverts penetrating through the new sheet pile wall included in the Shoreline Repair works.

3.9 Timeline

Construction periods for the Project marine infrastructure components are outlined in **Table 3-3**. While the schedule is subject to change pending contractor selection and confirmation of installation methodology, it provides an outlook of Woodfibre LNG's commitment to focus in-water construction activities that have the potential to affect fish within Howe Sound during the August 16 through January 31 MLRW. Detailed construction scheduling is underway with various construction contractors and will be reviewed when available in the context of potential Project effects and interactions with fish and fish habitat, including review of mitigation requirements.

Table 3-3 Anticipated Schedule of Marine Construction Activities

Component	Start	Finish	In-Water Works within Least Risk Window
Shoreline Upgrades			
Sheet Piling (East End of Site)	01-Oct-23	01-Oct 24	Yes
Demo, excavation and Installation of Shoreline	01-Sep-23	31-Jan-25	Yes
East Creek Outfall	15-Aug-23	01-Sep-23	Yes
All Other Outfalls – Installation	01-Sep-23	31-Jan-24	
Floatel			
Piles, Berthing Dolphins, Gangways	01-Sep-23	31-Jan-24	Yes
Floatel Berthing & Hook-Up	01-Feb-24	15-Mar-24	No
Floatel Operation	01-Jan-24	2026 Commissioning	No
Offloading Platform			
Sheet Piling and Riprap Installation	18-Nov-23	30-Jan-24	Yes
Infilling and Grading	15-Aug-24	16-Dec-24	Yes
Material Offloading Facility (MOF)			
MOF Piles	01-Sep-23	31-Jan-24	Yes
Dolphin Piles	01-Sep-23	01-Jan-24	Yes
Mooring Buoys & Anchors	01-Sep-23	01-Jan-24	Yes
Dolphin Concrete Slabs	05-Jan-24	20-Jan-24	No
Steel Deck & Precast Panels	15-Jan-24	30-Mar-24	No
Concrete Topping Slabs	01-Apr-24	30-Apr-24	No
Bridges Over Mill Creek			
Bridge Decommissioning	03-July-25	19-July-25	Instream least risk window
Bridge Foundations	30-Jan-24	29-Feb-24	N/A
Set Modular Road Bridge	01-Mar-24	15-Mar-24	N/A
Set Modular Pipe Bridge	16-Mar-24	31-Mar-24	N/A
Raw Water Intakes	01-Sep-23	Through construction 01-Mar-26	Yes
Marine Terminal			
Blasting	01-Nov-23	31-Jan-24	No in-water works
Marine Pile Installation	01-Nov-23	31-Jan-25	Yes
Marine Terminal Structure Installation	15-Aug-24	31-Jan-25	Yes
FSTs Berthing and Permanent Mooring	20-May-25	15-Aug-25	No
Roll-on Roll-off (Ro-Ro) Ramp Dock & Dolphins Refurbishment	01-Sep-23	01-Mar-26	Yes

4. REGULATORY FRAMEWORK

The regulatory framework informs the development of this Plan and includes environmental assessment commitments and conditions of approval, legislative requirements and criteria that have become binding through regulatory approvals. Best management practices and standards that are used to inform project design, mitigation and Ínexwantas (monitoring) are also identified.

4.1 Environmental Assessment Conditions and Commitments

Woodfibre LNG has received environmental assessment approvals under the SNEAA (October 2015), BC EAC (October 2015, as amended July 17, 2017, and July 19, 2018), and the *Impact Assessment Act* –FDS (March 17, 2016 – as amended March 7, 2018). Environmental conditions and commitments as they relate to this Plan are summarized in **Table 4-1**.

In fulfilling the conditions of the FDS, EAC and SNEAA, all actions outlined in this plan are considered in a careful and precautionary manner, promote sustainable development, are informed by the best available information and knowledge, including community and Indigenous traditional knowledge, are based on validated methods and models, are undertaken by qualified individuals, and have applied the best available economically and technologically feasible mitigation measures.

Table 4-1 Conditions for Marine Fish and Fish Habitat Management and Monitoring Plan

Condition Number	Condition	MFFHMMP Reference
EAC Condition 1 Environmental Monitor	Prior to commencing Construction, the Holder must retain the services of a Qualified Professional as an Environmental Monitor throughout the Construction phase of the Project. The Holder must give the Environmental Monitor the authority to stop Project work if the Environmental Monitor determines that the Holder has not, or may have not, complied fully with the Certificate requirements and the Environmental Monitor determined that stopping work is necessary to prevent or reduce significant harm. The Environmental Monitor must be retained by the Holder throughout Construction. The Holder must notify EAO of any non-compliance with the Certificate within 72 hours of the Environmental Monitor or the Holder becoming aware of any such non-compliance, or immediately for any non-compliance that may cause significant adverse effects. The Holder must prepare monthly reports on the Holder's compliance with this Certificate. These reports must be retained by the Holder through the Construction phase of the Project and for five years after commencing Operations.	Sections 4, 5, 6, 7, 8, 9, 11

Condition Number	Condition	MFFHMMP Reference
EAC Condition 2 Consultation Regarding Management Plans	Where a condition of this EA Certificate requires the Holder to consult a particular party or parties regarding the content of a management plan, the Holder must: Provide written notice to each such party that: • includes a copy of the management plan; • invites the party to provide its views on the content of such management plan; and indicates: • if a timeframe providing such views to the Holder is specified in the relevant condition of this EA Certificate, that the party may provide such views to the Holder within such time frame; or • if a timeframe providing such views to the Holder is not specified in the relevant condition of this EA Certificate, specifies a reasonable period during which the party may submit such views to the Holder; • Undertake a full and impartial consideration of any views and other information provided by a party in accordance with the timelines specified in a notice given pursuant to paragraph (a); • Provide a written explanation to each party that provided comments in accordance with a notice given pursuant to paragraph (a) as to: • how the views and information provided by such party to the Holder received have been considered and addressed in a revised version of the management plan; or • why such views and information have not been addressed in a revised version of the management plan; • Maintain a record of consultation with each such party regarding the management plan; and • Provide a copy of such consultation record to the EAO, the relevant party, or both, promptly upon the written request of the EAO or such party.	Section 3
EAC Condition 8 Marine Fish and Fish Habitat	The Holder must develop, in consultation with DFO and Indigenous Groups, a marine fish and fish habitat management and Ínexwantas (monitoring) plan that must include at a minimum: The means by which the mitigation measures in the Application (Section 22, Table 22-1) and the recommendations in the Slhawt' (herring) Survey Summary Report, section 4.0 (May 2016) will be implemented.	Sections 6, 7, 8

Condition Number	Condition	MFFHMMP Reference
EAC Condition 8 Marine Fish and Fish Habitat *(cont'd)*	Identification of reduced risk work windows and the work that will occur within these windows. Identification of any work that will occur outside of the reduced risk work windows, and measures to mitigate impacts to fish and fish habitat.	Sections 7, 7.2
	An adaptive management plan to address the effects of the Project on fish and fish habitat in the event (i) those effects on fish and fish habitat are not mitigated to the extent identified in the Application, or (ii) effects on fish and fish habitat occur that were not predicted in the Application	Section 7.13, 10.1
	A Qualified Professional must develop the plan and supervise the implementation of the plan. The Holder must provide the plan to EAO, DFO, OGC and Indigenous Groups no less than 30 days prior to the Holder's planned date to commence Construction. The Holder must implement the plan to the satisfaction of EAO.	Sections 3,5, 10.1
EAC Condition 22 Indigenous Consultation	The Holder must continue to engage Indigenous Groups for the life of the Project. Engagement must include information sharing and discussion of site-specific mitigation measures, including the development and implementation of plans and the conditions of this Certificate. The Holder must provide, to the satisfaction of EAO, an Indigenous consultation summary report no later than: Two years after the commencement of Construction; and One year after the commencement of Operations. The Holder must share the Indigenous consultation summary report with Indigenous Groups for no less than 30 days review and comment prior to providing it to EAO.	Section 3
EAC Condition 23 Indigenous Monitoring	The Holder must, through discussion with Indigenous Groups, seek to provide opportunities for members of Indigenous Groups to participate in Ínexwantas (monitoring) activities in the plans in this Table of Conditions that are occurring within their asserted traditional territory. In the Indigenous consultation reports required by Condition 22 to EAO, the Holder must include information regarding the opportunities provided and the participation of members of Indigenous Groups in Ínexwantas (monitoring) activities.	Sections 3, 5
FDS Condition 3.1 Timing Windows	The Proponent shall conduct in-water construction activities during timing windows of least risk for the area, unless otherwise agreed to by relevant federal and provincial authorities. If in-water construction activities cannot be conducted during timing windows of least risk, the Proponent shall develop and implement additional mitigation measures, in consultation with Fisheries and Oceans Canada and Indigenous groups, to protect fish during sensitive life stages.	Section 7.3

Condition Number	Condition	MFFHMMP Reference
FDS Condition 3.2 Marine Water Quality	The Proponent shall implement measures to mitigate adverse environmental effects of the Designated Project on fish and fish habitat from changes to water quality during all phases of the Designated Project. The mitigation measures shall include: • implementing erosion control measures and sediment control measures during all phases of the Designated Project; • revegetating disturbed riparian areas, using native plant species, after construction; • using silt control measures around in-water construction activities; and • preventing wet concrete or cement-laden water from entering the marine environment.	Section 7 MWQMMP CEMP
FDS Condition 3.3 Harmful Alteration Disruption or Destruction of Fish and Fish Habitat	The Proponent shall implement measures to mitigate adverse environmental effects of the Designated Project on fish, including mortality, physical injury and behavioural change, during all phases of the Designated Project. The mitigation measures shall include: • taking into consideration the BC Marine and Pile Driving Contractors Association's Best Management Practices for Pile Driving and Related Operations when conducting pile installation; and • implementing low-noise methods or sound dampening technologies to reduce the intensity of the sound generated or the level of sound propagation through the water column if underwater pressure pulse levels exceed 30 kilopascals during pile installation.	Sections 7.3, 7.5, 7.8 CEMP MMMMP DFO AEA
FDS Condition 3.4 Blasting	The Proponent shall prevent or avoid the destruction of fish, or any potentially harmful effects to fish habitat, during all phases of the Designated Project when using explosives in or around water frequented by fish.	Section 7.12 CEMP
FDS Condition 3.5 Creosote Pile Removal	The Proponent shall remove existing creosote-treated piles in a manner to prevent the mobilization of deleterious substances in water frequented by fish and taking into consideration navigational safety.	Section 7.9 MWQMMP
FDS Condition 3.6 Water Intake	The Proponent shall design, install and operate any marine water intake to avoid or reduce the incidental capture of fish through entrainment and impingement, including the risk of entrainment of Pacific slhawt' (herring) (*Clupea pallasii*) larvae.	Section 7.1, 7.3, 7.6
FDS Condition 3.11 Offsetting Plan	The Proponent shall, in consultation with Fisheries and Oceans Canada and Indigenous groups, develop and implement any plan(s) required to offset the loss of fish and fish habitat associated with the carrying out of the Designated Project.	Sections 8, 9

Condition Number	Condition	MFFHMMP Reference
FDS Condition 3.12 Offsetting Plan Impacts	For any fish habitat offset areas proposed in any offsetting plans(s) under condition 3.11, prior to submitting the offsetting plan to Fisheries and Oceans Canada, the Proponent shall determine whether there are adverse effects: • on migratory birds and their habitats; • on terrestrial species, including amphibians and reptiles, and their habitats; • on listed species at risk and their habitats • on the current use of lands and resources for traditional purposes by Indigenous peoples; • on the flow rates, water depths or water widths that may affect the passage of a vessel including a vessel used by Indigenous peoples in the context of their current use of lands and resources for traditional purposes; • on physical and cultural heritage and structure, site or thing that is of historical, archaeological, paleontological or architectural significance to Indigenous peoples; and • from potential sources of contamination including polycyclic aromatic hydrocarbons, dioxins, furans, copper, lead, zinc, tri-n-butyltin, arsenic, cadmium and methyl-mercury in the receiving environment.	Sections 6, 8, 9, 10 MWQMMP
FDS Condition 3.13 Offsetting Plan Mitigation	The Proponent shall, if there are adverse effects on any of the elements set out in conditions 3.12.1 to 3.12.7, avoid or lessen those adverse effects.	Sections 7, 8, 9, 10
FDS Condition 3.14 Verification Monitoring of EA Accuracy	The Proponent shall, in consultation with Fisheries and Oceans Canada and Indigenous groups, develop, prior to construction, and implement, during all phases of the Designated Project, a follow-up program to verify the accuracy of the environmental assessment and to determine the effectiveness of the mitigation measures identified under conditions 3.1 to 3.10.	Section 9 MWQMMP MMMMP CEMP

Additionally, the mitigation measures presented in the Woodfibre LNG application for EAC are summarized in the **Table 4-2** below. These measures are incorporated into the MFFMMP.

Table 4-2 Proposed Mitigation Measures (Woodfibre LNG Application for an Environmental Assessment Certificate)

Mitigation Number	Mitigation Name	Proposed Mitigation	Project Phase	Timing of Implementation	MFFHMMP Reference
5.8 Surface Water Quality					
M5.8-1	**Erosion Prevention and Sediment Control Plan**	Woodfibre LNG Limited will develop and implement an Erosion Prevention and Sediment Control Plan as part of the Construction Environmental Management Plan (CEMP). Existing applicable guidelines will be followed as appropriate to mitigate erosion and sediment transport and include the following: › Environmental Protection and Management Guide (OGC 2013) › Land Development Guidelines for the Protection of Aquatic Habitat (DFO 1992) › Develop with Care Environmental Guidelines for Urban and Rural Land Development in British Columbia (MOE 2014) › Standards and Best Practices for Instream Works (MWLAP 2004) The following erosion and sediment control measures will be implemented at the site during the construction and decommissioning phases and included in the Erosion Prevention and Sediment Control Plan (refer to **Section 13.0 Summary of Proposed Environmental and Operation Management Plans and Follow-up Programs**): › Activities within riparian management areas, a 30-m-wide area on either side of both Mill Creek and Woodfibre Creek, will be minimized. Erodible material will not be stockpiled in these areas and no refueling will occur within these areas. › Vegetation cover will be maintained wherever possible. Disturbed areas adjacent to watercourses will be re-vegetated as soon as possible to prevent surface erosion or downstream water quality effects. › Overland flows will be diverted from undisturbed areas away from or around construction areas. › Erosion and sediment control measures, including silt fences, filter fabric, straw bales, gravel filter dikes, sedimentation ponds, perimeter ditches, cut-off swales or other water quality management measures, will be selected, implemented, monitored, maintained, and repaired as required. • Sediment pond(s) will be incorporated as required, and appropriately designed in accordance with current guidelines to meet site conditions and requirements. Sediment ponds will be maintained until construction or decommissioning is completed and the affected areas are sufficiently stabilized and re-vegetated to minimize erosion risk or sediment transport at the site as a result of construction activities. • Construction wastes, overburden, soil, or any other substances potentially deleterious to riparian, aquatic or marine habitat will be stored or disposed of in such a manner as to prevent entry to riparian, aquatic or marine areas. • No erodible materials will be stockpiled within riparian management areas. Soil stockpiles will be diked, sloped, and seeded or appropriately covered to minimize erosion. If temporary stockpiles are constructed, then appropriate erosion prevention measures will be installed and regularly maintained until these stockpiles are decommissioned or seeded. Spoil will be managed in accordance with the appropriate Project-specified regulatory approvals or applicable legislation, regulations, and guidelines prior to the completion of construction activities. • Erosion and sediment control measures will be maintained, and any required changes made promptly to ensure they are working effectively. An inspection and maintenance program will be developed and followed as part of the Erosion Prevention and Sediment Control Plan. Water collected in temporary sediment control structures will be analyzed and its quality determined. If water quality meets acceptable guidelines, it will be discharged into Howe Sound; otherwise, it will be treated prior to discharge.	Construction Decommissioning	Pre-construction	Sections 7.1.3, 7.2.1, 7.2.2, and 7.2.6

Mitigation Number	Mitigation Name	Proposed Mitigation	Project Phase	Timing of Implementation	MFFHMMP Reference
M5.8-2	**Design for Stormwater Management**	Woodfibre LNG Limited will include stormwater management in the Project design with the following considerations: › Stormwater that comes into contact with areas that are not subject to LNG facility spills (e.g., roads, material storage areas, roof areas) will be collected in ditches and catch basins. It will then be directed through a stormwater treatment system to remove any oil and sediment prior to discharge into Howe Sound. › Stormwater that comes into contact with the LNG facility or other process areas will be captured in the new lined stormwater retention pond. The water will be tested for compliance with the BC water quality guidelines. If it meets guidelines, stormwater will be discharged directly into Howe Sound; if not, stormwater will be pumped to the water treatment plant prior to being discharged into Howe Sound. › Surface drains and ditches constructed as part of the Project will be graded according to BMPs and vegetated or lined to minimize erosion and increase the retention time of runoff. Particular attention will be given to the construction methodology and design of new or upgrades to access roads to avoid the potential to alter existing drainage patterns by collecting overland drainage and concentrating it at specific locations, which may result in localized erosion.	Operation	Final design	Sections 7.1.3, 7.1.4 and 7.7
M5.8-3	**Follow Instream Works Best Management Practices**	Woodfibre LNG Limited will mitigate effects to freshwater from instream works required during the construction and maintenance of the Mill Creek intake by implementing the following strategies: › Instream construction activities will be completed in isolation of stream flows (e.g., flow diverted around work area) as much as possible. › All fill materials or materials that will contact watercourse waters, including shoreline works or surfacing, will be clean and free of organic material and deleterious substances. Water intakes will be designed and constructed following existing regulation and BMPs, such as *Best Management Practices for Installation and Maintenance of Water Line Intakes* (MOE 2006).	Construction	Construction	Sections 3.10, 4.3, and 7.2.4.
M5.8-4	**Water Quality Monitoring**	Woodfibre LNG Limited will retain a qualified Environmental Monitor to oversee the implementation of the selected mitigation measures. The Environmental Monitor will evaluate the performance of mitigation measures (e.g., through water quality sampling) and will have the authority to suspend activities that are causing an unexpected adverse effect, or potentially contravening environmental legislation. The Environmental Monitor will be given the authority to immediately suspend all activities that are resulting, or could imminently result, in the release of sediment or other deleterious substances to the watercourses in the Project area.	Construction Decommissioning	Construction Decommissioning	Sections 7.1.4, 7.2.4, 7.3, and 7.12; MWQMMP
M5.8-5	**Develop and Implement a Water Quality Monitoring Program**	Woodfibre LNG Limited will develop and implement a water quality Ínexwantas (monitoring) program for Mill Creek and Woodfibre Creek. Information to be included within this program will include sample sites, frequency of sampling, and parameters to be monitored.	Construction Operation	Pre-construction	Section 7.2.4; MWQMMP
5.9 Surface Water Quantity					
M5.9-1	**Minimum Instream Flow Releases**	Woodfibre LNG Limited will ensure that the minimum instream flow releases (IFRs) will be established by a qualified professional. When required, the water diversions will be interrupted or reduced as required to maintain minimum or higher instream flows.	Construction Operation Decommissioning	Final Design	Section 3.10
M5.9-2	**Minimize Vegetation Clearing**	Woodfibre LNG Limited will limit clearing of native vegetation communities to the extent required for construction of Project facilities. Where feasible, temporary construction features, such as laydown areas, will be located on paved or previously disturbed areas to reduce clearing. In addition, areas to be cleared will be delineated to help limit clearing to what is planned. Reducing the clearing area to the minimal amount required to accommodate the Project footprint will reduce the direct loss of vegetation communities and sekw'ekw'inexw (wildlife) habitat. Ínexwantas (monitoring) will be conducted to ensure that mitigation measures are properly implemented and effective.	Construction	Construction	Sections 7.2.1, 7.2.3, and 7.2.6

Mitigation Number	Mitigation Name	Proposed Mitigation	Project Phase	Timing of Implementation	MFFHMMP Reference
5.10 Marine Water Quality					
M5.8-1	**Erosion Prevention and Sediment Control Plan**	See description for M5.8-1 above.	Construction Decommissioning	Pre-construction	Sections 7.1.3, 7.2.1, 7.2.2, and 7.2.6
M5.8-2	**Design for Stormwater Management**	See description of M5.8-2 above.	Operation	Final Design	Sections 7.1.3, 7.1.4 and 7.7
M5.10-1	**Marine Works Management Plan**	Woodfibre LNG Limited will prepare and implement a Marine Works Management Plan to minimize sediment disturbance during construction and prevent discharge or runoff containing high TSS, concrete wash water and fuel from entering the marine environment. The plan will contain (but not be limited to) the following measures: › All construction operations will be monitored by a qualified Environmental Monitor who will be onsite during the high-risk construction and demolition activities to determine whether the works are resulting in any adverse effects on marine environment. Frequency of Ínexwantas (monitoring) will be detailed in a Ínexwantas (monitoring) plan. Any adverse effects will be reported to DFO by WLNG. › Marine works will be conducted during the least risk fisheries work window specific by DFO for the region if practical. If the work window cannot be followed, additional mitigation measures including the advice provided by DFO (Measures to Avoid Causing Harm to Fish and Fish Habitat (2013b)) will be implemented. The work window for Howe Sound is currently August 16 - January 31 (DFO 2014). › Work activities will cease and DFO will be contacted, if aggregations of slhawt' (herring) (e.g., slhawt' (herring) spawn) and salmonids (e.g., smolts) are observed within the work area. › Marine works will be avoided during weather that may increase sediment suspension as determined by a QEP. › All works will be conducted in a manner to prevent the discharge or introduction, either direct or indirect, of soil, sediment or sediment laden water, turbid water or any other deleterious substance into the marine environment. All discharges from construction activities shall meet BC water quality guidelines (MOE 2009). › Construction materials, excavation wastes, overburden, sediment, or other substances potentially deleterious to marine life shall be disposed of off-site in accordance with regulatory requirements, or placed in such a manner by the contractor, to prevent their entry into the marine environment. › The contractor shall follow Best Management Practices for Pile Driving and Related Operations (BCMPDCA and DFO 2003). › Vessels and other equipment involved in pile driving and construction activities will be positioned in a manner that will prevent damage to the seafloor and shoreline. › Where required, turbidity Ínexwantas (monitoring) will be implemented during all pile drilling/driving activities, to determine that turbidity levels in the marine environment do not exceed established water quality regulatory criteria during Project works. › The following water quality criteria will be applied based on BC water quality guidelines (MOE 2009) with regards to discharge or introduction of sediment or sediment- laden water in the marine environment: • Turbidity: • change from background of 2 NTU when the background level is less than 8 NTU. • change from background of 5 NTU when background is 8-50 NTU. • change from background of 10% when background is more than 50 NTU. • TSS: • change from background of 5 mg/L when background is less than 25 mg/L.	Construction Decommissioning	Pre-construction	Sections 7.1, 7.2 and 7.3

Mitigation Number	Mitigation Name	Proposed Mitigation	Project Phase	Timing of Implementation	MFFHMMP Reference
M5.10-1 ***(cont'd)***	**Marine Works Management Plan** ***(cont'd)***	• change from background of 10 mg/L when background is 25-100 mg/L. • change from background of 10% when background is more than 100 mg/L. › If the criteria outlined above is exceeded as a result of Project-related activities, these works or activities will be halted until measures that will result in compliance with the criteria outlined above are put in place. › Where the sediment control criteria cannot be practically met, the work areas and activities contributing to these conditions will be isolated from tidal and flowing waters. This may include use of silt curtains and other silt control measures. › For dredging activities, the following mitigation measures will be followed: • Prior to dredging, the perimeter of the dredge area will be identified, so that work occurs within the confines of the project area. Tools such as real-time kinematic positioning controls (e.g., differential GPS) may be used to assist in positioning. • Employ sediment containment and water filtering devices on the barge to meet the TSS and turbidity criteria outlined above. This may require containment and treatment of barge dewatering effluent that exceeds the criteria. • Water quality Ínexwantas (monitoring) will be implemented during dredging works to verify that the turbidity and TSS criteria are being met and enable management decisions to be made in the event that the performance criteria are not met. • The contract specifications will include operational controls to minimize disturbance of substrates (e.g., making additional dredge passes rather than dragging a bucket or beam to level the dredge surface, not stockpiling material underwater, controlling the rate of ascent and descent of the bucket). • The dredged material barge will not be overloaded beyond the top of the side rails to minimize loss of dredged material from the barge and to prevent barge listing or instability. • The barge will not come to rest on the seafloor (no grounding) (spuds may be used to anchor the barge).			
M5.10-2	**Concrete Works Management Plan**	Woodfibre LNG Limited will prepare and implement a Concrete Works Management Plan as part of the CEMP. The following mitigation measures will be included in this plan to mitigate potential effects to the marine environment from concrete works: › When pouring concrete, all spills of fresh concrete will be prevented from entering into the marine environment at the site. › If the concrete is being placed with a concrete pump, all hose and pipe connections will be sealed and locked properly so that lines will not leak or uncouple. › All concrete forms will be constructed in a manner which will prevent fresh concrete or cement-laden water from leaking into the surrounding water. › If fresh water is used to cure concrete, the runoff will be monitored for acceptable pH levels. If the pH levels are outside the allowable limits, then the runoff water will be contained and neutralized. › During inclement weather, uncured concrete will be protected or covered in a manner that minimizes the creation of high pH water. › Barriers will be used as appropriate to prevent splashing over forms and into the water. › Wash equipment and tools that have come in contact with concrete in a designated area away from the marine environment and drainages, so that concrete affected water is prevented from entering watercourses (tidal waters, streams, storm drains). › If necessary to pour concrete within the intertidal or subtidal zones (e.g., piling installation), contact between cementitious materials and surrounding seawater will be avoided to the extent possible. › When grinding cured concrete, water pH and TSS levels will be monitored not to exceed allowable limits from the effect of dust and fines. In the event that the levels are outside the acceptable ranges, preventative measures will be introduced. This may include introducing silt curtains to contain the solids and to prevent fish from entering a contaminated area or constructing catch basins to recover the runoff and neutralizing it prior to disposal. › Excess or spilled concrete will be contained, immediately cleaned up and disposed of in an environmentally acceptable manner.	Construction	Pre-construction	Section 7.7; MWQMMP

Mitigation Number	Mitigation Name	Proposed Mitigation	Project Phase	Timing of Implementation	MFFHMMP Reference
M5.10-3	**Minimize the Effects of Creosote Pile Removal**	Woodfibre LNG Limited will prepare and implement creosote pile removal mitigation measures as part of the CEMP, including the following measures: › A reasonable attempt will be made to remove the entire creosote-treated pile. › Piles will be removed by a slow, steady pull to minimize disturbance of seafloor habitats and to avoid bringing creosote-contaminated sediments to the surface. If the pile breaks off below the biologically-active zone in the sediment, it may not be advisable to dredge the remainder out, depending on the sensitivity of the habitat at the site. › Used/decommissioned piles will be disposed of on land in an appropriate waste management facility (Hutton and Samis 2000). › Work will follow procedures outlined in DFO's Guidelines to Protect Fish and Fish Habitat from Treated Wood Used in Aquatic Environments in the Pacific Region (Hutton and Samis 2000). › A sediment containment system (e.g., silt curtains) will be installed as appropriate during piling removal to prevent the dispersion of suspended sediments. › Creosote piling removal will be conducted during the least-risk fisheries work window specified by DFO for the region, unless a self-assessment determines that the work will not cause serious harm to fish or their habitat.	Construction	Pre-construction	Section 7.9
M5.10-4	**Waste Management Plan**	Woodfibre LNG Limited will develop and implement a Waste Management Plan for hazardous and non-hazardous waste to ensure that waste generation is minimized, and that waste is properly stored and disposed of. The plan will contain (but is not limited to) the following measures: Hazardous Wastes: › The *Hazardous Waste Regulation* (Government of BC 1988) will be followed under the *Environmental Management Act* for containment, storage and handling, disposal, and transportation of substances identified as hazardous waste. › Where activities involve the handling, storage, and removal of hazardous waste, the following records will be maintained: • inventories of types and quantities of hazardous waste generated, stored, or removed. • manifests identifying hazardous waste haulers and disposal destinations. • disposal certification documents. Non-Hazardous Wastes: › Solid waste materials that are not acceptable under the existing landfill permit will be transported offsite by barge for disposal to an appropriate designated disposal or recycling facility. › Whenever possible, the materials used in construction will be reused and recycled. Recyclable materials will be separated and transported off site. › Clearly labelled garbage bins with lids and recycling containers will be made available for food waste and recyclables. › Food waste will be stored in sekw'ekw'inexw (wildlife)-proof bins.	Construction Operation	Pre-construction	Sections 7.9 and 7.12.3
5.15 Freshwater Fish and Fish Habitat					
M5.8-3	**Follow Instream Works Best Management Practices**	See description of M5.8-3 above.	Construction	Construction	Sections 3.10, 4.3, and 7.2.4.
M5.9-2	**Minimize Vegetation Clearing**	See description of M5.9-2 above.	Construction	Construction	Sections 7.2.1, 7.2.3, and 7.2.6

Mitigation Number	Mitigation Name	Proposed Mitigation	Project Phase	Timing of Implementation	MFFHMMP Reference
M5.15-1	**Follow Instream Works Best Management Practices for Fish**	Woodfibre LNG Limited will follow instream works best management practices, including those outlined in M5.8-3 and those outlined below. › Reduced risk instream work windows Project activities and physical works conducted in freshwater fish habit will be undertaken during the reduced risk instream work window unless otherwise approved by MFLNRO. The reduced risk instream work windows for the Lower Mainland (Region 2) are between July 15 and September 15 for salmon, and between August 1 and 31 for trout and Tl'itl'elxiws (Dolly Varden) (MOE 2006). › Avoidance of instream disturbance Project activities and physical works pertaining to placement of water supply infrastructure, as well as bridge construction on Mill Creek will avoid, wherever possible, instream operation of equipment and release of debris within the creek. › Isolation of instream works The installation of the water supply intake in Mill Creek will require work areas within the creek to be isolated. If isolation of instream work areas will be required, activities will adhere to the provincial Standards and Best Practices for Instream Works (MWLAP 2004). If construction of required intake structures cannot avoid disturbance of instream environments from equipment operation, structure placement, or debris entering the creek, these activities will be isolated to minimize effects to the stream. If construction of the water supply intake cannot avoid the disturbance of instream environments, either directly by equipment operation or structure placement, or indirectly by causing debris to enter the creek, these activities will be isolated to minimize flow effects on bank erosion, will be protected from high flow events, will include the use of clean materials, and will allow for the salvage of fish. › Salvage of fish prior to instream works Any habitat isolation conducted in instream work areas will require fish salvage prior to the commencement of works. Prior to any fish salvage, fish sampling permits will be required under the provincial *Wildlife Act* (RSBC 1996, c. 488) and the federal *Fisheries Act*. Sampling methods will adhere to fish collection methods and standards (RISC 1997) and general operational BMPs for salvage of fish (MOE 2014c). › Minimize the duration of activities within watercourses and riparian setbacks The duration of necessary activities, including both dismantling and constructing structures, which must occur within watercourses and within the 30-m riparian setback, will be minimized to avoid potential fish mortality and changes in fish presence, the quality and quantity of fish habitat, habitat availability, and riparian habitat.	Construction	Pre-construction	Sections 3.10, 7.2.7, 7.3, 7.6
M5.15-2	**Water Management Plan**	Woodfibre LNG Limited will develop a Water Management Plan for Mill Creek, which will afford protection of fish and fish habitat by prescribing the minimum instream flow releases (IFRs). During low flows, water withdrawals from Mill Creek will be reduced to meet IFRs. If stream flows are less than the IFR, water will not be withdrawn from Mill Creek. Instream flow releases specific to the existing flow regime and geomorphology of Mill Creek will be developed in general accordance with *Assessment Methods for Aquatic Habitat and Instream Flow Characteristics in Support of Applications to Dam, Divert, or Extract Water from Streams in British Columbia* (Lewis et al. 2004) and consultation with MFLNRO. The information requirements for determining IFRs include the fish-bearing status of the stream, historic flow records, and any recently collected data. This current and historical information will allow for the establishment of seasonally adjusted instream flow thresholds calculated as percentiles of natural mean daily flows each month. Until such time as the Mill Creek-specific IFRs can be developed, the Project will adhere to IFRs calculated in accordance with the methods outlined in *Development of Instream Flow Thresholds as Guidelines for Reviewing Proposed Water Uses* (Hatfield et al. 2003) Ínexwantas (monitoring) will be a requirement of the Water Management Plan to confirm that the plan is effective in protecting fish and fish habitat. Effective Ínexwantas (monitoring) will include a combination of compliance Ínexwantas (monitoring) and biotic response Ínexwantas (monitoring) and the definition of program objectives. Design of a Ínexwantas (monitoring) program will consider program objectives, scope of effort, timing, and duration. Typical designs include, though are not limited to, the following: › Continuous streamflow Ínexwantas (monitoring) downstream of point of withdrawal › intermittent Ínexwantas (monitoring) of biotic variables (e.g., fish abundance or density) › random IFR compliance audits	Construction Operation Decommissioning	Pre-construction	Sections 3.10, 7.2.4, and 8

Mitigation Number	Mitigation Name	Proposed Mitigation	Project Phase	Timing of Implementation	MFFHMMP Reference
5.16 Marine Benthic Habitat					
M5.10-1	**Marine Works Management Plan**	See description of M5.10-1 above.	Construction	Pre-construction	Sections 7.1, 7.2 and 7.3
M5.10-3	**Minimize the Effects of Creosote Pile Removal**	See description of M5.10-3 above.	Construction	Pre-construction	Section 7.9
M5.16-1	**Minimize Marine Shading**	Woodfibre LNG Limited will employ the following measures to minimize shading associated with the installation of marine structures: › Where possible, ramps and gangways used to access floating facilities will be installed at an elevation of at least 2 m above the highest high water mark to allow ambient light to reach the seafloor. › Where possible, docks, ramps and gangways will be surfaced with aluminum grating (or other light permeable material), allowing ambient light to reach the benthic communities below.	Operation	Construction	Section 7.4
M5.16-2	**Ballast Water Management Plan**	Woodfibre LNG Limited will comply or require its contractors to comply with all legislated shipping requirements, including those related to the management of ballast water: › Ballast Water Control and Management Regulations (Government of Canada 2011) under the Canada Shipping Act, RSC 1985, c.S-9. › International Maritime Organization Resolution A. 868(20): Guidelines for the Control and Management of Ships Ballast Water to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens, in particular section 7.1 (IMO 2004) › Model Ballast Water Management Plan developed by the International Chamber of Shipping and the International Association of Independent Tanker Owners (IMO 2004) › Regulation B-1 of the International Maritime Organization's Regulations for the Control and Management of Ships' Ballast Water and Sediments (IMO 2004) › Part B of the Annex to Resolution MEPC.127 (53), Guidelines for Ballast Water Management and Development of Ballast Water Management Plans (IMO 2004)	Operation	Operation	Section 7.10
5.18 Forage Fish and Other Fish (Marine)					
M5.8-1	**Erosion Prevention and Sediment Control Plan**	See description of M5.8-1 above.	Construction Decommissioning	Pre-construction	Sections 7.1.3, 7.2.1, 7.2.2, and 7.2.6
M5.8-2	**Design for Stormwater Management**	See description of M5.8-2 above.	Operation	Final Design	Sections 7.1.3, 7.1.4 and 7.7
M5.10-1	**Marine Works Management Plan**	See description for M5.10-1 above.	Construction Decommissioning	Pre-construction	Sections 7.1, 7.2 and 7.3
M5.10-2	**Concrete Works Management Plan**	See description for M5.10-2 above.	Construction	Pre-construction	Section 7.7; MWQMMP

Mitigation Number	Mitigation Name	Proposed Mitigation	Project Phase	Timing of Implementation	MFFHMMP Reference
M5.10-3	**Minimize the Effects of Creosote Pile Removal**	See description for M5.10-3 above.	Construction	Pre-construction	Section 7.9
M5.12-6	**Blasting Management Plan**	Woodfibre LNG Limited will develop and implement a blasting management plan as part of the CEMP to mitigate effects of blasting to freshwater and marine aquatic life and sekw'ekw'inexw tl'a shkwen (marine birds). Ínexwantas (monitoring) of effects should be incorporated into the plan so that corrective mitigation measures can be undertaken if necessary. Blasting activities will conform to the Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters (Wright and Hopky 1998). Where feasible, underwater blasting will be scheduled to occur during periods when the number of birds in the area is lowest (likely the summer), with a maximum of one underwater blast per day, or at intervals of several hours (Cooper 1982). In addition, noises or blasts (e.g., "thunderflashes") to scare birds away from the immediate vicinity of the blast site will be emitted immediately prior to detonation (Cooper 1982; Demarchi and Bentley 2004).	Construction	Pre-construction	Sections 7.2.4, 7.3.5, 7.5, and 7.6
M5.10-4	**Waste Management Plan**	See description for M5.10-4 above.	Construction Operation	Pre-construction	Sections 7.9 and 7.12.3
M5.16-1	**Minimize Marine Shading**	See description for M5.16-2 above.	Operation	Construction	Section 7.4
M5.16-2	**Ballast Water Management Plan**	See description of M5.16-3 above.	Operation	Operation	Section 7.10
M5.17-6	**Underwater Noise Management Plan**	See description for M5.17-6 above.	Construction Operation Decommissioning	Pre-construction	Section 7.5

4.2 Legislative Requirements and Criteria

A summary of the federal and provincial regulatory and policy settings relevant to marine fish and fish habitat are provided in **Table 4-3**.

Table 4-3 Regulatory Framework for the Marine Fish and Fish Habitat Management and Monitoring Plan

Name	Jurisdiction	Description
Fisheries Act	Federal	Safeguards both fish and fish habitat. It is also an offence for anyone to deposit or permit the deposit of any type of deleterious substance in water frequented by fish without a permit or under a regulation. The fish and fish habitat protection provisions: • 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) • A prohibition against the deposition of deleterious substances in any type of water frequented by fish (section 36(3)). A S35(2)(b) Authorization will be needed for proposed works associated with the terminal. Regulated information requirements will include an offsetting plan and a detailed Offset Effectiveness Monitoring Protocol.
Canada Shipping Act, SC 2001, c. 26	Federal	Protects the marine environment from damage due to navigation and shipping activities (e.g., from discharges). Ballast Water Regulations control ballast water and aquatic invasive species management.
Species at Risk Act	Federal	A principal federal government commitment to prevent sekw'ekw'inexw (sekw'ekw'inexw (wildlife)) species from becoming extinct and securing the necessary actions for their recovery. The act provides for legal protection of sekw'ekw'inexw (wildlife) species and the conservation of their biological diversity. Issues permits or the conclusion of agreements for certain scientific or educational activities and for the implementation of special emergency measures. DFO is responsible for administering the *Species at Risk Act* for aquatic species at risk. Permits under SARA are not expected as part of the project for marine fish and fish habitat.
Water Sustainability Act	Provincial	Protects water use and extraction and fish habitat in the province of BC. Short term water use permit under Section 10 of the WSA to be issued by OGC or BC FLNRORD. Section 11 describes Works in and About a Stream and a S11 Change Approval or Notification may be required for clear span bridge over Mill Creek.

Name	Jurisdiction	Description
Oil and Gas Activities Act	Provincial	Regulates oil and gas and related activities in BC, including wells, facilities, oil refineries, natural gas processing plants, pipelines and oil and gas roads, through permits, authorizations, orders and regulations. The project has received an OGC Facilities Permit under Section 25(1) of the *Oil and Gas Activities Act*, to construct, maintain and operate a facility, subject to conditions.
Local Government Act	Provincial	The primary legislation for regional districts and improvement districts which sets out a framework for structure and operations, as well as the main powers and responsibilities. The *Local Government Act* includes important authorities such as planning and land use powers.
District of Squamish's Official Community Plan Bylaw 2500	Municipal	District of Squamish requires development permit for all proposed activities within terrestrial, riparian and marine environmental review area.

4.3 Best Management Practices and Standards

A list of Best Management Practices used to inform the MFFHMMP are provided in **Table 4-4**. Best Management Practices have been identified by the EAC and/or FDS and are included as conditions for management and Ínexwantas (monitoring). Other guidance documents were consulted in forming mitigation measures.

Table 4-4 Regulatory Framework for MFFHMMP Best Management Practices

Best Management Practice	Description
International Maritime Organization Resolution A.868(20): *Guidelines for the Control and Management of Ships Ballast Water to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens*, in particular section 7.1 (IMO 204)	Ballast Water and Aquatic Invasive Species Management
Model Ballast Water Management Plan developed by the International Chamber of Shipping and the International Association of Independent Tanker Owners (IMO 2004)	Ballast Water and Aquatic Invasive Species Management
Regulation B-1 of the International Maritime Organization's *Regulations for the Control and Management of Ship's Ballast Water and Sediments* (IMO 2004)	Ballast Water and Aquatic Invasive Species Management
Part B of the Annex to Resolution MEPC.127(53), *Guidelines for Ballast Water Management and Development of Ballast Water Management Plans* (IMO 2004)	Ballast Water and Aquatic Invasive Species Management
Best Management Practices for Pile Driving and Related Operations (BCMPDCA and DFO 2003)	Marine Fish Protection
Guidelines to Protect Fish and Fish Habitat from Treated Wood Used in Aquatic Environments in the Pacific Region (Hutton and Samis 2000)	Marine Fish Protection
Best Management Practices for Installation and Maintenance of Water Line Intakes (MOE 2006)	Instream Works Best Practices

5. ROLES AND RESPONSIBILITIES

The Construction Environmental Management Plan describe the roles and responsibilities of the Environmental Manager, Contractor, QP, and Environmental Monitor. Specific to the MFFHMMP, the QP is responsible for:

- Preparing the Plan
- Providing discipline-specific expertise in management and effects Ínexwantas (monitoring) of fish and fish habitat
- Providing training to the EM and Contractor on the recognition of effects to fish and fish habitat and recommendations for adaptive mitigation measures where required
- Supervising surveys to refine mapping or biophysical inventories of fish and fish habitat during and after construction as required based on Ínexwantas (monitoring) results
- Providing guidance and recommendations to Contractors who are implementing activity specific mitigation measures
- Attending kickoff, daily, and weekly site meetings to communicate potential environmental and safety concerns and requirements.

The QP will be experienced in the identification and management of fish and fish habitat and will be either a registered professional or an accredited practitioner.

6. BASELINE ENVIRONMENTAL CONDITIONS

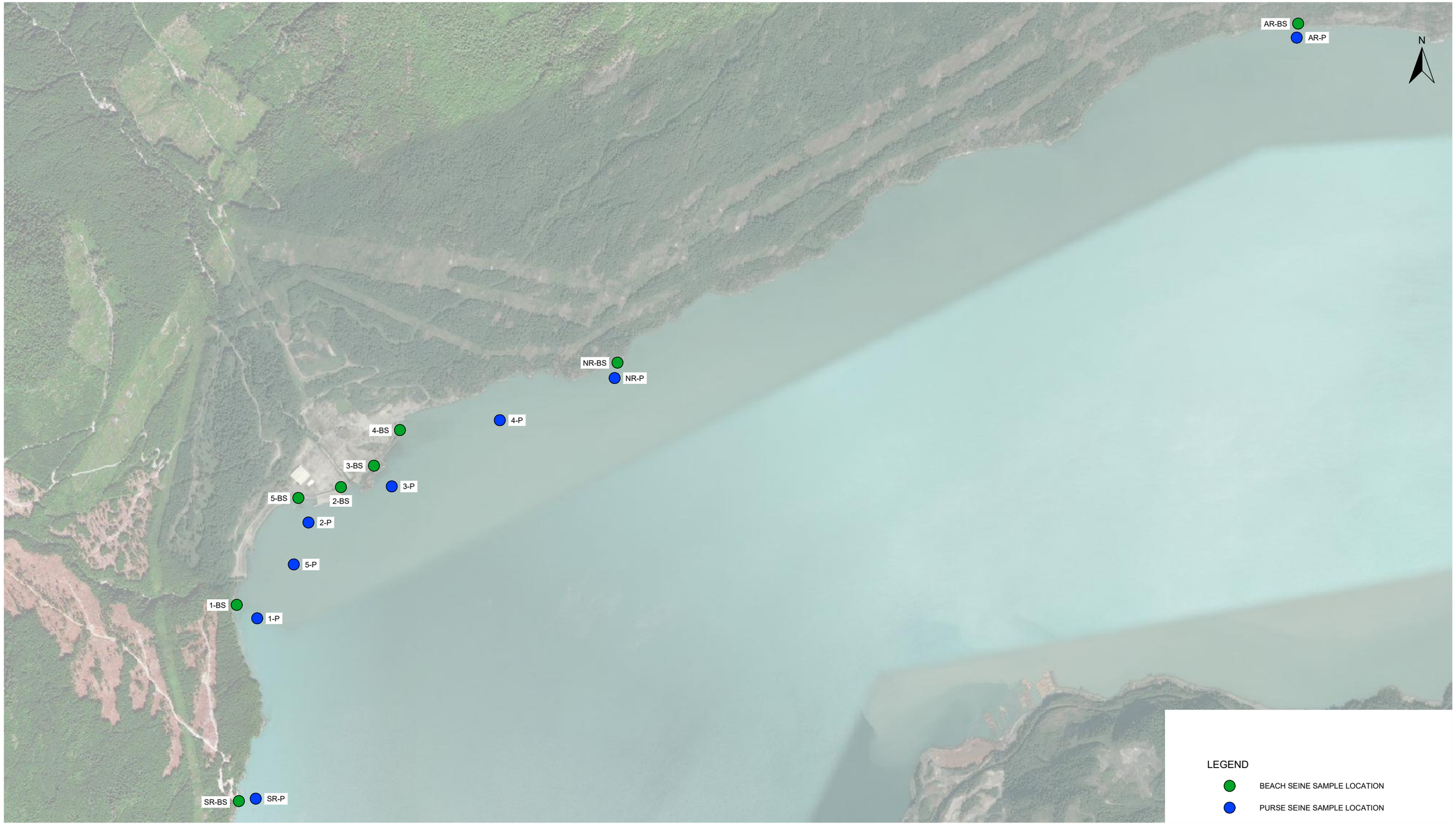
This section will be superseded by a stand-alone Marine Fish Baseline Report in 2024

This section describes the existing conditions with respect to fish, fish habitat, and the surrounding marine environment. This section also describes other physical factors with a potential to directly or indirectly influence fish and fish habitat. Existing ambient underwater noise levels and ship traffic are described the Marine Mammal Management and Ínexwantas (monitoring) Plan (Stantec 2022 in prep). Marine water quality is described in the Marine Water Quality Management and Ínexwantas (monitoring) Plan (Keystone 2023). Multiple years of field studies have been completed since 2013 in and around the CPA. These studies included marine riparian, intertidal, and subtidal surveys to assess the marine habitat types present, substrate composition, fauna and fish populations, estimate habitat usage, marine water quality, and the presence of marine aquatic invasive species.

Sampling methods included: dive surveys to map marine habitat and slhawt' (herring) spawn, beach and purse seine sampling to assess fish populations (**Figure 6-1**), sediment sampling for substrate and benthic invertebrates, and monthly baseline water quality sampling (in-situ and analytical) (**Figure 6-2**). Details regarding sediment sampling can be found in the Marine Water Quality Management and Ínexwantas (monitoring) Plan (Keystone 2023). Keystone Environmental, Golder Associates, Frontier Geosciences and Hemmera have all completed assessments and surveys in the area. The results of these studies have been used to inform development of EA related mitigation and management plans and follow up programs, along with supporting pre-construction activities (e.g., exploratory geotechnical investigations). These studies have been incorporated into this Plan. Studies that address the marine and riparian environmental conditions are listed below for reference and outlined in further detail in the following subsections.

- Executive Summary of project activities and site background including bio-physical characteristics (Golder 2013)
- Underwater Towed Video Surveys (Golder 2013 and 2014)
- Report on Hydrographic and Geophysical Sub-Bottom Seismic Surveys (Frontier Geosciences 2014, 2016 and 2018)
- Benthic Habitat Summary Report (Hemmera 2015)
- Herring Survey Summary Report (Hemmera 2015, 2016 and 2019)
- Marbled Murrelet (Piyís) Radar Survey Summary Report (Hemmera 2015)
- Juvenile Pink Salmon (Lháwichen) Outmigration Surveys (Hemmera 2016)
- Detailed Bio-Inventory Summary Report (Hemmera 2019)
- Stream Survey and Riparian Assessment (Hemmera 2020)
- Detailed Bio-Inventory Summary Report (Hemmera 2020)
- Herring Dive Surveys (Keystone Environmental 2019, 2020, 2021b, 2023a and 2023b)
- Marine Fish Presence Surveys (Keystone Environmental 2020, 2021 and 2022)
- 2020 Marine Biophysical Survey of Floatel Footprint (Keystone Environmental 2021a)
- Marine Bio-Inventory (In preparation) (Keystone Environmental 2022)
- Site visit to map riparian vegetation along the marine shoreline (Keystone Environmental 2022)
- Site visit to investigate habitat offsetting reference sites (Keystone Environmental 2023)

Woodfibre LNG will continue to review and consider regional data as part of future reporting.



Keystone Environmental

NOTES: ALL MAPPED FEATURES ARE APPROXIMATE AND SHOULD BE USED FOR DISCUSSION PURPOSES ONLY.
PROJECT FEATURES MAY BE SUBJECT TO CHANGE.
SOURCES:
1. DATE OF AERIAL PHOTO IS 2019, OBTAINED FROM GOOGLE MAPS.

150m 0 500m
SCALE: 1:15,000(approx.)

Squamish Pulp Mill (Woodfibre)
Squamish, B C
Woodfibre LNG Limited

REVISION No.	DATE	PROJECT No.
01	June 2023	17227-100

Figure 6-1
2022 Marine Fish Surveys

PLOT SCALE: 1:1 DRAWN BY: TL CADD FILE No. I:\17900-17999\17953 WLNG 2023 Bio\100 Env Permitting and Planning\DFO\FAA\report\June 2023 FAA\Figures\CADD\Fig6.1-2022 Marine Fish Surveys-R1.dwg

LEGEND

- CERTIFIED PROJECT AREA
- MARINE WATER SAMPLING LOCATION
- SURFACE WATER SAMPLES

Keystone Environmental

NOTES:
1. THIS DRAWING IS FOR GENERAL INFORMATION ONLY. LOT BOUNDARIES AND FEATURES ARE APPROXIMATE.
2. DATE OF AERIAL PHOTO IS 2019, DISTRICT OF SQUAMISH.

Woodfibre
Squamish, B C
Woodfibre LNG Limited

REVISION No.	DATE	PROJECT No.
A	May. 2022	17227-100

Figure 6-2
WLNG Marine Water Quality
Baseline Sampling Stations

DRAWN BY: CS Document Path: I:\0-GIS\1-Projects\1-WLNG\GIS_CADD\17227\00100\2022_05May_16__DFO_FA_Authorization\Fig4-2-WQ_SampleLocation-RA.mxd

6.1 Ecological Setting

This section will be superseded by a stand-alone Marine Fish Baseline Report in 2024

The Project is located in Howe Sound, southwest of the Skwxwú7mesh Stakw (Squamish and Mamquam Rivers). The Site is within the Coastal Western Hemlock-Dry Maritime (CWHdm) biogeoclimatic zone and subzone. The elevation range for the zone is sea level to approximately 650 m (Green and Klinka, 1994). The climate is relatively sunny with dry summers and mild and wet winters with little snowfall (Green and Klinka 1994). The closest Environment Canada weather station to the Project is Skwxwú7mesh (Squamish) STP Central station (Latitude: 49°42' N; Longitude: 123°09' W, Climate ID: 1047671). The weather station is located approximately 8.3 km from the Project and provides historical data with at least 15 years of collected data between 1981 and 2010. Average annual rainfall is approximately 2,143.3 mm with the highest accumulation occurring in November to January. Snowfall is greatest in the same months, with an annual precipitation of 87.0 cm on average. Mean annual temperature is 10.1° C, with the warmest temperatures found in July and August (17.8° C) and the coldest month being December (2.5°C). Monthly averages for precipitation and temperature are listed in **Table 6-1**.

Table 6-1 Average Annual Precipitation and Temperature from Environment Canada's Squamish STP Central Station (1981–2010)

Month	Average Rainfall (mm)	Average Snowfall (cm)	Average Temperature (°C)
January	300.2	25.9	2.7
February	179.7	13.1	4.6
March	198.4	8.1	6.7
April	152.5	0.1	9.9
May	115.7	0	12.9
June	82.6	0	15.5
July	59.3	0	17.8
August	66.2	0	17.8
September	82.6	0	15
October	255.5	0	10.3
November	382.2	9.2	5.5
December	268.4	30.6	2.5
Yearly Average	**2,143.3**	**87**	**10.1**

6.2 Marine Existing Conditions

This section will be superseded by a stand-alone Marine Fish Baseline Report in 2024

Marine substrate mapping for the Project area has been consolidated based on studies identified below and is presented in **Figures 6-3A, 6-3B, and 6-3C**. Marine biota mapping at the Site has been identified by the various surveys described in **Section 6** including visual observations, mapping surveys on foot, shoreline swims, and dive transects and are presented in **Figures 6-4A, 6-4B, and 6-4C**.

This marine habitat baseline summary uses historical marine studies from the Woodfibre Site including:

- Golder baseline surveys in 2013 and 2014 (Golder 2014);
- Hemmera dive surveys in 2015, 2016 and 2019 (Hemmera 2015, 2016a, 2016b, and 2019); and
- Keystone Environmental dive surveys, nearshore marine beach seine and purse seine surveys from 2019 through 2022 (Keystone 2019, 2020, 2021).

In 2022, marine riparian and intertidal substrate and biota mapping (e.g., rockweed distribution) were compared against recent imagery[1] and ground-truthed and updated to present the most recent configuration of the biota on-Site. Upland riparian and intertidal areas were surveyed on foot with all habitats visually assessed to confirm habitat types. Dominant substrate, vegetation, and fauna were recorded.

Habitat was mapped using Self-Contained Underwater Breathing Apparatus (SCUBA) in April 2015 with supplemental dives conducted each spring during the slhawt' (herring) surveys to confirm if there were changes in the habitat substrate or biota. Initially, transects were surveyed to a depth of 26 m below the water surface or approximately 21 to 24 m below chart datum (m CD). These depths were chosen based on the preliminary design of the Project (Hemmera 2015).

The dive surveys were conducted by a team of three WorkSafeBC certified SCUBA divers and one WorkSafeBC certified dive tender, all professional marine biologists, following the Marine Foreshore Environmental Assessment Procedure (DFO, 2004). Transects were established perpendicular to shore in the area of each structure's footprint. The start and end of each transect were recorded with a Garmin global positioning system (GPS). Underwater video of each transect was recorded with a high-definition GoPro camera. All fish observed were recorded by the lead diver while travelling to the deepest portion of the dive, while laying a measuring tape to a maximum of either 60 m in length or 27 m below the water's surface. Dive surveys consisted of sampling on either side of a transect line every five metres using a 1 m x 1 m quadrat. If bottom time was constrained and habitat between observation points was similar, the sampling interval was increased to ten metres. Within each quadrat, the diver recorded: transect position, depth, substrate type, vegetation cover, sessile invertebrate cover, mobile invertebrate density, and fish density.

Table 6-2 below shows categories and definitions for sediment and substrate types used when classifying the substrate in the CPA. These definitions were also used when determining impacts and effects that may possibly result from project activities. Some sediment types identified in the CPA during surveys also included organic material such as wood debris.

[1] District of Squamish WebMap: https://maps.squamish.ca/html5viewer/?viewer=webmap.

Table 6-2 Substrate Classification (Scale adapted from Wentworth 1922)

Category	Diameter (mm)
Silt/Mud/Clay	<0.0625
Sand	0.0625–2
Pebble	2–64
Cobble	64–256
Boulder	>256
Bedrock	n/a

6.2.1 Marine Intertidal Conditions

This section will be superseded by a stand-alone Marine Fish Baseline Report in 2024

The intertidal zone is mainly hard substrate (e.g., riprap, boulders, cobble or bedrock) (**Photograph 1)**, with patches of sand and cobble (**Photograph 2)** observed within the low intertidal and shallow subtidal areas between approximately 0.5 m CD to -2.0 m CD. The intertidal is dominated by riprap (0.5 m in diameter plus) with occasional boulders and steep bedrock (**Photograph 3)** near the far northeast and southwest extents of the CPA (Hemmera 2015, Hemmera 2016a, Hemmera 2016b). However, there are exceptions to these general trends, such as the intertidal zones that previously hosted marine infrastructure in support of the former pulp mill. In these areas, the intertidal substrate is composed of cobble and gravel with sparse boulders and has a gentler slope than the surrounding riprap armor. These areas are located around the small delta of Mill Creek along the shoreline to the east and west and mainly devoid of biota.

Beginning from the top of bank, the majority the shoreline consists of a 2H:1V riprap slope. The upper areas/ splash zones of this slope are bare, with no notable occurrences of marine flora or fauna between 5.2 m and 4.5 m CD. At approximately 4.5 m CD, sparse coverage of green string lettuce (*Ulva intestinalis*) can be seen growing in some areas. A band of abundant rockweed begins at approximately 4.0 m CD and extends as low as 1.0 m CD. In other areas, where there is no riprap or where there are remnants of legacy developments in the intertidal, such as the areas immediately east and west of the Mill Creek delta, there is a gap in the band with only sparse coverage in the lower stratum near 0.5 m CD. Rockweed is the most abundant marine vegetation observed in the intertidal zone, but its distribution appears dependent on the availability of larger boulder substrate that is not frequently disturbed by wave exposure. The abundance of rockweed is common throughout the Site with the exception of the mouth of Mill Creek, where macroalgae growth is limited to green algae. Below the rockweed band, the intertidal areas, between 1.0 and 0.5 m CD have been colonized by sparse patches of sea lettuce (*Ulva lactuca*). Below 0.5 m CD, sparse laminarian kelps (*Saccharina latissima*) were present on boulder or bedrock substrate, extending into the shallow subtidal zone.

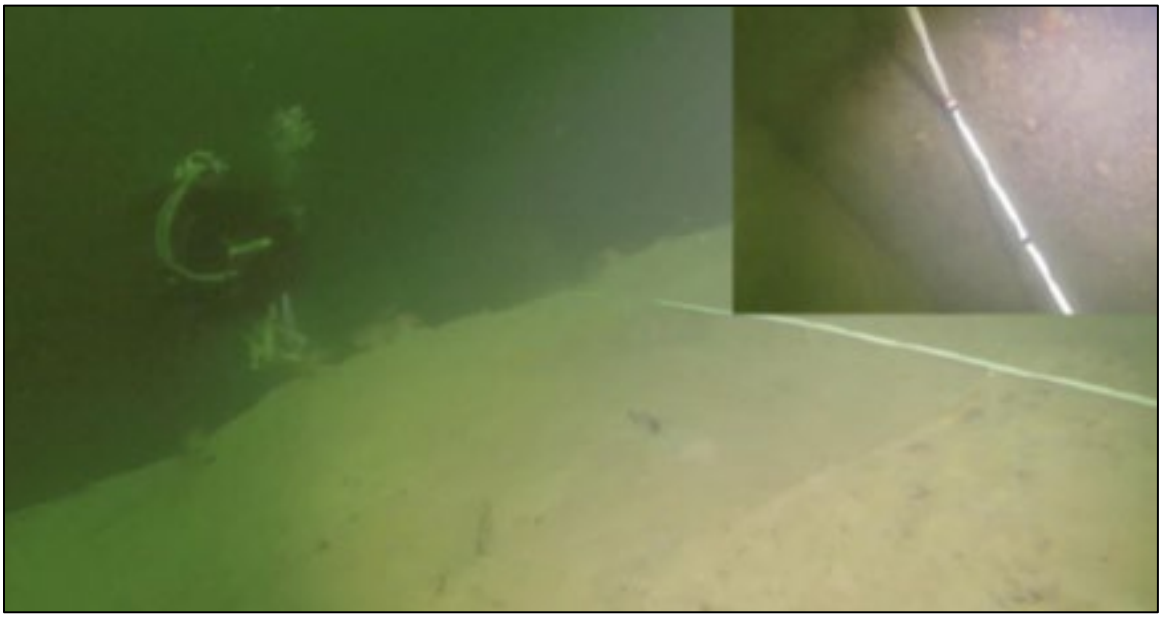
See **Photographs 4–16** for additional photographs documenting existing marine intertidal substrate.

As per the results of the consolidated marine vegetation and sessile invertebrate community mapping, the intertidal zone (approximately 5.1 m CD to 0.0 m CD) generally contained a low diversity of benthic invertebrates and a greater amount of macroalgae compared to the subtidal zone. Dive surveys performed by Keystone Environmental and Hemmera (2015) and intertidal transect surveys completed by Golder (2014)

observed the following macroalgae taxa in the intertidal area; green string lettuce (*Ulva intestinalis*), rusty rock (*Hildenbrandia sp.*), rockweed (*Fucus distichus*), green tuft (*Cladophora sp.*), and filamentous brown algae. Rockweed was the dominant species observed within the intertidal zone between the approximate elevations of 4.0 m CD and 0.0 m CD (**Photograph 17**). In addition, acorn barnacle (*Balanus glandula*), limpet (*Lottia spp.*), blue mussel (*Mytilus trossulus*), thatched barnacles (*Semibalanus cariosus*), beach hoppers (family *Amphipoda*) and red velvet mites (*Neomolgus littoralis*) were observed in sparse amounts on riprap and boulders in intertidal surveys performed by Golder (2014) and Hemmera (2014).

Photograph 1: View of riprap slope east of the site access dock on May 22, 2019.

Photograph 2: View of a patch of boulder and **cobble** in the subtidal zone on May 22, 2019.



Photograph 3: Diver over steep bedrock outcrop near the far northeast area of the CPA (Hemmera 2015).

Photograph 4: Looking west between the access dock and Ro-Ro. The majority of shoreline is armoured with a band of intertidal rockweed is visible on larger riprap.

Photograph 5: Looking west at the shoreline between the access dock and Ro-Ro showing the transition from riprap with rockweed to bare silty sand, gravel, and sparse cobble in the subtidal zone with some wood debris.

Photograph 6: View of the shoreline west of Mill Creek showing the remnants of the deep-sea dock concrete wall. The remaining shore is primarily cobble and gravel with sparse boulders. The small substrate size has limited the growth of rockweed or green algae in this area with only sparse coverage near the low water line.

Photograph 7: Remnants of an old timber wharf and an outfall east of Mill Creek. The timber wharf makes up most of the intertidal zone in this section, with natural cobble, gravel and sand near the low water line.

Photograph 8: Shoreline between the west barge landing and the Ro-Ro. Riprap with green algae and rockweed bands visible.

Photograph 9: Riprap armoured shoreline east of the Ro-Ro with green algae and rockweed bands typical of armoured slopes throughout the site.

Photograph 10: Shoreline east of the site access dock. Riprap toes out into soft sediment without macroalgae. Riparian area is largely unvegetated, with a cluster of three fir trees visible.

Photograph 11: Cobble/gravel substrate with sparse algae east of the site access dock. Algal growth is much less abundant in this area compared to riprap armoured shoreline sections due to the smaller substrate being unstable in the wave exposed environment.

Photograph 12: Bare cobble gravel intertidal zone west of Mill Creek. Substrate is primarily devoid of macro algae with the exception of a riprap berm, where rockweed was observed.

Photograph 13: Cobble gravel substrate on the west side of Mill Creek and riprap armoured shoreline on the east. Biota is limited to green algae, with rockweed not being observed directly at the mouth of Mill Creek likely due to the freshwater influence.

Photograph 14: View of the mouth of Mill Creek. Sparse vegetation is visible along the top of bank on either side of the creek.

Photograph 15: Cobble/ gravel intertidal shoreline east of Mill Creek with reduced macroalgae coverage compared to riprap armoured shoreline sections.

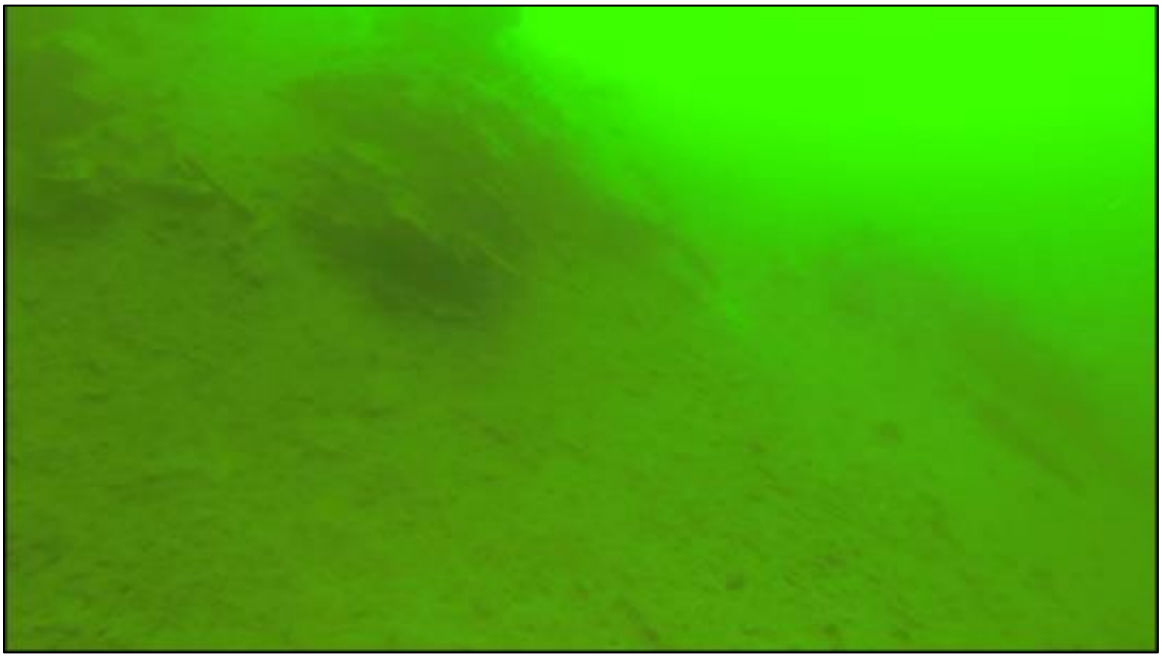
Photograph 16: Typical backshore conditions at the east barge landing. Generally highly disturbed, former industrial areas with gravel, concrete, riprap or cobble and no vegetation. Green algae and rockweed bands are visible on riprap armoured sections of the shoreline.

Photograph 17: View looking southwest from the northwest corner of the CPA at the rockweed dominated intertidal zone.

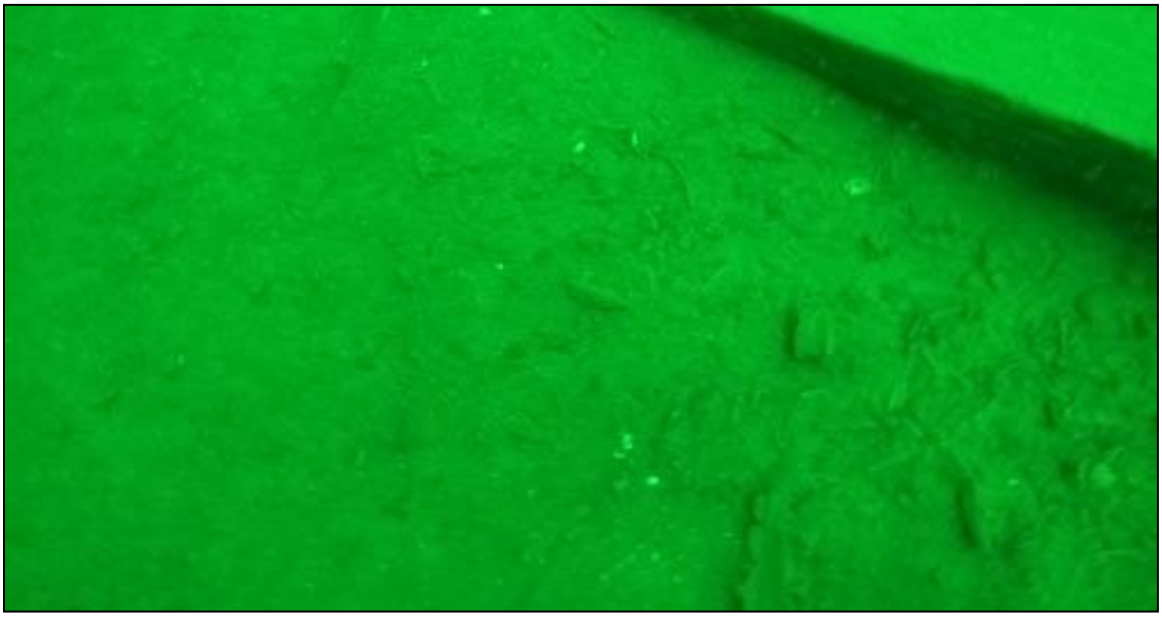
6.2.2 Marine Subtidal Conditions

This section will be superseded by a stand-alone Marine Fish Baseline Report in 2024

The subtidal zone is dominated by soft sediment with varying mixtures of sand, silt and wood debris throughout the Site (**Photograph 18, Photograph 19)**. Wood chips (estimated >0.3 m thick) covers the seafloor at water depths of up to approximately -30.0 m CD (Hemmera 2016a) northeast of Mill Creek. From dive surveys conducted by Keystone Environmental in 2019 and information from Golder (2014, wood debris decreases southwest of Mill Creek and was mainly observed as fine particulate. White bacterial mats were observed on the sediment surface southwest and northeast of Mill Creek, likely indicating the presence of fine organic matter (i.e., wood waste) (**Photograph 23, Photograph 24)**. Woodfibre Creek and Mill Creek both had areas of wood debris (e.g., large logs and wood chips) and organic debris (e.g., leaf litter) observed adjacent to the outflows (Golder 2014 and Hemmera 2016a). Dive surveys in the northern half of the CPA provide a detailed map of substrate –expanding the steep bedrock outcrops or terraces around-10 m CD depth (Hemmera 2016a). Deeper subtidal surveys were not conducted in the southern half of the CPA (below -10 m CD) because the majority of Project-related infrastructure will be built in the northern half of the CPA.



Photograph 18: Side view of thick wood debris present in historic dredge pocket with thin silt covering near future FSTs.



Photograph 19: Silt and fine wood waste in central subtidal area west of dock.

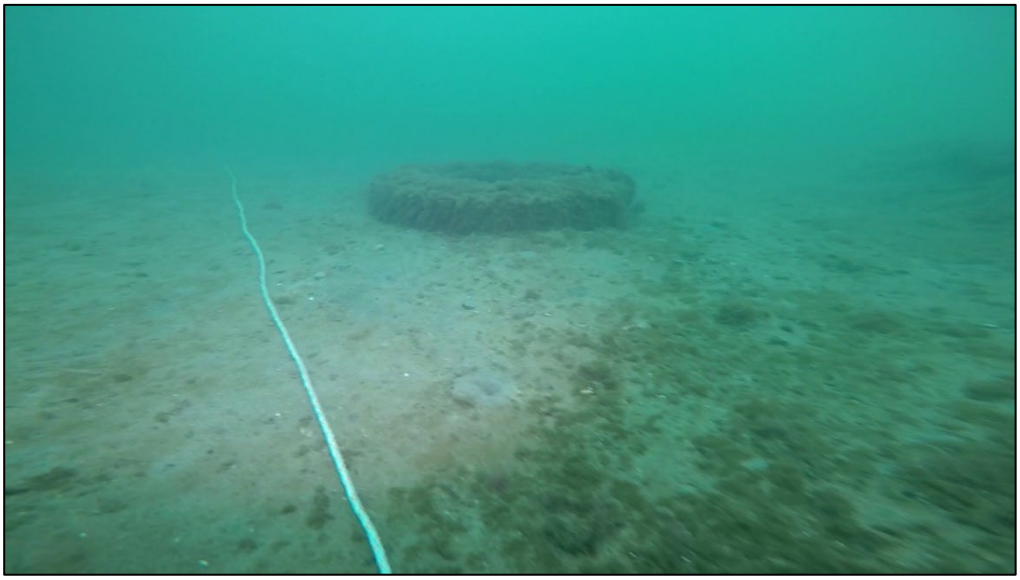
Within the shallow subtidal zone from 0.0 to --3.0 m CD, a sparse mix of laminarian kelps (*Saccharina latissima*) and diatoms (Class Bacillariophyceae) were associated with hard substrate, while rare occurrences of bacteria mats (*Beggiatoa* sp.) and few diatoms were observed growing amongst sparse cobble mixed with sand and silt (**Photographs 21 and 22**). Below -1 m CD in areas of subtidal silt and wood debris the diversity and abundance of marine organisms was low and was limited to coverage by few diatoms and some rare occurrences of bacteria mats and fauna such as mottled stars and anemones. Surficial sediment cores (to – 0.3 m below seafloor) were collected throughout the Site, with little to no infaunal biota present (**Photograph 20**).

The subtidal zone (beginning at 0.0 m CD) contained a low abundance and diversity of macroalgae and a greater abundance and diversity of benthic invertebrates. Small pockets of laminarian kelps (mainly *Saccharina [60] aggregate*) were identified in the subtidal area from approximately -1.0 m CD to -9.0 m CD (**Photograph 26**). Benthic epifauna observations by Golder (2014), Hemmera (2015) and Keystone Environmental included: Aẏx (Dungeness crabs; *Metacarcinus magister*), tanner crabs (*Chionoecetes bairdi*), shrimp (*Decapoda*), squat lobsters (*Galathoidea*), sea cucumbers (*Holothuroidea*), urchins (*Echinoidea*), anemones (*Anthozoa*), and sea stars (*Asteroidea*) (**Photograph 27 and 28**).

Taxonomic analysis of benthic infaunal samples collected by Golder (2014) revealed lower benthic invertebrate density was observed in samples that contained higher proportions of wood debris. Benthic infauna communities were dominated by mobile and sedentary polychaete species at most stations, which had high silt and clay content while some shallow subtidal sandy stations had a high number of bivalves (clams and mussels). Samples collected at the mouth of Mill Creek had high proportions of insects within the benthos communities that are more common for low-salinity environments.

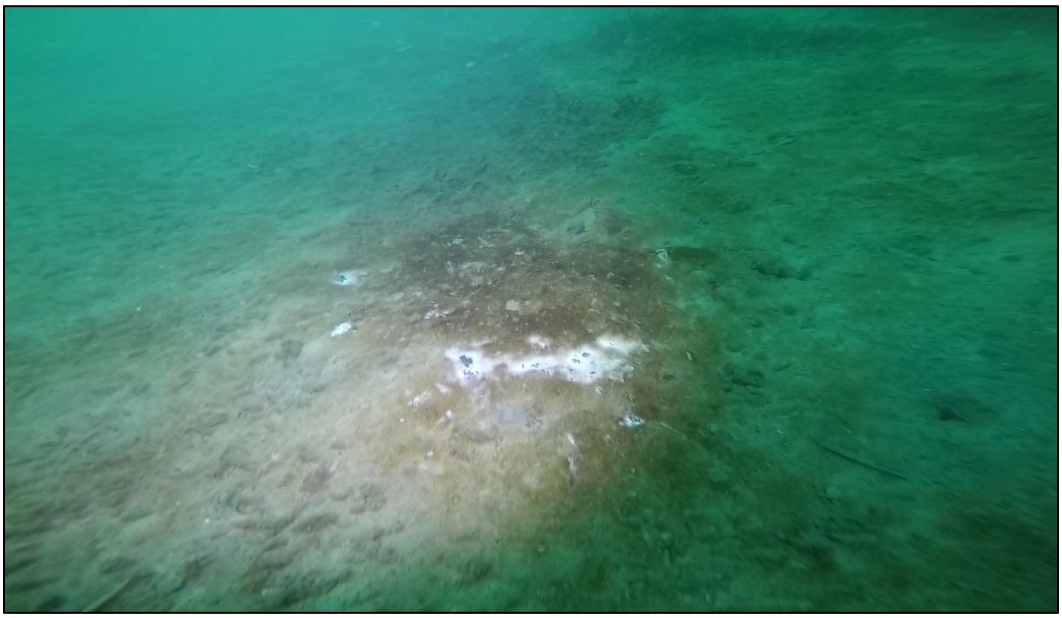
Benthic invertebrate sampling (n=5) conducted in December 2019 using 0.4 m cores found few to no benthic infaunal marine life in areas high in wood chips in the northeast by the deep water dock, and silty sediments containing fine wood debris just north of the Ro-Ro.

Photograph 20: Sediment core taken in 2019 to assess sediment composition and benthic infauna.



Photograph 21: Typical subtidal south of access dock consisting of silt with sand intermixed with fine woody debris with cover of diatoms and sparse infaunal mounds.

Photograph 22: Close-up of subtidal silt intermixed with fine woody debris from legacy operations at the Site.



Photograph 23: White bacteria (*Beggiatoa* sp.) growing in sand and silt with fine wood particulate and sparse cobble substrate in the shallow subtidal.

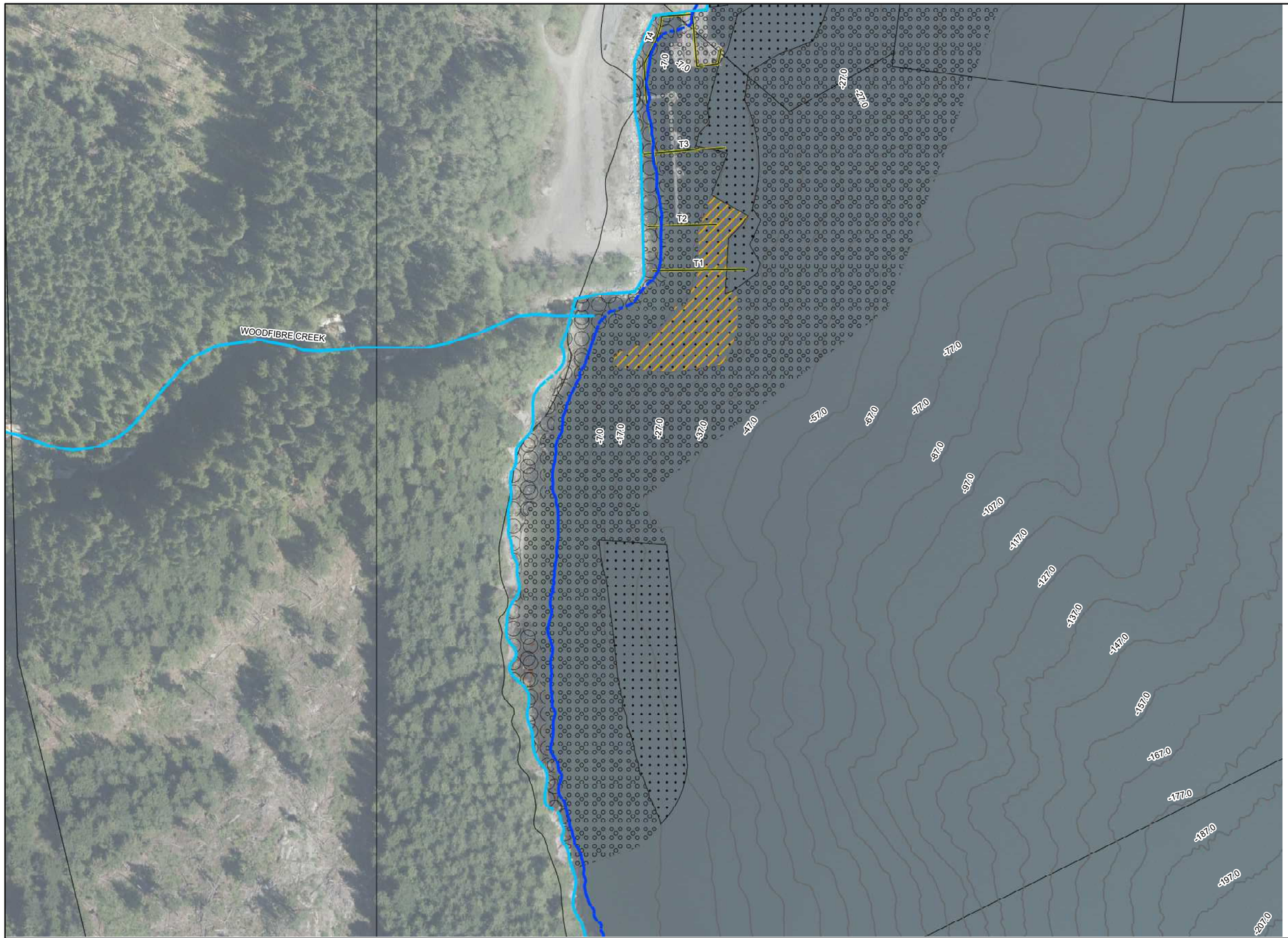
Photograph 24: White bacteria, striped perch and rare laminarian kelps within the shallow subtidal zone near the Ro-Ro. Kelp abundance is likely limited by the relative lack of stable hard substrate for attachment.

Photograph 25: Riprap toe showing diatoms and sugar kelp growth in shallow subtidal, December 2019.

Photograph 26: Sugar kelp growing on a cobble patch within the CPA.

Photograph 27: Mottled star observed on cobble.

Photograph 28: Aẏx (Dungeness crab) presence wood waste covered silt (Hemmera 2015)



LEGEND

- LOT LINES & WATER LOT
- MARINE HIGHER HIGH WATER LINE (HHWL)
- 0.0m CD LOW WATER MARK (LWM)
- CREEK
- TRANSECT (KEYSTONE ENVIRONMNETAL MAY 2019)
- CONTOUR (METRES CHART DATUM)
- BEDROCK
- COBBLE/GRAVEL
- RIPRAP
- SOFT SEDIMENT
- WOODWASTE/SILT

Keystone Environmental

NOTES:
1. *THIS DRAWING IS FOR GENERAL INFORMATION ONLY. LOT BOUNDARIES AND FEATURES ARE APPROXIMATE.*
2. *DATE OF AERIAL PHOTO IS 2016.*
3. *CONTOUR ELEVATION IS IN CHART DATUM (CD).*

Data collected from:
-Keystone Environmental Ltd. 2019 Dive Surveys at Woodfibre, Squamish, BC. Data Collected for Woodfibre. May 2019
-Hemmera. 2016. Figure 1 - Benthic Habitat Survey Summary Report. Prepared for Woodfibre LNG. September 2015
-Golder Associates Ltd. 2014. Marine Resources Baseline Study. Prepared for Woodfibre LNG. October 2014

25 0 100 m

SCALE: 1:2,000 (approx.)

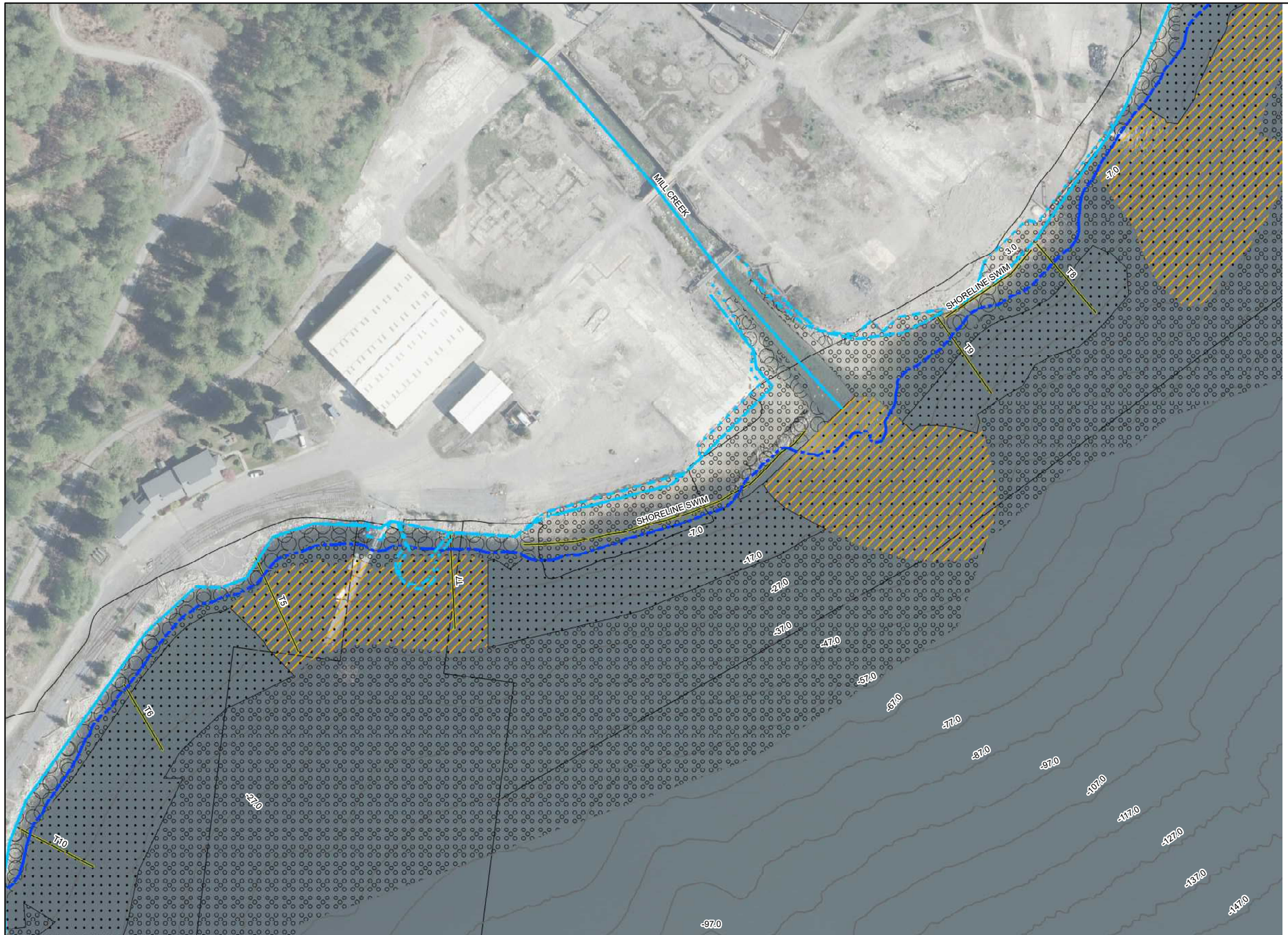
Woodfibre
Squamish, B C
Woodfibre LNG Limited

REVISION No.	DATE	PROJECT No.
00	Jan. 2023	17227-100

Figure 6-3A

Habitat Substrate Feature
(Southwest of Mill Creek)

DRAWN BY: CY Document Path: \\key-fs2012\Common\0-GIS\1-Projects\1-WLNG\GIS_CADD\17227\00100\2022_10Oct_07__DFO_FA_Authorization\Fig5-1A-HabitatSubstrate-South-R0.mxd



N

LEGEND

- LOT LINES & WATER LOT
- MARINE HIGHER HIGH WATER LINE (HHWL)
- 0.0m CD LOW WATER MARK (LWM)
- CREEK
- TRANSECT (KEYSTONE ENVIRONMNETAL MAY 2019)
- CONTOUR (METRES CHART DATUM)
- COBBLE/GRAVEL
- RIPRAP
- SOFT SEDIMENT
- WOODWASTE/SILT

Keystone Environmental

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25 0 100 m

SCALE: 1:2,000 (approx.)

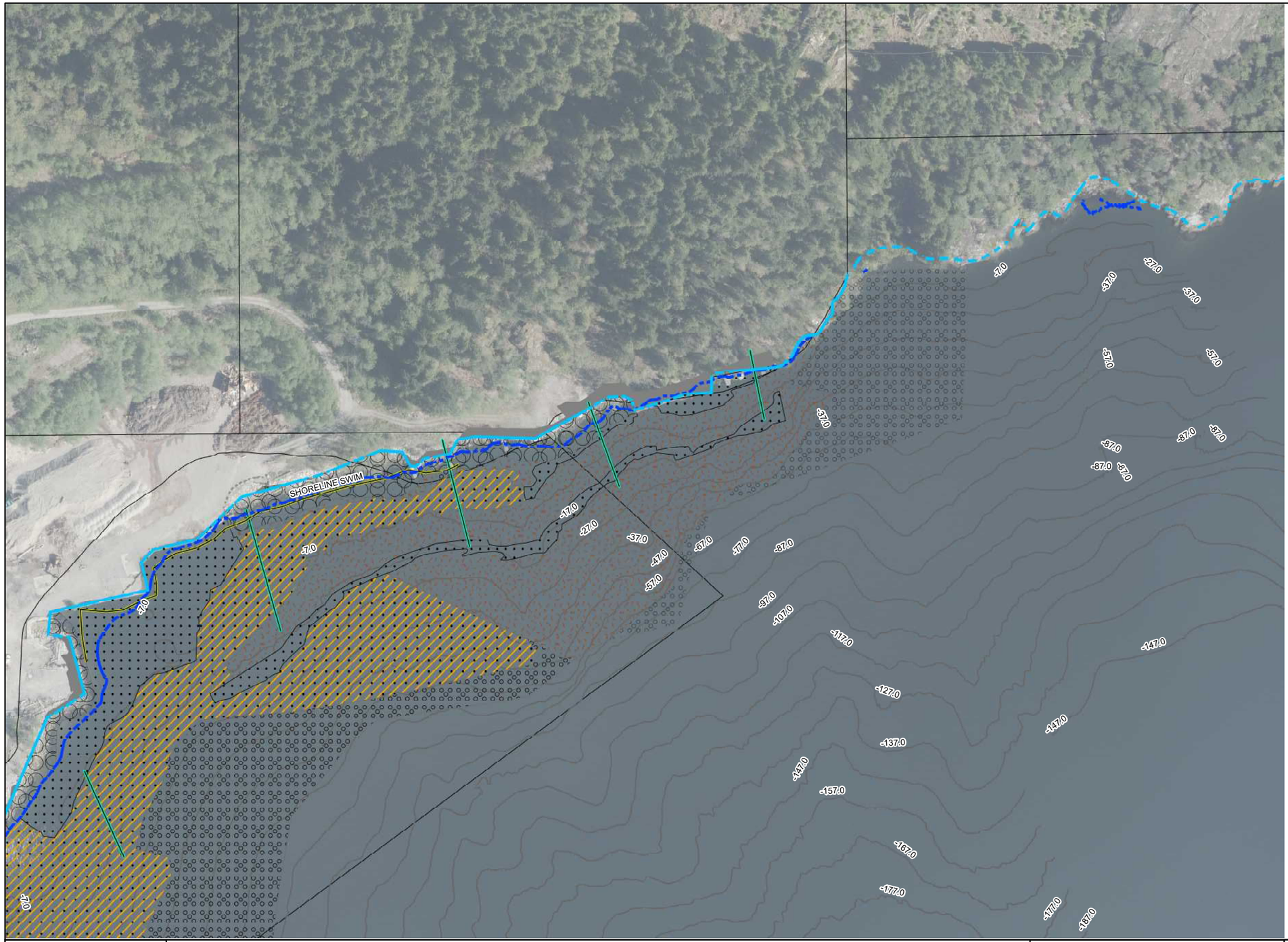
Woodfibre
Squamish, B C
Woodfibre LNG Limited

REVISION No.	DATE	PROJECT No.
00	Jan. 2023	17227-100

Figure 6-3B

Habitat Substrate Feature
(Central Mill Creek)

DRAWN BY: CY Document Path: \\key-fs2012\Common\0-GIS\1-Projects\1-WLNG\GIS_CADD\17227\00100\2022_10Oct_07__DFO_FA_Authorization\Fig5-1B-HabitatSubstrate-Central-R0.mxd



N

LEGEND

- LOT LINES & WATER LOT
- MARINE HIGHER HIGH WATER LINE (HHWL)
- 0.0m CD LOW WATER MARK (LWM)
- TRANSECTS (HEMMERA, 2016)
- TRANSECT (KEYSTONE ENVIRONMNETAL MAY 2019)
- CONTOUR (METRES CHART DATUM)
- BEDROCK
- COBBLE/GRAVEL
- RIPRAP
- SOFT SEDIMENT
- WOODWASTE/SILT
- UPLAND INDUSTRIAL

Keystone Environmental

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- *Golder Associates Ltd. 2014. Marine Resources Baseline Study. Prepared for Woodfibre LNG. October 2014*

25 0 100 m

SCALE: 1:2,000 (approx.)

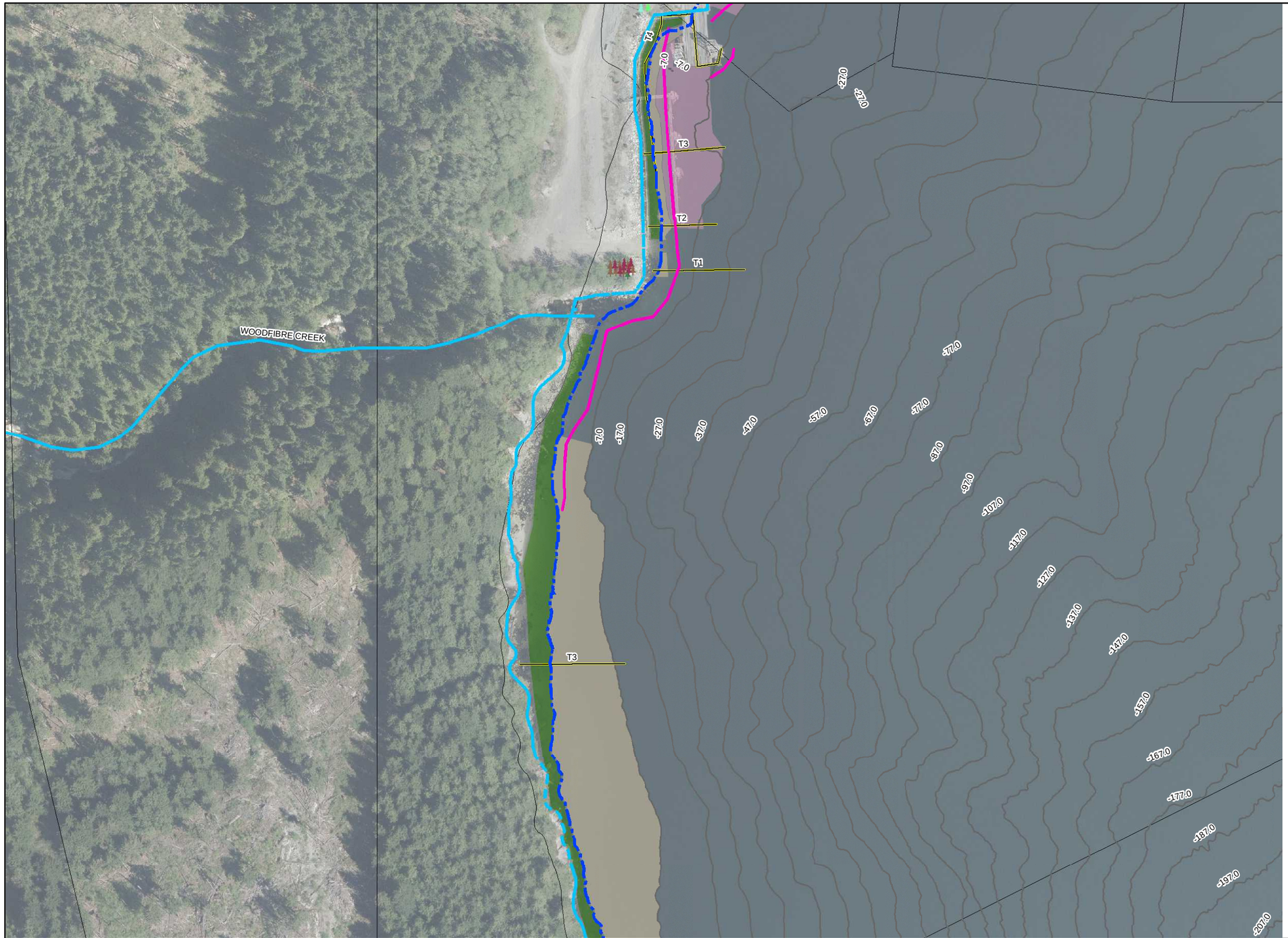
Woodfibre
Squamish, B C
Woodfibre LNG Limited

REVISION No.	DATE	PROJECT No.
00	Jan. 2023	17227-100

Figure 6-3C

Habitat Substrate Feature
(Northwest of Mill Creek)

DRAWN BY: CY Document Path: \\key-fs2012\Common\0-GIS\1-Projects\1-WLNG\GIS_CADD\17227\00100\2022_10Oct_07__DFO_FA_Authorization\Fig5-1C-HabitatSubstrate-North-R0.mxd



N

LEGEND

- LOT LINES & WATER LOT
- LINGCOD EGG MASSES
- MARINE HIGHER HIGH WATER LINE (HHWL)
- 0.0m CD LOW WATER MARK (LWM)
- CREEK
- HISTORIC HERRING EGG OBSERVATIONS
- TRANSECT (KEYSTONE ENVIRONMNETAL 2019)
- CONTOUR (METRES CHART DATUM)
- SPARSE DIATOMS
- GREEN STRING LETTUCE
- SEA LETTUCE, LAMANARIAN KELP AND DIATOMS
- ROCKWEED

VEGETATION

- ALDER
- APPLE
- CEDAR
- COTTONWOOD
- SALMONBERRY

Keystone Environmental

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-Golder Associates Ltd. 2014. Marine Resources Baseline Study. Prepared for Woodfibre LNG. October 2014

25 0 100 m

SCALE: 1:2,000 (approx.)

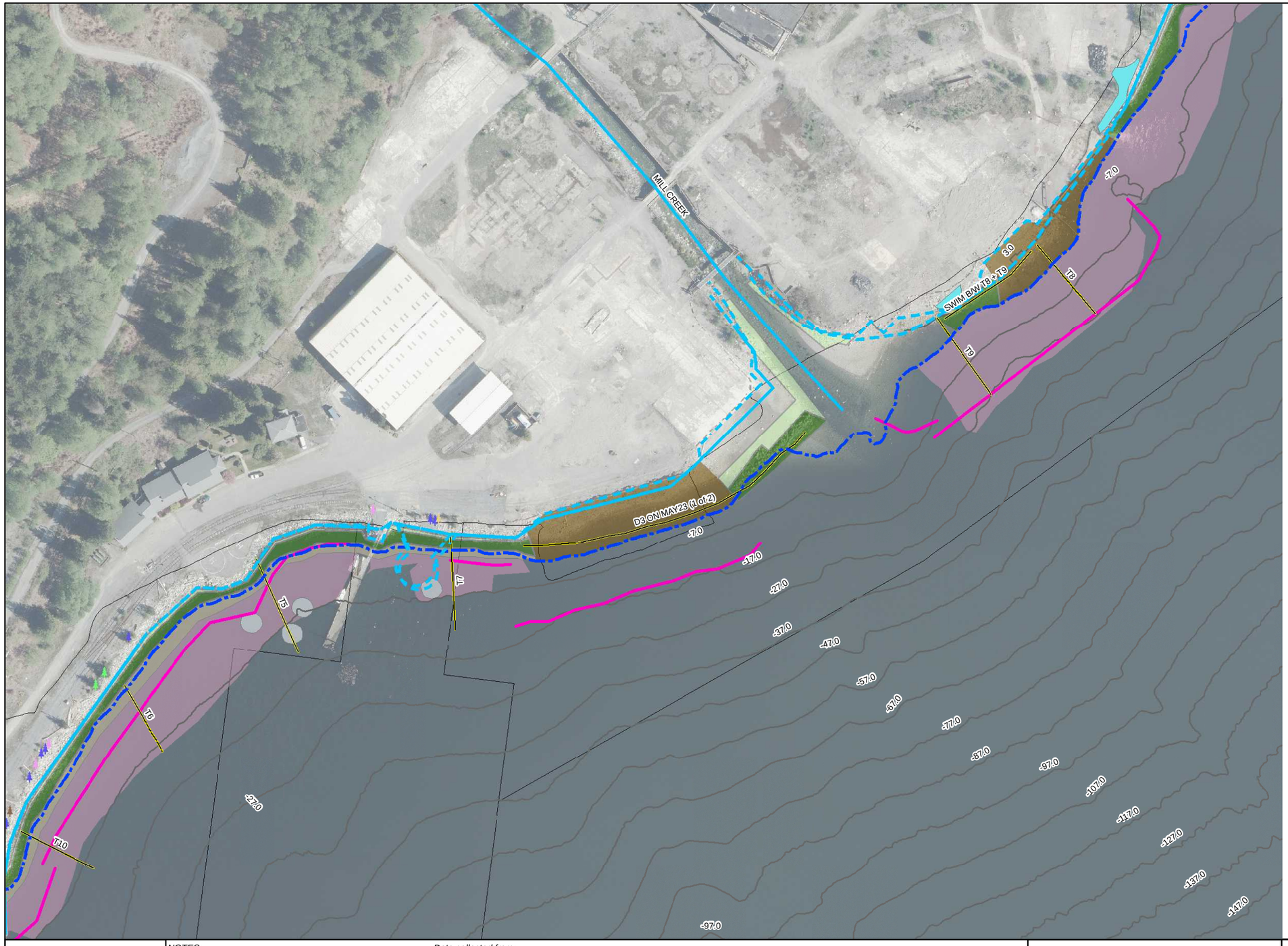
Woodfibre
Squamish, B C
Woodfibre LNG Limited

REVISION No.	DATE	PROJECT No.
00	Jan. 2023	17227-100

Figure 6-4A

Marine Vegetation and Fish Observations
(Southwest of Mill Creek)

DRAWN BY: CY Document Path: \\key-fs2012\Common\0-GIS\1-Projects\1-WLNG\GIS_CADD\17227\00100\2022_10Oct_07__DFO_FA_Authorization\Fig5-2A-MarineVegetationFish-South-R0.mxd



N

LEGEND

- LOT LINES & WATER LOT
- MARINE HIGHER HIGH WATER LINE (HHWL)
- 0.0m CD LOW WATER MARK (LWM)
- CREEK
- HISTORIC HERRING EGG OBSERVATIONS
- TRANSECT (KEYSTONE ENVIRONMNETAL MAY 2019)
- CONTOUR (METRES CHART DATUM)
- BEGGIATOA BACTORIA
- SPARSE DIATOMS
- GREEN STRING LETTUCE
- SEA LETTUCE, LAMANARIAN KELP AND DIATOMS
- ROCK WEED AND SPARSE ULVA
- ROCKWEED

VEGETATION

- ALDER
- CEDAR
- FIR
- KNOTWEED
- NOBLE FIR
- SCOTCH BROOM

Keystone Environmental

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-Hemmera. 2016. Figure 1 - Benthic Habitat Survey Summary Report. Prepared for Woodfibre LNG. September 2015
-Golder Associates Ltd. 2014. Marine Resources Baseline Study. Prepared for Woodfibre LNG. October 2014

25 0 100 m

SCALE: 1:2,000 (approx.)

Woodfibre
Squamish, B C
Woodfibre LNG Limited

REVISION No.	DATE	PROJECT No.
00	Jan. 2023	17227-100

Figure 6-4B

Habitat Substrate Feature
(Central Mill Creek)

DRAWN BY: CY Document Path: \\key-fs2012\Common\0-GIS\1-Projects\1-WLNG\GIS_CADD\17227\00100\2022_10Oct_07__DFO_FA_Authorization\Fig5-2B-MarineVegetationFish-Central-R0.mxd

N

LEGEND

- LOT LINES & WATER LOT
- MARINE HIGHER HIGH WATER LINE (HHWL)
- 0.0m CD LOW WATER MARK (LWM)
- HISTORIC HERRING EGG OBSERVATIONS
- TRANSECT (KEYSTONE ENVIRONMNETAL MAY 2019)
- TRANSECTS (HEMMERA, 2016)
- CONTOUR (METRES CHART DATUM)
- SPARSE DIATOMS
- GREEN STRING LETTUCE
- SEA LETTUCE, LAMANARIAN KELP AND
- ROCKWEED
- LINGCOD EGG MASSES

VEGETATION

- ALDER
- COTTONWOOD
- SCOTCH BROOM
- VEGETATED, INACCESSIBLE (NO TREES)

Keystone Environmental

NOTES:
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3. CONTOUR ELEVATION IS IN CHART DATUM (CD).

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-Hemmera. 2016. Figure 1 - Benthic Habitat Survey Summary Report. Prepared for Woodfibre LNG. September 2015
-Golder Associates Ltd. 2014. Marine Resources Baseline Study. Prepared for Woodfibre LNG. October 2014

25 0 100 m

SCALE: 1:2,000 (approx.)

Woodfibre
Squamish, B C
Woodfibre LNG Limited

REVISION No.	DATE	PROJECT No.
00	Jan. 2023	17227-100

Figure 6-4C

Habitat Substrate Feature
(Northwest of Mill Creek)

DRAWN BY: CY Document Path: \\key-fs2012\Common\0-GIS\1-Projects\1-WLNG\GIS_CADD\17227\00100\2022_10Oct_07__DFO_FA_Authorization\Fig5-2C-MarineVegetationFish-North-R0.mxd

6.2.3 Sediment Existing Conditions

This section will be superseded by a stand-alone Marine Fish Baseline Report in 2024

As part of the environmental assessment, seasonal field studies were conducted to characterize existing conditions within the CPA (eight stations) and comparison areas outside the CPA (two stations) in July and September 2013, and April to June 2014 (Golder Associates, 2014). Samples were analyzed for particle size, nutrients and anions, metals, acid volatile sulphides (AVS) and simultaneously extracted metals (SEM), polychlorinated biphenyls (PCBs), total organic carbon (TOC), moisture content, light and heavy extractable petroleum hydrocarbon (LEPH/HEPH) and PAH, and dioxins and furans. Baseline sediment quality data showed elevated concentrations of metals (arsenic, cadmium, copper, and zinc), PAHs, PCB, and dioxin and furans, when compared to the CCME and Interim Sediment Quality Guidelines (ISQG). Highest levels of metals were found 400 m east of Mill Creek, but all locations had elevated copper. PAHs were highest below Mill Creek, and slightly lower 400 m to the east, and even lower southwest of Mill Creek.

Historical dredging was completed during the past decade (2013) to remove wood waste and sediments containing very high concentrations of metal concentrations. Based on Human Health and Ecological Risk Assessments summarized in this document, unacceptable risks to humans consuming fish and shellfish within the Woodfibre water lot were no longer present. Risk management specific to recommendations to prohibit fishing and crabbing within the waterpot are not required; however, mitigation measures, Ínexwantas (monitoring), and adaptive management to protect marine water quality during construction, as outlined in this document are required as part of conditions of the environmental assessment certificate, federal decision statement, and consultation with skwxwú7mesh Úxwumixw (Squamish Nation).

6.3 Fish and Fish Habitat

This section will be superseded by a stand-alone Marine Fish Baseline Report in 2024

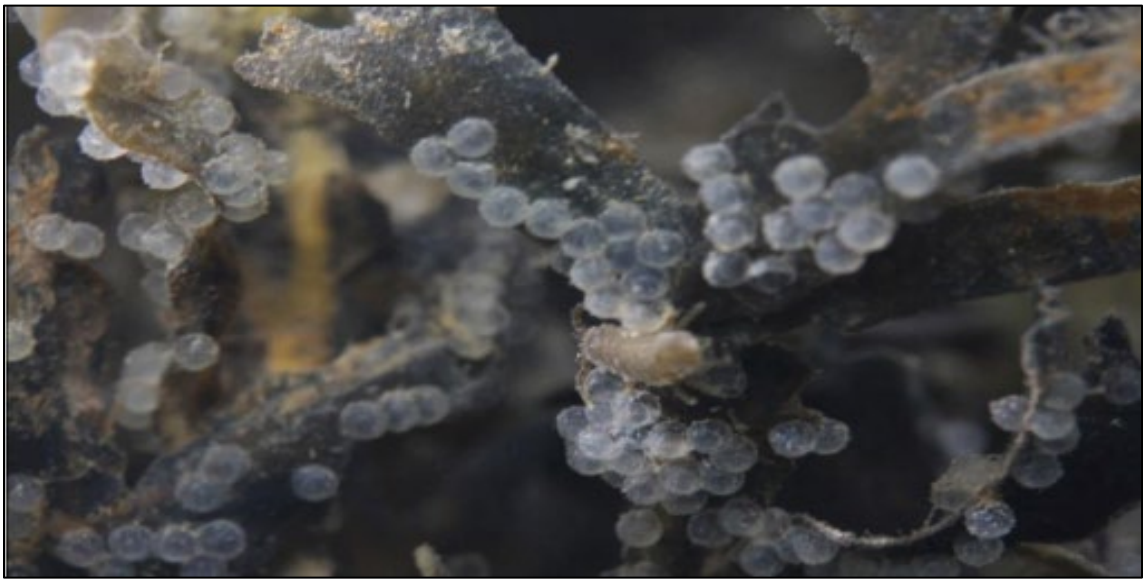
The following fish were observed on or adjacent to the Woodfibre LNG site:

- Pacific salmon: chum (*Oncorhynchus keta*), tsáẇin (coho) (*O. kisutch*), Kwu7s (Chinook; *O. tshawytscha*), lháwichen (pink; *O. gorbuscha*);
- Trout: rainbow/steelhead (*O. mykiss*), cutthroat (*O. clarkii*);
- Char: Tl'ítl'elxiws (Dolly Varden) (*Salvelinus malma*);
- Forage fish: Pacific slhawt' (herring) (*Clupea palasii*), surf smelt (*Hypomesus pretiosus*), sand lance (*Ammodytes hexapterus*);
- Other fish: lingcod (*Ophiodon elongatus*), sculpin (various species within *Cottoidae*), blackbelly eelpout (*L. pacifica*), gobies (Gobiidae), northern ronquil (*Ronquilus jordani*), élhk̲aẏ̓ (snake) prickleback (*Lumpenus sagitta*), slender sole (*L. exilis*), rock sole (*L. bilineata*), gray starsnout poacher (*B. alascana*), gunnels (*Pholidae*), striped perch (*E. lateralis*), shiner perch (*C. aggregate*), pile perch (*R. vacca*), white-spotted greenling (*H. stelleri*), speckled sanddab (*C. stigmaeus*), and Pacific sanddab (*C. sordidus*).

Surf smelt and sand lance have not been observed spawning within the CPA; however, slhawt' (herring) spawn has been documented within the CPA boundaries. Dive surveys for the presence of slhawt' (herring) were conducted by Hemmera in 2015, 2016, and 2019 and spawn was observed on timber piles, sheet piles and rockweed. Approximate slhawt' (herring) spawn and egg masses locations are shown in **Figure 6-4A, Figure 6-4B** and **Figure 6-4C**. While timber piles provide a secure structure ideal for egg growth, the creosote coating used to preserve the piles is known to negatively affect embryonic development. An experiment conducted by Vines et al. (2000), revealed that creosote pilings resulted in a 90% reduction in Pacific slhawt' (herring) hatching rates. This correlation has been attributed to polycyclic aromatic hydrocarbons (PAHs) comprising 80% of creosote's composition (Basok et al. 2019). This is supported by Hemmera (2015 and 2016b), whereby eggs were known to have a low success rate on creosote treated piles. Within the CPA, most of the eggs observed on the piles were opaque (**Photograph 30**), indicating low viability. The timber piles and most of the marine infrastructure within the intertidal and subtidal zones were removed between August 2018 and January 31, 2019. In 2019 only light slhawt' (herring) spawn was observed on rockweed along the riprap shoreline (**Photograph 31**) south of the site access dock (Hemmera 2019). Slhawt' (herring) spawn was not observed in the CPA in 2020 or 2022 (Keystone Environmental 2020, 2022). In 2021, herring spawn was found within the southwest corner of the CPA along an approximately 50 m stretch of shoreline and continuing south outside of the CPA (Keystone Environmental 2021). The spawn consisted of a patchy distribution, not more than one layer thick attached to rockweed on intertidal bedrock.

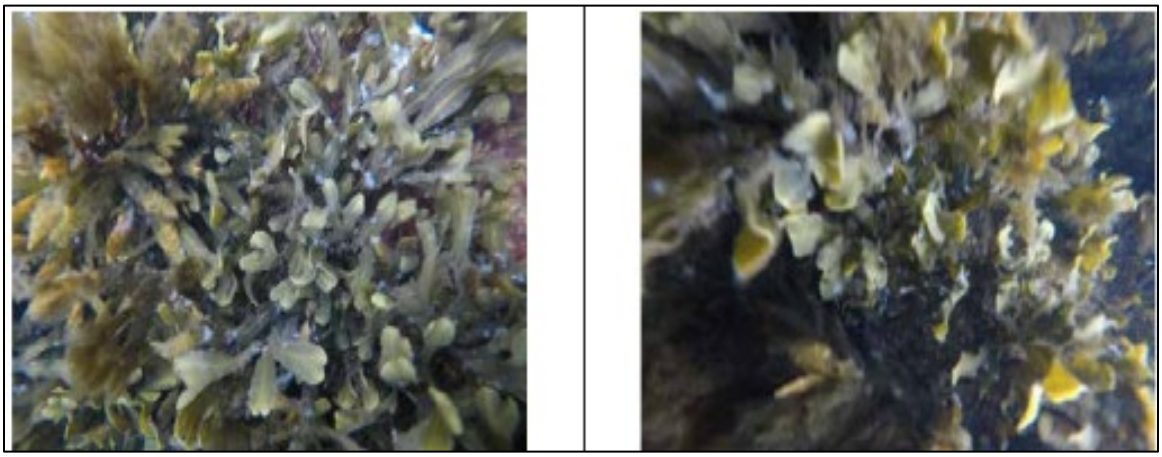
Mill Creek and Woodfibre Creek provide freshwater input to the marine environment of the CPA and act as spawning areas for salmonids. Sḵiẇx (Rainbow trout), tl'ítl'elxiws (Dolly Varden), *Cottus aleuticus* (coast-range sculpin), Tsáẇin (chum salmon), lháwichen (pink) salmon, and Kwu7s (Chinook salmon) have been documented in Mill Creek. In Woodfibre Creek there have been documented sightings of both rainbow and coastal cutthroat trout. Pacific salmon have limited spawning opportunities in either of Woodfibre Creek or Mill Creek, as the creeks have been highly modified in lower reaches and possess a number of barriers to upstream passage (e.g., falls, dams, boulder drops, high water velocities). At the head of Howe Sound, Sḵwx̱wú7mesh Stakw (Squamish River) and its tributaries support runs of coho, chum, Kwu7s (Chinook), and lháwichen (pink) salmon, including anadromous steelhead, cutthroat trout, bull trout and tl'ítl'elxiws (Dolly Varden). Juveniles of these species may migrate past the Woodfibre shoreline toward the open shḵweṅ (ocean) and may intermittently seek shelter amongst boulders and beneath marine structures during the spring and early summer.

Subtidal and intertidal marine habitat within the CPA may serve as feeding, migratory, and spawning habitat for other marine fish species such as, gunnel, sculpin, perch, greenling, eelpout and several species of flatfish observed during dive surveys in 2015, 2016, 2019, 2020, 2021, and 2022. For example, lingcod egg masses (**Photograph 32**) were observed amongst boulder substrate during 2015, 2016 and 2019 slhawt' (herring) dive surveys along the northeast side of the CPA (Hemmera 2015, 2016a, 2019). Moreover, Marine Stewardship Initiative (MSI) conducted a snorkel survey on March 21, 2021 near the Woodfibre site (MSI 2021). In 2021, herring spawn was observed from the southern mouth of Woodfibre Creek running south along the shoreline (MSI 2021). In 2022, the survey was conducted on March 26, 2022 where a big spawn event was noted from Foulger Creek reaching down to Woodfibre Creek (MSI 2022).



Photograph 29: Pacific herring eggs observed on rockweed (Hemmera 2015)

Photograph 30: Pacific herring eggs observed on timber pile (Hemmera 2016b)



Photograph 31: A light covering of Pacific herring eggs observed on rockweed (Hemmera 2019)

Photograph 32: Lingcod egg mass observed amongst boulders in northeast CPA (Hemmera 2016b)

Ínexwantas (monitoring) of fish presence along the shoreline within the CPA is used to assess juvenile salmon and forage fish access through the CPA, upstream (east) and downstream (west) of the proposed marine FST terminal, MOF and Mill Creek. Predetermined locations were sampled and recorded in the field using a handheld GPS. Minor adjustments to the locations were made in consideration of suitability for beach seining, which includes safe access, suitable space for fish retention and enumeration, and avoidance of potential obstructions to the seine net. The sample locations for marine fish and fish habitat sampling are summarized in **Table 6-3** and shown in **Figure 6-1.**

Table 6-3 Seine Sample Locations for 2020-2022

Site ID	Site Location Description	Latitude Longitude	Timing
SR-BS	Beach Seine South Reference (Outside CPA)	49° 39.190'N 123° 15.540'W	Late February and mid-September
SR-P	Purse Seine South Reference (Outside CPA)	49° 39.196'N 123° 15.482'W	Late February and mid-September
1-BS	Beach Seine South of Woodfibre Creek	49° 39.630'N 123° 15.550'W	Late February and mid-September
1-P	Purse Seine South of Woodfibre Creek	49° 39.600'N 123° 15.479'W	Late February and mid-September
2-BS	Beach Seine South of Mill Creek	49° 39.895'N 123° 15.191'W	Late February to March and mid-September Ju
2-P	Purse Seine South of Mill Creek	49° 39.815'N 123° 15.303'W	Late February to March and mid-September
3-BS	Beach Seine North of Mill Creek	49° 39.943'N 123° 15.078'W	Late February to March and mid-September
3-P	Purse Seine North of Mill Creek	49° 39.897'N 123° 15.016'W	Late February to March and mid- September
4-BS	Beach Seine Barge Ramp	49° 40.023'N 123° 14.988'W	Late February to March and mid-September
4-P	Purse Seine Barge Ramp	49° 40.046'N 123° 14.643'W	Late February to March and mid-September
5-BS	Beach Seine South of Mill Creek – Additional Site (2022)	49° 39.870'N 123° 15.338'W	Late March and mid-June to early July
5-P	Purse Seine South of Mill Creek – Additional Site (2022)	49° 39.721'N 123° 15.353'W	Late March and mid-June to early July
NR-BS	Beach Seine North Reference (Outside CPA)	49° 40.176'N 123° 14.237'W	Late February to March and mid-September
NR-P	Purse Seine North Reference (Outside CPA)	49° 40.141'N 123° 14.247'W	Late February to March and mid-September
AR-BS	Beach Seine Area Reference (Squamish Estuary, Outside CPA)	49° 40.940'N 123° 11.889'W	March and mid-June to early July
AR-P	Purse Seine Area Reference (Squamish Estuary, Outside CPA)	49° 40.909'N 123° 11.894'W	March and mid-June to early July

6.3.1 2020 Marine Fish Surveys

This section will be superseded by a stand-alone Marine Fish Baseline Report in 2024

6.3.1.1 Beach Seine

In May and September 2020, fish presence surveys were completed using beach seines at four locations within the CPA (1-BS, 2-BS, 3-BS, 4-BS) and two locations outside the CPA (SR-BS, NR-BS). Sample site location information is provided in **Table 6-3.**

Over the two-day sample effort in May 2020, fifty-one salmonid smolts were caught (**Table 6-4**). Salmonids were caught at each of the six sites sampled within and outside the CPA. Most sites had fewer than two or three salmonids. SR-BS. NR-BS had the largest catches of salmonids with 14 and 28, respectively. Coho (*O. kisutch*) were the most abundant salmonid (42) overall with fewer numbers of Kwu7s (Chinook; *O. tshawytscha*) (78), chum (*O. keta*) (1) and rainbow/steelhead trout (*O. mykiss)* (1) (**Photograph 33, Photograph 34**). Both tsáẇin (coho) and Kwu7s (Chinook) were significantly larger at the sites outside the CPA, indicating a different cohort.

Results indicate juvenile salmonids (i.e., tsáẇin (coho) and Kwu7s (Chinook)) are present and likely move through the entire Site and outside the CPA in late spring.

Fewer salmonids (3 in total) were caught during September 2020 compared to May 2020. Salmonids caught consisted of one larger tsáẇin (coho) at SR-BC, one rainbow/steelhead trout at 2-BS, and one tl'ítl'elxiws (Dolly Varden) char (*Salvelinus malma)* at 1-BS (**Table 6-4 and Table 6-5, Photograph 35, Photograph 36**). Juvenile salmonids likely move off the Site by fall. Most fish caught in September were forage fish.

Northern anchovy (*Engraulis mordax*) was the most abundant fish caught as post-larval young of the year in both May and September 2020. Slhawt' (herring) or spawning activity were not observed in the spring of 2020; however, sampling may have been late for this species. Results indicate forage fish use the Site and are found outside the CPA through the spring and summer. Based on the surveys conducted over the two days of sampling, the observed fish abundance (i.e., total number of individuals) and species richness (i.e., number of species observed) was low for sample locations within the CPA in both seasons. Sample sites outside the CPA in the spring had highest numbers of juvenile salmonids and forage fish (northern anchovy); although 10–15 juvenile salmonids tsáẇin (coho) and Kwu7s (Chinook)) were observed evading the seine at 3-BS on May 13, 2020 (Keystone 2020). Fish health appeared normal, with no observed lesions, abnormalities, or parasites.

Table 6-4 Fish Presence May 2020 Summary

Species	1-BS	2-BS	3-BS	4-BS	Mean	FL[3]	SR-BS	NR-BS	Mean	FL
Kwu7s (Chinook)	1	0	1	1	**0.8**	**48.0± 12.7**	0	4	**2.0**	**108.6 ±29.8**
Coho	0	1	2	1	**1.0**	**46.2± 12.1**	14	24	**19.0**	**82.3± 13.0**
Chum	0	0	1	0	**0.3**	**38.0**	0	0	**0.0**	**0.0**

Species	1-BS	2-BS	3-BS	4-BS	Mean	FL[3]	SR-BS	NR-BS	Mean	FL
Rainbow / Steelhead Trout	0	0	0	1	**0.0**	**0.0**	0	0	**0.0**	**0.0**
Tl'ítl'elxiws (Dolly Varden)	0	0	0	0	**0.0**	**0.0**	0	0	**0.0**	**0.0**
Pacific Slhawt' (herring)	0	0	0	0	**0.0**	**0.0**	0	0	**0.0**	**0.0**
Northern Anchovy	0	0	69	22	**22.8**	**27.2± 3.5**	310	372	**341.0**	**30.4± 5.3**
Other Forage Fish	0	0	16	0	**4.0**	**NA[4]**	4	1	**2.5**	**NA[4]**
Total	**1**	**1**	**89**	**25**	**29.0**		**328**	**401**	**364.5**	
Richness[5]	**1**	**1**	**5**	**4**	**2.8**		**3**	**4**	**3.5**	

Table 6-5 Fish Presence September 2020 Summary

Species	1-BS	2-BS	3-BS	4-BS	Mean	FL	SR-BS	NR-BS	Mean	FL
Kwu7s (Chinook)	0	0	0	0	**0.0**	**-**	0	0	**0.0**	**-**
Coho	0	0	0	0	**0.0**	**-**	1	0	**0.5**	**115.0**
Chum	0	0	0	0	**0.0**	**-**	0	0	**0.0**	**-**
Rainbow/Steelhead Trout	0	1	0	0	**0.3**	**211.0**	0	0	**0.0**	**-**
Tl'ítl'elxiws (Dolly Varden)	1	0	0	0	**0.3**	**325.0**	0	0	**0.0**	**-**
Pacific Slhawt' (herring)	2	0	0	0	**0.5**	**97.0± 4.2**	0	0	**0.0**	**-**
Northern Anchovy	14	5	0	6	**6.3**	**34.2± 2.0**	35	13	**24.0**	**33.4± 11.4**
Other Forage Fish	9	12	2	10	**8.3**	**NA**	1	4	**2.5**	**NA[3]**
Total	**26**	**18**	**2**	**16**	**15.5**	**-**	**37**	**17**	**27.0**	**-**
Richness	**4**	**3**	**1**	**2**	**2.5**	**-**	**3**	**2**	**2.5**	**-**

Photograph 33: Coho from 4-BS in May 2020.

Photograph 34: Chinook smolt caught at NR-BS site in May 2020.

Photograph 35: Rainbow/steelhead trout caught at 2-BS in September 2020.

Photograph 36: Dolly Varden char caught at 1-BS in September 2020.

6.3.2 2021 Marine Fisheries Data

This section will be superseded by a stand-alone Marine Fish Baseline Report in 2024

6.3.2.1 Beach Seine

In April and July 2021, additional fish presence surveys were completed using beach seines at four locations within the CPA (1-BS, 2-BS, 3-BS, 4-BS) and two locations outside the CPA (SR-BS, NR-BS). Sample site location information is provided in **Table 6-3**.

Over the two-day beach seine sample effort in April 2021, 853 salmonids were caught (**Table 6-6)**. Fish were caught at each of the six sites sampled. Outside the CPA, SR-BS and the NR-BS had catches of salmonids with 654 and 52 individuals caught, respectively. Within the CPA, 131 salmonids were caught at 4-BS, and fewer than ten salmonids were caught per site at 1-BS, 2-BS and 3-BS.

Chum (*O. keta*) were the only salmonid (853) caught. Results indicate juvenile salmonids are present within and outside the CPA and likely move through the entire Site in the spring.

Over the two-day beach seine sample effort in July 2021, 36 salmonids were caught (**Table 6-7**). Salmonids were caught at each of the sample locations within and outside the CPA.

Fewer than ten salmonids were caught at each of 1-BS, 2-BS and 3-BS. 4-BS had the largest catch of salmonids, with a total of 21 tsáẃin (coho) caught. Most of the salmonids caught during the July sampling were coho, with one Kwu7s (Chinook) caught at NR-BS, and one chum caught at SR-BS. The results indicate that salmonids move through the Site and outside the CPA primarily in spring. Mostly chum salmon were found to move through the site in spring, whereas mostly tsáẃin (coho salmon) were found in summer.

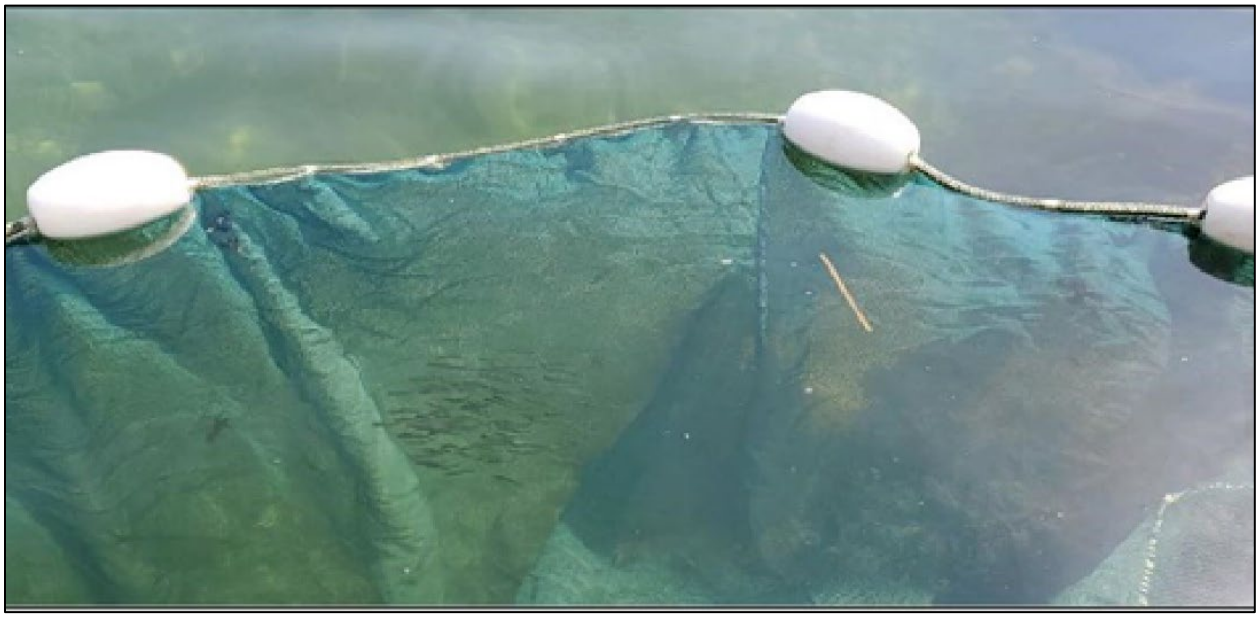
Table 6-6 Fish Presence April 2021 Summary

Site/Spp	1-BS	2-BS	3-BS	4-BS	Mean	FL	SR-BS	NR-BS	Mean / Site	FL
Kwu7s (Chinook)	0	0	0	0	0.00	0.0	0	0	0.0	0.0

Site/Spp	1-BS	2-BS	3-BS	4-BS	Mean	FL	SR-BS	NR-BS	Mean / Site	FL
Coho	0	0	0	0	0.00	0.0	0	0	0.0	0.0
Chum	3	4	9	131	36.8	36.0± 0.6	654	52	353.0	36.1± 0.4
Rainbow/ Steelhead Trout	0	0	0	0	0.00	0.0	0	0	0.0	0.0
Tl'ítl'elxiws (Dolly Varden)	0	0	0	0	0.00	0.0	0	0	0.0	0.0
Pacific Slhawt' (herring)	0	0	0	0	0.00	0.0	0	91	45.5	31.7± 1.6
Northern Anchovy	0	0	0	0	0.00	0.0	0	0	0.0	0.0
Other Forage Fish	1	1	0	0	0.50	NA	0	1	0.5	NA
Total	**4**	**5**	**9**	**131**	**37.3**		**654**	**144**	**399.0**	
Richness	**2**	**2**	**1**	**1**	**1.5**		**1**	**3**	**2**	

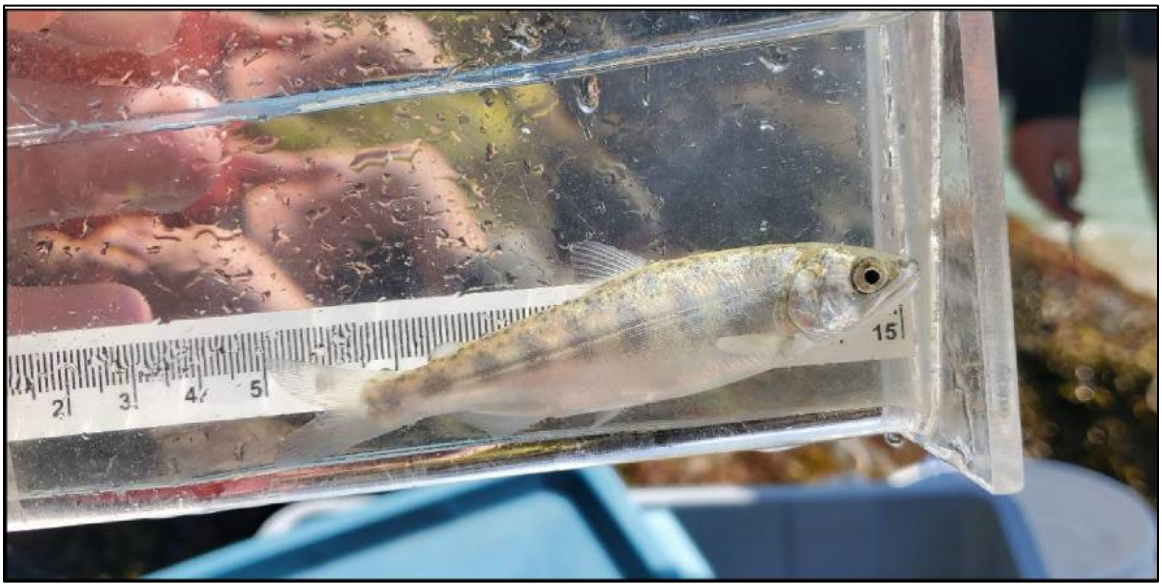
Table 6-7 Fish Presence July 2021 Summary

Site/Spp	1-BS	2-BS	3-BS	4-BS	Mean	FL	SR-BS	NR-BS	Mean / Site	FL
Kwu7s (Chinook)	0	0	0	0	0.0	0.0	0	1	1.0	91.0
Coho	3	6	1	21	7.8	62.0 ± 3.3	0	3	2.0	65.0± 3.3
Chum	0	0	0	0	0.0	0.0	1	0	0.5	76.0
Rainbow/ Steelhead Trout	0	0	0	0	0.0	0.0	0	0	0.0	0.0
Dolly Varden	0	0	0	0	0.0	0.0	0	0	0.0	0.0
Pacific Slhawt' (herring)	0	0	0	0	0.0	0.0	0	0	0.0	0.0
Northern Anchovy	0	0	0	0	0.0	0.0	0	0	0.0	0.0
Other Forage Fish	16	3	2	12	8.0	NA	1	3	0.0	NA
Total	**19**	**9**	**3**	**32**	**15.8**		**2**	**7**	**4.5**	
Richness	**7**	**2**	**3**	**4**	**4.0**		**2**	**3**	**3.0**	

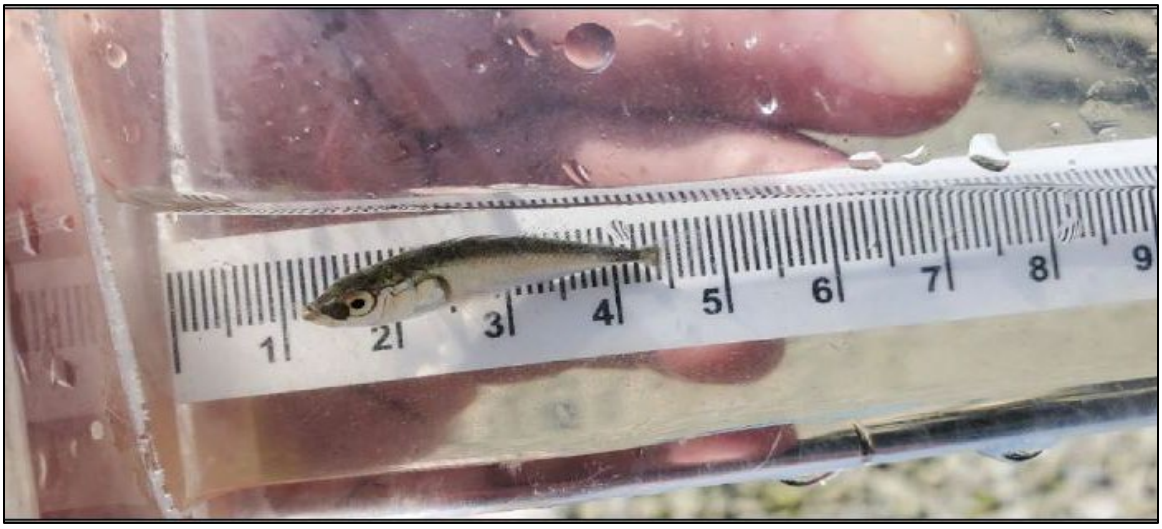


Photograph 37: Schooling juvenile chum salmon at 4-BS during the April 2021 sampling.

Photograph 38: Juvenile chum salmon caught at SR-BS during the April 2021 sampling.



Photograph 39: Juvenile Chinook salmon caught at NR-BS during the July 2021 sampling.



Photograph 40: Three spine stickleback caught at 1-BS during the July 2021 sampling.

6.3.2.2 Purse Seine

Over the two-day purse seine sample effort in May 2021, a total of one salmonid was caught (**Table 6-8**). A juvenile tsáw̓in (coho; *O. kisutch*) was caught at NR-BS. Results indicate a low usage of the offshore CPA by salmonids in spring.

Over the two-day purse seine sample effort in July, four juvenile tsáw̓in (coho) and four juvenile Kwu7s (Chinook) were caught at sites within the CPA, 1-BS, 3-BS and 4-BS (**Table 6-9**). Results indicate a low usage of the offshore CPA by salmonids in summer.

Table 6-8 Fish Presence May 2021 Summary

Species	Site									
	1-P	2-P	3-P	4-P	Mean/ Site	FL	SR-P	NR-P	Mean/ Site	FL
Kwu7s (Chinook)	0	0	0	0	0.0	0.0	0	0	0.0	0.0
Coho	0	0	0	0	0.0	0.0	0	1	0.5	95.0
Chum	0	0	0	0	0.0	0.00	0	0	0.0	0.0
Rainbow / Steelhead Trout	0	0	0	0	0.0	0.0	0	0	0.0	0.0
Tl'itl'elxiws (Dolly	0	0	0	0	0.0	0.0	0	0	0.0	0.0
Pacific Slhawt' (herring)	0	0	0	1	0.3	162.0	0	9	4.5	159.3± 4.8
Northern Anchovy	0	0	0	0	0.0	0.0	0	0	0.0	0.0
Other Forage Fish	0	0	0	0	0.0	NA	0	0	0.0	NA
Total	**0**	**0**	**0**	**1**	**0.3**		**0**	**10**	**5.0**	
Richness	**0**	**0**	**0**	**1**	**0.3**		**0**	**2**	**1.0**	

Table 6-9 Fish Presence July 2021 Summary

Species	Site									
	1-P	2-P	3-P	4-P	Mean/ Site	FL	SR-P	NR-P	Mean /Site	FL
Kwu7s (Chinook)	2	0	2	0	1.0	114.8± 25.7	0	0	0.0	0.00
Coho	0	0	1	3	1.0	74.0± 3.0	0	1	0.5	106.0
Chum	0	0	0	0	0.0	0.0	0	0	0.0	0.0
Rainbow / Steelhead Trout	0	0	0	0	0.0	0.0	0	0	0.0	0.0
Tl'itl'elxiws (Dolly	0	0	0	0	0.0	0.0	0	0	0.0	0.0
Pacific Slhawt' (herring)	1	0	1	11	3.3	117.2± 3.5	0	2	1.0	127.5± 7.5
Northern Anchovy	0	0	0	0	0.00	0.0	0	0	0.0	0.0
Other Forage Fish	0	1	0	0	0.3	NA	0	0	0.0	NA
Total	**3**	**1**	**4**	**14**	**5.5**		**0**	**3**	**1.5**	
Richness	**2**	**1**	**3**	**2**	**2.0**		**0**	**2**	**1.0**	

6.3.3 2022 Marine Fisheries Data

This section will be superseded by a stand-alone Marine Fish Baseline Report in 2024

6.3.3.1 Beach Seine

Summaries of species captured during the beach seining sampling events in early March, late March, June and July 2022 are provided in **Table 6-10** through **Table 6-13** below. Overall, fish abundance (i.e., total number of individuals) was higher in spring compared to summer. In the spring, sites outside the CPA (SR-P, NR-P, AR-P) had highest numbers of juvenile salmonids and forage fish. Species richness (i.e., number of species observed) was low within the CPA and outside the CPA in both seasons, with the exception of 1-P in June 2022, where species richness was higher with several forage fish species and juvenile tsáw̓in (coho salmon) were caught. Fish health appeared normal, with no observed lesions, abnormalities, or parasites (Keystone Environmental, 2023).

Over the two-day sample effort in early March 2022, 21 salmonids were caught (**Table 6-10**). Fish were caught at six of the seven sites sampled. One salmonid was caught at each of 1-P, 3-P and SR-P, two salmonids were caught at 4-P. NR-P and AR-P had the largest catches of salmonids with 9 and 7 individuals caught, respectively. Zero salmonid were caught at 2-P.

Chum (*O. keta*) comprised 11 of the salmonids caught (**Photograph 41**) and lháwichen (pink; *O. gorbuscha*) comprised 10 of the salmonids caught (**Photograph 42**). Results indicate juvenile salmonids (i.e., chum and lháwichen (pink)) are present and likely move through the entire Site and outside the CPA in the spring.

Over the three-day sample effort in late March, 140 salmonids were caught (**Table 6-10**). Salmonids were caught at 1-BS, SR-BS, NR-BS and AR-BS. One salmonid was caught at 1-BS and NR-BS, 7 salmonids were caught at AR-BS and 131 were caught at SR-BS (**Photograph 43**). Most salmonids caught during the March 28, 29, 31 sampling were chum (118), the remaining 22 salmonids were lháwichen (pink) (**Photograph 44**), caught at SR-BS and AR-BS. The results indicate that juvenile salmonids are present, with mostly chum salmon moving through the site in spring.

Over the two-day sample effort in June 2022 a total of 38 salmonids were captured (**Table 6-11**). 1-BS had the greatest number of salmonid captures with 22, including 17 chum salmon. Chum salmon were found within the CPA at 1-BS, 4-BS and 5-BS, and outside the CPA at SR-BS, NR-BS and AR-BS. Tsáw̓in (coho) were found at 1-BS and 5-BS, and kwu7s (Chinook) were found at 1-BS, 5-BS and AR-BS.

Over the two-day sample effort in July 2022 a total of 19 salmonids were captured (**Table 6-13**). AR-BS yielded the largest number of captures, with 6 chum and 1 kwu7s (Chinook) salmon. 5-BS yielded 5 kwu7s (Chinook) captures. Salmonids were captured within the CPA at 1-BS, 2-BS and 5-BS as well as outside the CPA at SR-BS, NR-BS and AR-BS.

Forage fish were found at all sampling sites in 2022. A variety of different forage fish were captured including prickly sculpin (**Photograph 45**)**,** one bay pipefish (**Photograph 46**), two starry finder (**Photograph 47**), and 22 fluffy sculpin.

Table 6-10 Fish Presence March 3 and 4, 2022 Summary

Species	Site											
	1-BS	2-BS	3-BS	4-BS	Mean/Site	FL	SR-BS	NR-BS	AR-BS	Mean/Site	FL	Total
Kwu7s (Chinook)	0	0	0	0	0	0	0	0	0	0	0	0
Coho	0	0	0	0	0	0	0	0	0	0	0	0
Lháwichen (pink)	0	0	0	1	0.25	39	1	6	2	4.5	34.67± 0.53	10
Chum	1	0	1	1	0.75	36.67± 2.19	0	3	5	4	39.63± 1.51	11
Rainbow/ Steelhead Trout	0	0	0	0	0	0	0	0	0	0	0	0
Tl'ítl'elxiws (Dolly Varden)	0	0	0	0	0	0	0	0	0	0	0	0
Pacific Slhawt' (herring)	0	0	0	0	0	0	0	0	0	0		0
Northern Anchovy	0	0	0	0	0	0	0	0	0	0	0	0
Other Forage Fish	1	4	0	2	1.75	N/A	5	2	15	11	N/A	29
Total	**2**	**4**	**1**	**4**	**2.75**		**6**	**11**	**22**	**8.5**		**50**
Richness	**2**	**1**	**1**	**3**	**1.75**		**2**	**3**	**3**	**2.5**		

Table 6-11 Fish Presence March 28, 29 and 31, 2022 Summary

Species	Site												
	1-BS	2-BS	3-BS	4-BS	5-BS	Mean /Site	FL	SR-BS	NR-BS	AR-BS	Mean/ Site	FL	Total
Lháwichen (pink)	0	0	0	0	0	0	0	20	0	2	7.3	32.79± 0.68	22
Chum	1	0	0	0	0	0.17	38	111	1	5	39	36± 0.65	118
Clupeidae	0	0	0	0	0	0	0	0	4	0	1.3	26±2.09	4
Other Forage Fish	19	2	0	1	4	4.33	N/A	3	1	15	6.3	N/A	45
Total	**20**	**2**	**0**	**1**	**4**	**4.5**		**134**	**6**	**22**	**54**		**189**
Richness	**5**	**1**	**0**	**1**	**2**	**1.5**		**4**	**3**	**3**	**3.3**		

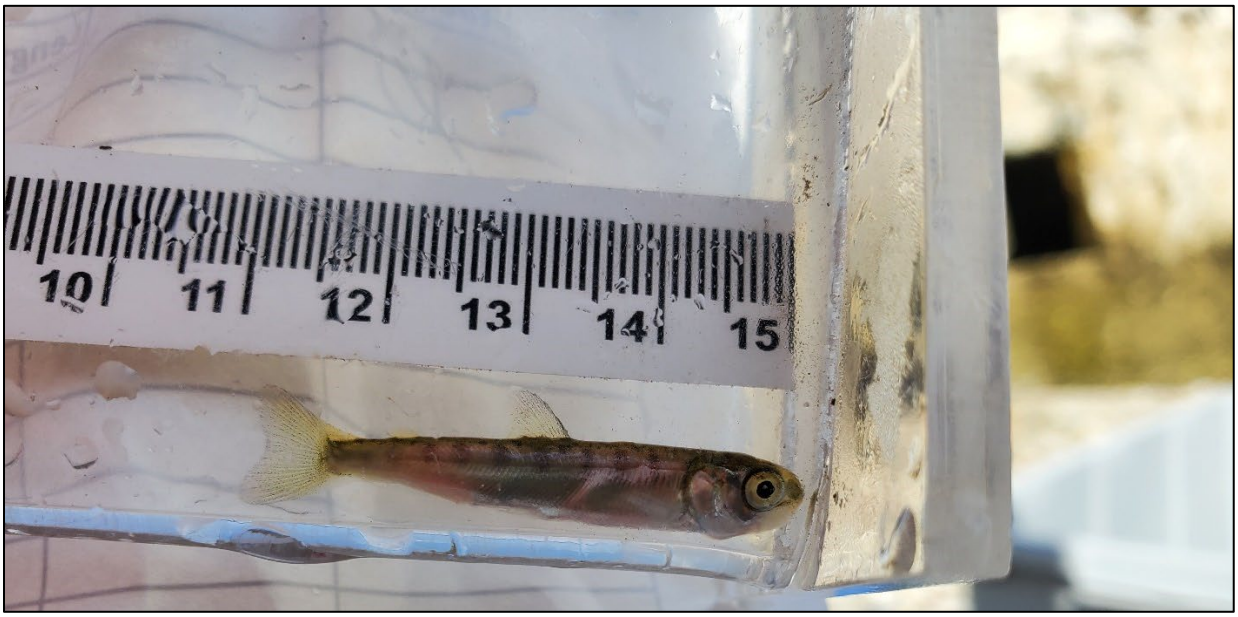
Table 6-12 Fish Presence June 23 and 24, 2022 Summary

Species	Site												
	1-BS	2-BS	3-BS	4-BS	5-BS	Mean/ Site	FL	SR-BS	NR-BS	AR-BS	Mean/ Site	FL	Total
Chum	17	0	0	2	1	4	52.9 ± 1.75	1	2	1	1.3	59.25 ± 6.75	24
Coho	1	0	0	0	1	0.4	39.50 ± 0.50	0	0	0	0		2
Kwu7s (Chinook)	4	0	0	0	1	1	64.00 ± 6.95	0	0	7	2.3	80.43 ± 2.94	12
Three Spine Stickleback	1	1	0	0	0	0.4	56.50 ± 4.50	0	0	1	0.3	62.00 ± 0.0	3
Bay Pipefish	0	0	0	1	1	0.4	139.50 ± 5.50	0	0	0	0		2
Saddleback Sculpin	0	0	0	0	1	0.2	32.00 ± 0	0	0	0	0		1
Fluffy Sculpin	1	0	0	1	19	4.2	29.29 ± 0.86	1	0	0	0.3	36.00 ± 0.0	22
Starry Flounder	0	0	0	0	2	0.4	117.50 v 5.50	0	0	0	0		2
Sculpin Spp	13	15	1	1	6	7.2	49.50 ± 4.63	0	0	4	1.3	33.25 ± 33.25	40
Gunnel Spp.	0	0	1	0	0	0.2	112 ± 0.0	0	0	0	0		1
Total	**37**	**16**	**2**	**5**	**32**	**18.4**		**2**	**2**	**13**	**5.7**		**109**
Richness	**6**	**2**	**2**	**4**	**8**	**4.4**		**2**	**1**	**4**	**2.3**		

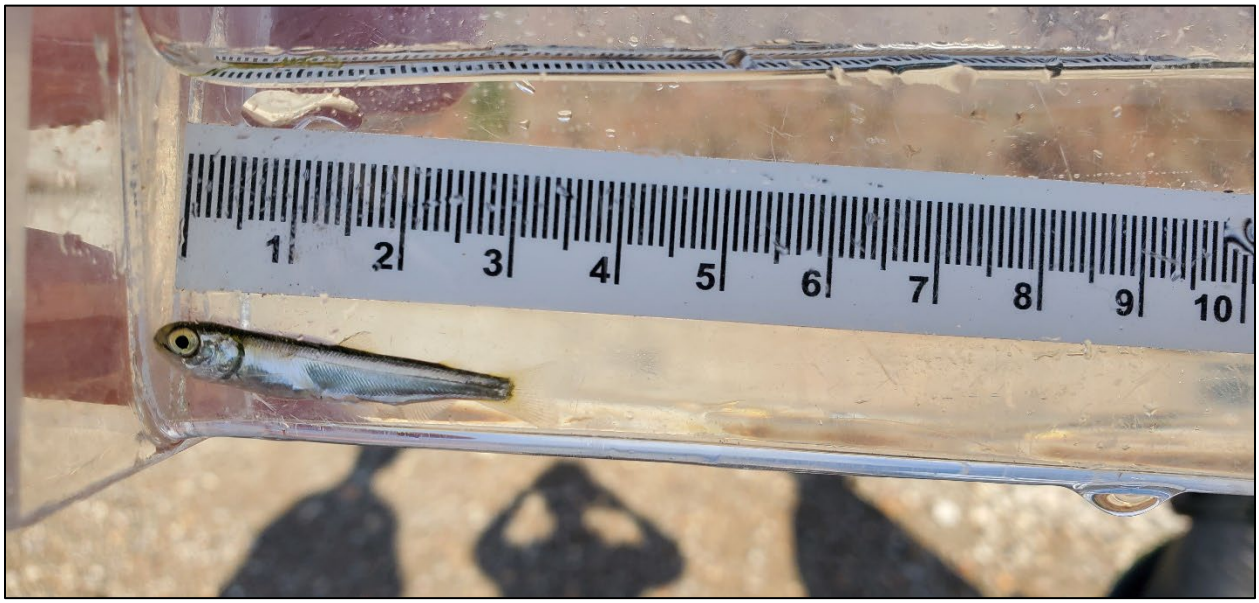
Table 6-13 Fish Presence July 18 and 19, 2022 Summary

Species	Site												
	1-BS	2-BS	3-BS	4-BS	5-BS	Mean/ Site	FL	SR-BS	NR-BS	AR-BS	Mean/ Site	FL	Total
Chum	0	0	0	0	0	0		0	0	6	2	59.27 ± 3.13	6
Coho	0	1	0	0	1	0.4	43.00 ± 6.00	1	2	0	1	68.33 ± 18.00	5
Kwu7s (Chinook)	1	1	0	0	5	1.4	90.86 ± 3.72	0	0	1	0.3	104	8
Three Spine Stickleback	0	0	0	0	0	0		0	0	1	0.3	30	1
Fluffy Sculpin	5	0	2	3	2	2.4	27.92 ± 1.00	0	0	4	1.3	33.00 ± 4.26	16
Sculpin Spp	0	0	0	0	5	1	22.20 ±4.91	0	0	2	0.7	44.50 ± 10.50	7

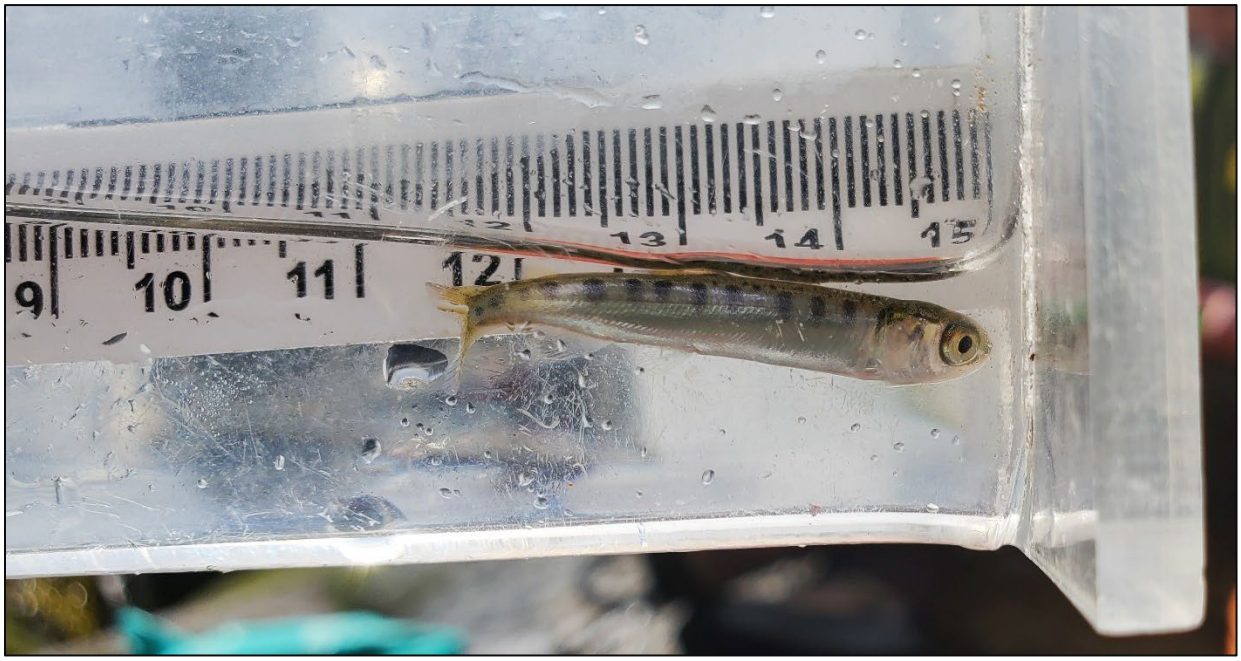
Species	Site												
	1-BS	2-BS	3-BS	4-BS	5-BS	Mean/ Site	FL	SR-BS	NR-BS	AR-BS	Mean/ Site	FL	Total
Prickly Sculpin	2	0	0	0	0	0.4	47.00 ± 1.00	0	0	1	0.3	65	3
Staghorn Sculpin	0	0	0	0	0	0		0	0	1	0.3	179	1
Shiner Perch	0	0	0	0	0	0		3	0	0	1	100.67 ± 6.17	3
Fry Spp.	0	2	0	0	4	1.2	34.83 ± 1.22	8	0	1	3	27.44 ± 2.60	15
Gunnel Spp.	0	0	0	0	1	0.2	45	0	0	0	0		1
Total	**8**	**4**	**2**	**3**	**18**	**7**		**12**	**2**	**17**	**10.3**		**66**
Richness	**3**	**3**	**1**	**1**	**6**	**2.8**		**3**	**1**	**8**	**4**		



Photograph 41: Juvenile chum salmon caught at 3-BS during early March 2022 sampling.

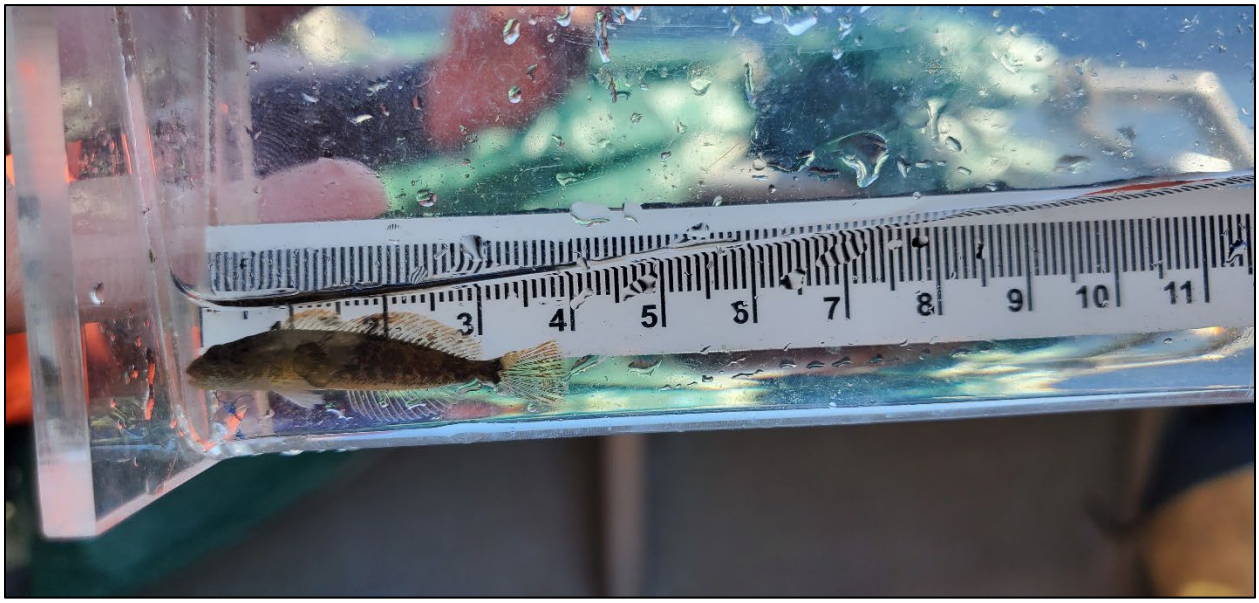


Photograph 42: Juvenile pink salmon caught at 4-BS during early March 2022 sampling.



Photograph 43: Juvenile chum salmon caught at SR-BS during late March 2022 sampling.

Photograph 44: Juvenile pink salmon captured at AR-BS during late March 2022 sampling.



Photograph 45: Prickly sculpin captured at AR-BS during early March 2022 sampling.

Photograph 46: Bay pipefish captured at 5-BS during June 2022 sampling.

Photograph 47: Starry flounder captured at 5-BS during June 2022 sampling.

6.3.3.2 Purse Seine

Summaries of species captured during the spring and summer purse seining are provided in **Table 6-14** through **Table 6-17.** Overall, sts'úkwi7 (fish) abundance (i.e., total number of individuals) and species richness (i.e., number of species observed) was low at all purse seine sample locations in 2022. 4-P had the highest numbers of juvenile salmonids and forage sts'úkwi7 (fish) (including Pacific slhawt' (herring)) during the June sampling.

Over the two-day sample effort in March, zero salmonids were caught (**Table 6-14**). Results indicate a low usage of the offshore CPA by salmonids in spring. A total of 130 forage sts'úkwi7 (fish) were captured at AR-P.

Over the three-day sample effort in late March and early April, 137 salmonids were caught at three of the eight sites. At 1-P, 27 salmonids were caught, consisting of 6 lháwichen (pink) and 21 chum. At 2-P, 98 salmonids were caught consisting of 40 lháwichen (pink) (**Photograph 48**) and 50 chum (**Photograph 49**). At 4-P, 12 salmonids were caught consisting of 7 lháwichen (pink) and 5 chum (**Table 6-15**).

Over the two-day sample effort in June 2022, 8 salmonids were captured, all of which were kwu7s (Chinook) salmon (**Photograph 50**). Kwu7s (Chinook) were most abundant at 1-P, but were also found at 3-P, 5-P, and AR-P (**Table 6-16**). Pacific Slhawt' (herring) were also noted at 1-P, 4-P and 5-P (**Photograph 51**).

Over the 2-day sample effort in July 2022, 9 salmonids were captured, all of which were kwu7s (Chinook) salmon (**Photograph 52**). Kwu7s (Chinook) were most abundant at SR-P but were also found at 2-P, 3-P and NR-P. Pacific slhawt' (herring) were observed at 2-P and 3-P (**Table 6-17, Photograph 53**).

Three-spine stickleback (*Gasterosteus aculeatus*) was the most abundant sts'úkwi7 (fish) caught as post-larval young of the year in 2022. Results indicate that forage sts'úkwi7 (fish) use the Site and are found outside the CPA primarily in spring.

Table 6-14 Fish Presence March 1 and 2, 2022 Summary

Species	Site											
	1-P	2-P	3-P	4-P	Mean/ Site	FL	SR-P	NR-P	AR-P	Mean/ Site	FL	Total
Kwu7s (Chinook)	0	0	0	0	0	0	0	0	0	0	0	0
Coho	0	0	0	0	0	0	0	0	0	0	0	0
Chum	0	0	0	0	0	0	0	0	0	0	0	0
Rainbow/ Steelhead Trout	0	0	0	0	0	0	0	0	0	0	0	0
Tl'ítl'elxiws (Dolly Varden)	0	0	0	0	0	0	0	0	0	0	0	0
Pacific Slhawt' (herring)	0	0	0	0	0	0	0	0	0	0	0	0

Species	Site											
	1-P	2-P	3-P	4-P	Mean/ Site	FL	SR-P	NR-P	AR-P	Mean/ Site	FL	Total
Northern Anchovy	0	0	0	0	0	0	0	0	0	0	0	0
Other Forage Sts'úkwi7 (fish)	0	0	0	0	0	NA	1	0	130	65.5	NA	131
Total	**0**	**0**	**0**	**0**	**0**		**1**	**0**	**130**	**65.5**		**131**
Richness	**0**	**0**	**0**	**0**	**0**		**1**	**0**	**1**	**1**		

Table 6-15 Fish Presence March 30, 31 and April 1, 2022 Summary

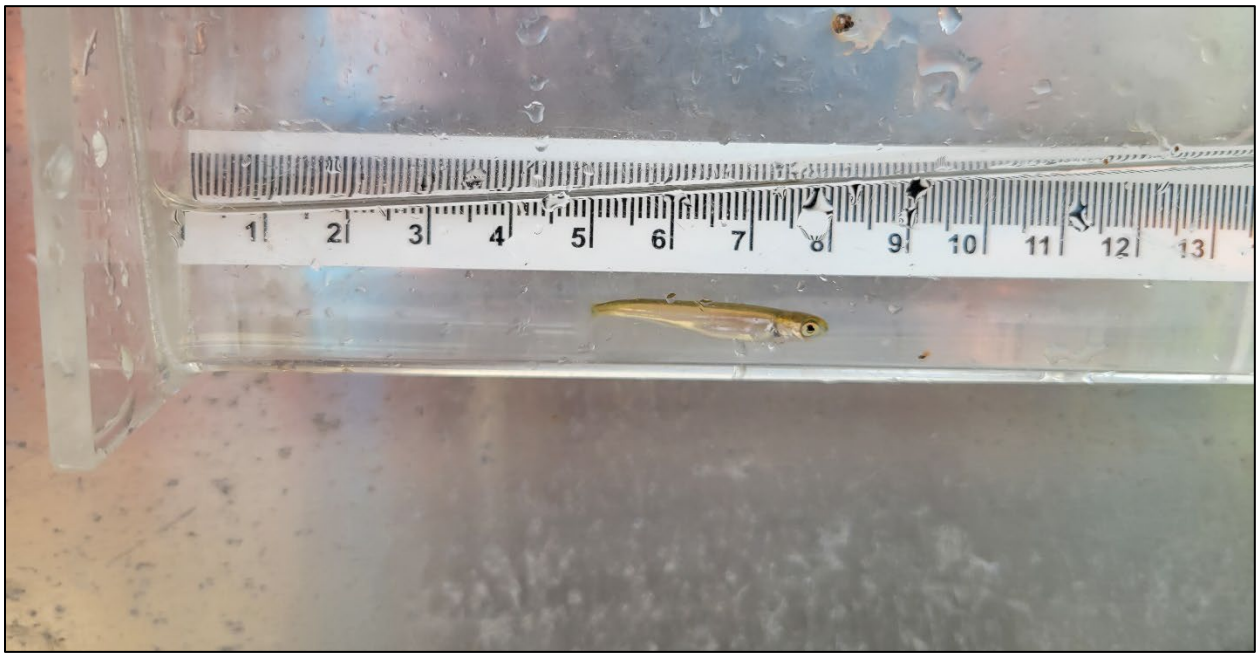
Species	Site											
	1-P	2-P	3-P	4-P	5-P	Mean/ Site	FL	SR-P	NR-P	AR-P	Mean/ Site	FL	Total
Lháwichen (pink)	6	48	0	7	0	12.2	39.24± 0.76	0	0	0	0	NA	61
Chum	21	50	0	5	0	15.2	34.62± 0.57	0	0	0	0	NA	76
Three Spine Stickleback	0	7	0	1	1	1.8	45.56± 1.96	2	0	26	9.3	58.17± 1.95	37
Total	**27**	**105**	**0**	**13**	**1**	**29.2**		**2**	**0**	**26**	**9.3**		**174**
Richness	**2**	**3**	**0**	**3**	**1**	**1.8**		**1**	**0**	**1**	**0.7**		

Table 6-16 Fish Presence from June 27 and 28, 2022 Summary

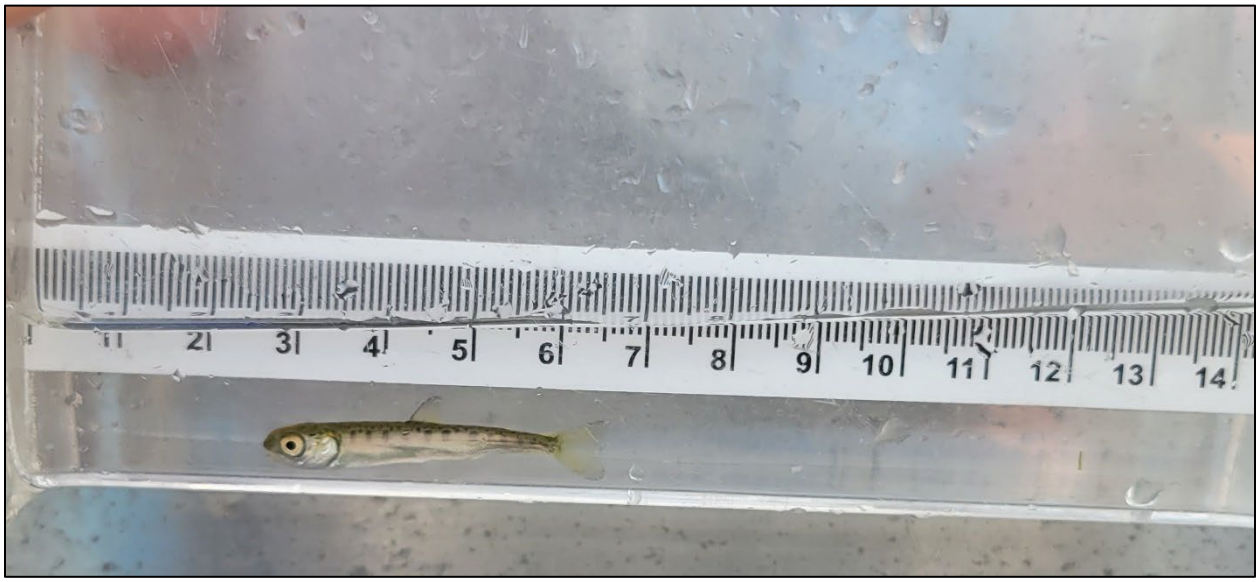
Species	Site												
	1-P	2-P	3-P	4-P	5-P	Mean/ Site	FL	SR-P	NR-P	AR-P	Mean/ Site	FL	Total
Kwu7s (Chinook)	4	0	1	0	1	1.2	90.17 ± 3.43	0	0	2	0.7	71.00 ± 28.99	8
Three Spine Stickleback	0	0	0	0	1	0.2	67.00 ± 0.0	0	0	2	0.7	38.00 ± 0.0	3
Pacific Slhawt' (herring)	1	0	0	7	3	2.2	118.09 ± 13.16	0	3	1	1.3	156.00 ± 35.49	15
Sculpin Spp	13	15	1	1	1	6.2	38.00 ± 15.51	0	0	0	0		31
Total	**18**	**15**	**2**	**8**	**6**	**9.8**		**0**	**3**	**5**	**2.7**		**57**
Richness	**3**	**1**	**2**	**2**	**4**	**2.4**		**0**	**1**	**3**	**1.3**		

Table 6-17 Fish Presence from July 20 and 21, 2022 Summary

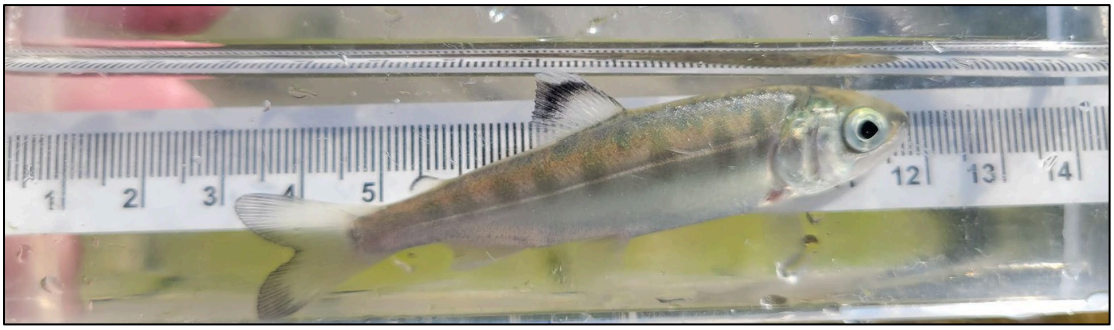
Species	Site												
	1-P	2-P	3-P	4-P	5-P	Mean/ Site	FL	SR-P	NR-P	AR-P	Mean/ Site	FL	Total
Kwu7s (Chinook)	0	2	2	0	0	0.8	97.00 ± 12.05	3	2	0	1.7	96.40 ± 6.99	9
Pacific Slhawt' (herring)	0	55	3	0	0	11.6	137.35 ± 2.45	0	0	0	0	NA	58
Total	**0**	**57**	**5**	**0**	**0**	**12.4**		**3**	**2**	**0**	**1.7**		**67**
Richness	**0**	**2**	**2**	**0**	**0**	**0.8**		**1**	**1**	**0**	**0.7**		



Photograph 48: Juvenile pink salmon caught at 2-P on March 31, 2022



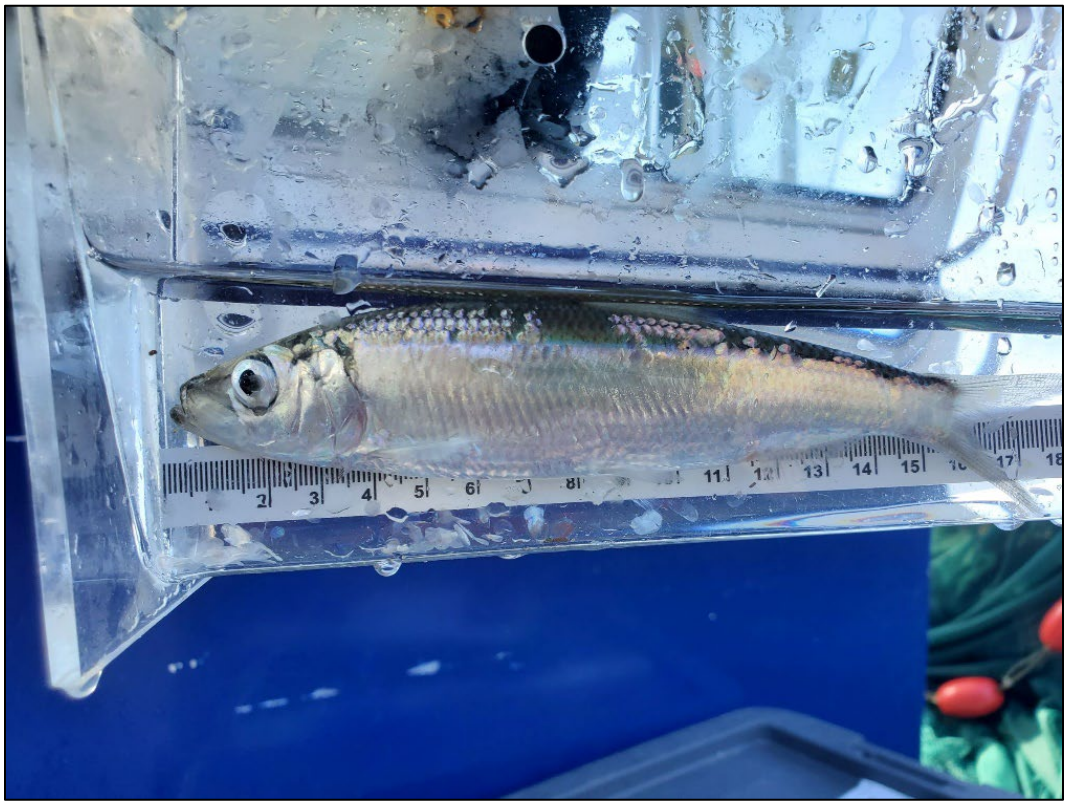
Photograph 49: Juvenile chum salmon caught at 2-P on March 31, 2022.



Photograph 50: Juvenile Chinook salmon captured at 1-P during June 2022 sampling.

Photograph 51: Pacific herring captured at 4-P during June 2022 sampling.

Photograph 52: Juvenile Chinook captured from 2-P during July 2022 sampling.



Photograph 53: Juvenile Herring captured from 2-P during July 2022 sampling.

6.4 Marine Invasive Species

*This section will be **superseded** by a stand-alone Marine Fish Baseline Report in 2024*

No occurrences of marine invasive species have been reported at the Site during the various surveys and studies that have been conducted in the marine environment. **Table 6-18** covers marine invasive species as listed by the IUCN Global Invasive Species Database that are found in BC and may be present in or around the site. If these species are observed on the site at any time, appropriate measures to prevent their propagation to other areas must be taken as stated in the *Ballast Water Management Plan*. These measures will vary by species, as an example, ballast water filtration and sterilization can prevent the spread of invasives such as colonial tunicate.

Data from AIS sampling stations established in 2022 have not yet been analyzed.

Table 6-18 Marine Invasive Species Listed by the IUCN as Having Occurrence Reports in BC (GISD, 2022)

Species	Habitat	Impact	Possible Presence
Asian Hornsnail (*Batillaria attramentaria*)	Commonly found in salt marshes and mud flats.	Outcompetes native species of hornsnail and can carry trematode parasites that harm native species.	Low, habitat on site is not the preferred habitat of this species.
Asian Oyster Drill (*Ceratostoma inornatum*)	Cool waters; not well understood.	This species primarily affects stocked and native oyster populations and can cause ~25% mortality in farmed stocks of oyster.	Low, no oyster beds or shellfish farms are located within or near the site.
Giant Pacific Oyster (*Crassostrea gigas*)	Hard surfaces and sheltered waters in estuaries in the tidal and sub-tidal zones.	C. gigas can settle in dense aggregations and exclude other intertidal species. They can smother other species and contribute to eutrophication.	Low, while there is significant hard substrate available in the CPA, no oysters have been observed during surveys and no suitable estuarine habitat is present.
Colonial Tunicate (*Didemnum* spp.)	Hard substrate in bays harbours and coastal waters. Common from intertidal depths down to 65m.	Primarily a nuisance species that can reproduce rapidly enough to quickly foul ships and marine structures. They will also quickly overgrow and smother other sessile fauna.	Medium, this species is quickly becoming widespread and reproduces rapidly. Much of the substrate in the CPA, including planned structures, provide suitable habitat. Potential for ship-mediated transport/introduction.
Cartilaginous Red Algae (*Gracilaria vermiculophylla*)	Low energy, shallow, near shore waters no colder than 5 °C. Attaches to hard substrate but can tolerate sand and silt.	Inhibits the growth and survival of native algae through competition. Documented negative effects on eelgrass beds (Zostera marina).	Low, while habitat in the CPA is technically suitable, no occurrences of this species have been documented in surveys. This species usually occurs as the dominant if not only algae in a habitat due to its hardy nature and tolerance of a wide range of stressors and environmental conditions.

Species	Habitat	Impact	Possible Presence
Sprengel (*Polysiphonia brodiei*)	Prefers the subtidal zone of near-shore environments. Frequently found on wooden structures, buoys vessels and attached to mussels and other shellfish. Typically associated with ports and harbours.	Causes fouling of slow-moving vessels such as barges as well as fouling on ropes, lines, anchors, and other in-water structures such as docks and wharves.	Medium, this species is suited to the environment in the CPA and the addition of new structures such as the MOF, Floatel and floating storage facility would create ideal conditions for this species.
Atlantic Salmon (*Salmo salar*)	This species is anadromous and prefers the benthopelagic zone of the marine environment. They spend 1-6 years in freshwater before moving to the ocean. They roam over great ranges while foraging in the shx̱weṉ (ocean) before returning to riverine environments.	Negative impacts of this species primarily pertain to finfish aquaculture and their interactions with wild salmon populations. Domestic populations that escape can have negative effects on wild populations by outcompeting them for food, hybridizing with them and spreading diseases such as infectious salmon anaemia (ISA) and parasites such as sea lice (*Caligidae* spp.).	High, this species is becoming more common in BC and is found in many of the same areas as native salmon species. Howe Sound supports a large population of salmonids and *Salmo salar* is likely among them.
Wire Weed (*Sargassum muticum*)	Commonly found on hard substrates in sheltered near-shore waters. This species prefers substrates composed of stones larger than 10cm in diameter, forming dense, monospecific stands.	Large stands of this species can hinder small boats, obstruct water intakes, and foul lines and nets. Their large size and explosive growth can also easily outcompete native species for light including eelgrass (Zostera marina).	Low, habitat in the CPA is not ideal in terms of substrate. Surveys of the area have not shown any signs of this species. When present, it quickly outcompetes native species for light and nutrients and forms dense stands of this one species, excluding all others.
Single Horn Bryozoan (*Schizoporella unicornis*)	Typically occurs on hard substrate in large, flat, shaded areas with adequate water flow. Prefers rocks, docks, hulls, and underwater debris.	Fouling caused by these animals can cause issues for vessels as well as industrial components such as water intakes. This species can exclude or inhibit growth of native bryozoans.	Medium, the habitat in the CPA is somewhat suited to this species with large areas of hard substrate and debris fields. The shading provided by structures such as the Floatel may make the area even more well suited for this species.
European Green Crab (*Carcinus maenus*)	Typically found in shallow waters with vegetated substrate. Common in salt marshes, rocky and sandy shores.	Green Crabs have been found to be highly detrimental to native eelgrass beds and can even destroy them completely with time. The loss of this habitat negatively affects many other species as a result.	Low to medium. The habitat in the majority of the CPA is unsuitable, however there are some areas that might support them. They have not been documented within the CPA during baseline surveys, however their planktonic larva has the potential to travel to the site in ship ballast water.

6.5 Species at Risk

*This section will be **superseded** by a stand-alone Marine Fish Baseline Report in 2024*

A review of the federal and provincial databases produced a list of species at risk that have the potential to use the Site's habitat or surrounding area. A brief description of each species has been provided along with an evaluation on the likelihood that the species will be directly impacted by the proposed work.

Sts'úkwi7 (fish) species listed on Schedule 1 of the *Species at Risk Act* (SARA) are not likely to be present at or near the Site.

- Marine mammals listed on Schedule 1 of the *Species at Risk Act* that have been documented in Nexwnéwu7ts Átlk'a7tsem (Howe Sound) include Skwúmechn (humpback whale), Kwenís (grey whale), Yéwyews (Killer Whale; all ecotypes), Kwexnís (Steller sea lion), and Kw'únut' (harbour porpoise) (BCCSN, 2019; Keple, 2002). There is no identified critical habitat for SARA listed species in northern Nexwnéwu7ts Átlk'a7tsem (Howe Sound) near the Site, nor are there any established haul out sites for seals or sea lions.
- The north Pacific population of skwúmechn (humpback whales; *Megaptera novaeangliae*) spend their summer season (May through October) feeding along the coastal waters and inlets of BC (COSEWIC, 2011). Skwúmechn (humpback whales) in BC forage for a variety of species, including zooplankton (e.g., krill) and small schooling sts'úkwi7 (fish) (e.g., slhawt' (herring)) (DFO, 2013). Skwúmechn (humpback whales) could be present in the nearby waters of the Site.
- Transient and southern resident killer whale populations have both been observed in Nexwnéwu7ts Átlk'a7tsem (Howe Sound) (Keple, 2002). The transient killer whales are mainly mammal specialists (e.g., asxw (harbour seals), porpoises, and sea lions; DFO, 2007), while the resident population feed primarily on sts'úkwi7 (fish) (DFO, 2018). Transient killer whale sightings have been documented within 500 m of the shoreline of the Site.
- Kwexnís (Steller sea lions) feed on a wide variety of prey species (over 50 species of sts'úkwi7 (fish) and invertebrates) in the waters of BC (COSEWIC, 2013). The preferred prey of these species varies on seasonal availability and tends to range from small or medium-sized schooling sts'úkwi7 (fish) (e.g., slhawt' (herring), salmon and sardine) to bottom sts'úkwi7 (fish) (e.g., rockfish) and cephalopods (e.g., squid and octopus) (COSEWIC, 2013). There are no recorded rookeries or haul-out sites of Kwexnís (Steller sea lions) in Nexwnéwu7ts Átlk'a7tsem (Howe Sound) (COSEWIC, 2013).
- Kw'únut' (harbour porpoises) are likely to be present year-round in the inlet waters of BC (DFO, 2009). They feed primarily in shallow waters on cephalopods such as squid and sts'úkwi7 (fish) such as sand lance (DFO, 2009).
- Northern Abalone occurs from the lower intertidal zone to at least 100 m depth. The abalone prefer firm substrate, usually rock, and are generally found in areas of moderate water exchange, such as occurs on exposed or semi-exposed coasts .
- Yellow Rockfish are present in all BC coastal waters. Juveniles and subadults are usually found between 40 – 100 m. Adults generally occur at depths less than 270 m. They prefer substrates that are hard, complex and with some vertical relief. They are opportunistic feeders (GOC 2023).

- Green Sturgeon are distributed along the entire coast of British Columbia. They are rarely encountered in freshwater but will inhabit the brackish waters found at the mouth of large rivers (GOC 2023).
- Rougheye Rockfish Type I and Type II occur along the continental slope and are typically found at depths between 170 and 660 m (GOC 2023). Highest densities of rougheye rockfish occur on the sea floor with soft substrates, in areas with frequent boulders and on slopes greater than 20° (GOC 2023). Rougheye rockfish primarily eat shrimp but will also eat various fish species such as walleye pollock, Pacific herring and eulachon. The principal spawning period off British Columbia is in April (GOC 2023).
- Longspine Thornyhead, in British Columbia this species occurs along the continental slope at depths between 500 and 1,600 m GOC 2023). They prefer soft sand or mud bottoms in deep-water environments characterized by low productivity (slow growth), high pressure, and reduced oxygen concentrations (GOC 2023). Juveniles eat krill; adults target brittle stars and other species found on the ocean bottom. Larger longspine thornyheads regularly prey upon smaller ones GOC 2023).

Table 6-19 summarizes the aquatic species at risk that have the potential to use the habitat or surrounding area (i.e., within 2 km) of the Project.

Table 6-19 Aquatic Species at Risk that have the Potential to Use the Habitat or Surrounding Area (2 km) of the Project

Common Name	Scientific Name	COSEWIC/ SARA Status[2]	Provincial Status	Probability
Yéwyews (Killer whale – northeast Pacific southern resident)	*Orcinus orca*	Endangered 2008	Red	Low to moderate
Yéwyews (Killer whale – northeast Pacific transient)	*Orcinus orca*	Threatened 2003 (SARA) Threatened 2008 (COSEWIC)	Red	Moderate to high
Leatherback sea turtle – Pacific	*Dermochelys coriacea*	Endangered 2003 (SARA) Endangered 2022 (COSEWIC)	Red	Low
Steller sea lion	*Eumetopias jubatus*	Special Concern 2013 (COSEWIC)	Blue	Moderate to high
Kw'únut' (Harbour Porpoise)	Phocoena	Special Concern 2016 (COSEWIC)	Blue	Moderate to high
Skwúmechn (Humpback whale – north Pacific)	*Megaptera novaeangliae*	Special Concern 2023 (SARA) Special Concern 2022 (COSEWIC)	Blue	Low to moderate

[2] Species listed as extirpated, endangered or threatened are protected under Schedule 1 of SARA and COSEWIC

Common Name	Scientific Name	COSEWIC/ SARA Status[2]	Provincial Status	Probability
Northern Abalone	*Haliotis kamtschatkana*	Endangered 2011 (SARA) Endangered 2009 (COSEWIC)	Red	Low
Yelloweye Rockfish	*Sebastes ruberrimus*	Special Concern 2011 (SARA) Threatened 2020 (COSEWIC)	Not Reviewed	Moderate
Green Sturgeon	*Acipenser medirostris*	Special Concern 2006 (SARA) Special Concern 2013 (COSEWIC)	Blue	Low
Longspine Thornyhead	*Sebastolobus altivelis*	Special Concern 2009 (SARA) Special Concern 2007 (COSEWIC)	Not Reviewed	Low to moderate
Rougheye Rockfish Type I	*Sebastes sp. type I*	Special Concern 2009 (SARA) Special Concern 2007 (COSEWIC)	Not Reviewed	Low to moderate
Rougheye Rockfish Type II	*Sebastes sp. type II*	Special Concern 2009 (SARA) Special Concern 2007 (COSEWIC)	Not Reviewed	Low to moderate

7. EFFECTS SUMMARY AND MITIGATION MEASURES

To support the establishment of the follow-up program to verify the accuracy of the environmental assessment and the effectiveness of mitigations this section provides a summary of the environmental assessment findings.

The application for an EAC (Woodfibre LNG 2015) concluded that, after the application of mitigation measures, the remaining residual effects to marine benthic habitat and forage sts'úkwi7 (fish) were not significant. The proposed mitigations from the environmental assessment Sections 5.16 and 5.18 are summated in **Table 7-1**, revised to reflect project changes (i.e., an approved amendment to switch from sea cooling to air cooling). In addition, project design measures applied during construction are intended to mitigate potential loss of habitat from construction or demolition of infrastructure (e.g., floating structures, pilings, outfalls, pipes and diffusers).

The environmental assessment found that residual effects are likely to be negligible with mitigation and are not carried forward to a cumulative effects assessment. Effects to forage sts'úkwi7 (fish) and other sts'úkwi7 (fish) species falls under federal jurisdiction with the federal *Fisheries Act*.

Table 7-1 Summary of Proposed Mitigations from Environmental Assessment Sections 5.16 and 5.18

Potential Adverse Residual Effect	Mitigation Measures	Mitigation Number	Phase
M5.16			
Potential remobilization of legacy contaminants from the sea bottom from ship propeller scour.	Placement of Project works; minimise propeller use inshore where scour can remobilize sediments; add scour protection.	Project design	Construction/ Operations
Potential direct loss of habitat from shading of marine vegetation.	Structures will be placed in marine areas of low habitat quality (i.e., low species diversity and abundance) or deep water.	Project design	Operations
	Measures to minimize marine shading (Section 6.3)	M5.16-1	Operations
Potential change in habitat quality due to seabed disturbance and siltation.	Marine Works Management Plan (See MWQMMP, Section 7.3)	M5.16, M5.18 (M5.10-1)	Construction
Minimize effects during creosote pile removal.	Creosote Pile Removal Plan (See Section 7.9)	M5.16, M5.18 (M5.10-3)	Construction
Potential introduction of invasive species from ballast water exchange during shipping	Ballast Water Management Plan (Section 7.10)	M5.16-2, M5.18	Operations

Potential Adverse Residual Effect	Mitigation Measures	Mitigation Number	Phase
M5.18			
Direct loss of habitat from construction and demolition of infrastructure	Structures will be placed in marine areas of low habitat quality (i.e., low species diversity and abundance).	Project design	
Potential change in habitat quality due to site erosion and sediment transport	Environmental Management Plan	Project design	Construction
	Erosion Prevention and Sediment Control Plan (See Section 7.2, 7.12.1)	M5.18 (M5.8-1)	Construction
	Design for stormwater management (See Section 7.12.2)	M5.18 (M5.8-2)	Operations
	Water Quality Ínexwantas (monitoring) Plan (See Section 7.2.4, MWQMMP)	M5.18 (M5.8-4, M5.8-5),	Construction/ Operations
Potential mortality and change in habitat quality due to release of cementitious material during cast-in-place works	Concrete Works Management Plan (See Section 7.7)	M5.18, (M5.10-2)	Construction
Potential contamination with waste leachate material	Treatment facility	Project design	Construction/ Operations
	Waste Management Plan (See Section 7.12.3)	M5.18 (M5.10-4)	Construction/ Operations
Potential mortality and behavioural changes from underwater noise	Underwater Noise Management Plan (See Section 7.5, MMMP)	M5.18 (M5.17-6)	Construction/ Operations
Potential change in habitat quality	Treatment facility	Project design	Construction/ Operations
Potential change in habitat quality due to accidental release of deleterious substances	CEMP	N/A	Construction/ Operations

As noted in the environmental assessment, mitigations for erosion prevention and sediment control plan and design for stormwater management (M5.8-1 and M5.8-2) are related to terrestrial mitigations and are addressed in the CEMP/OEMP and are only summated here for completeness. Mitigations for waste material leaching (Project design and waste management plan (M5.10-4) are addressed through existing permits, approvals, and the Certificate of Compliance (CoC) process.

The following sub-sections of the MFFHMMP describe measures that are to be implemented during the construction and operations phase of the Project, which have been prescribed by the EAC and additionally by the FDS, and SNEAA.

7.1 Avoidance Measures

As identified in the effects assessment and conditions of approval, the following project design measures will be applied to avoid effects to marine sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat.

7.1.1 Site Selection

The Woodfibre location was selected as a site for an LNG facility in part due to its brownfield history and generally low environmental value considering the legacy impacts that remained since the former pulp mill had been decommissioned. The Site is also surrounded by other industrial marine projects such as Skwxwú7mesh (Squamish) Terminals, the new Fortis Eagle-Mountain pipeline, and historic contamination of Nexwnéwu7ts Átlk'a7tsem (Howe Sound) at Britannia Mine. The Site allows for a marine terminal with floating storage and offloading over deep water, avoiding shading of large areas of shallow habitat, and reducing the Project footprint to terrestrial, riparian, and marine habitats. Not only does the Woodfibre Site offer substantial footprint reduction, but it also provides an opportunity for Woodfibre LNG to improve environmental conditions on a site that may have otherwise been risk-managed for decades to come.

7.1.2 Design Measures

To avoid impacts to marine sts'úkwi7 (fish) including larval stages of sts'úkwi7 (fish) and marine invertebrates, the marine seawater cooling intake was switched to on land air cooling.

Marine facilities will maximise the use of existing facilities or be placed in areas of low habitat quality. Further, construction and infrastructure installation/removal will employ methods to minimise footprint and seafloor disturbance. This includes walkways and ramps, except where not possible due to structural or safety requirements.

- The existing barge ramp will be upgraded or repaired for use.
- Use of piles rather than fill have been utilized where possible to support marine structures and reduce the marine footprint of the Project.
- Floatel and Offloading Platform will be installed where the log sort area used to be, an area historically affected by pulp and paper mill and log sort operations; this area is of relatively low-quality benthic habitat.

Except for the floatel where flexi-float is proposed, to minimize effects of marine shading, except where design requirements determine otherwise e.g., for structure or safety:

- ramps and gangways used to access floating facilities will be installed at an elevation of at least two metres above the highest high-water mark to allow ambient light to reach the seafloor; and
- Docks, ramps, and gangways will be surfaced with aluminium grating (or other light permeable material), allowing ambient light to reach the benthic communities below.

The Floatel has been positioned to allow for sts'úkwi7 (fish) passage along the shore as well as providing at least 2.0 metres of clearance from the bottom of the floating structure to the substrate at the lowest low tides. The Floatel will not obstruct sts'úkwi7 (fish) passage in this respect and will not prevent sts'úkwi7 (fish) from utilizing the area between the structure and shore or between the structure and the benthos.

7.1.3 Construction Phase

Marine facilities will maximize the use of existing facilities that have been preferentially located in areas of low habitat quality. Construction and infrastructure installation/removal will employ methods to minimize footprint and seafloor disturbance. This includes walkways and ramps except where not possible due to structural or safety requirements.

- Three existing barge ramps will be upgraded and repaired for use during construction.
- Use of piles rather than fill has been utilized where possible to support marine structures and reduce the marine footprint of the Project. The installation of steel piles will create additional hard substrate for colonization of sessile benthic invertebrates. While this is anticipated to result in a net positive effect on marine benthic communities over the lifespan of the Project, it is not considered as a credit for habitat offsetting.
- Existing marine outfalls that manage site drainage will be repaired or replaced rather than locating and building new outfalls.
- The existing roll-on / roll-off facility will be refurbished in its existing location.
- Shoreline protection and revetment work is required to enhance stability and mitigate existing erosion into the marine environment. This includes the removal of the existing sheet pile walls located near the FSO location, with a 2:1 rip-rap slope being replaced. This is also anticipated to result in a net positive effect on marine benthic communities over the lifespan of the Project but is not considered as a credit for habitat offsetting.
- Larger infrastructure such as the FSO and MOF have been preferentially located at the historic log sort area, an area historically affected by pulp and paper mill and log sort operations; this area is of relatively low-quality benthic habitat.

To minimize effects of marine shading, except where design requirements determine otherwise e.g., for structure or safety:

- Ramps and gangways used to access permanent facilities are designed to be installed at an elevation of at least two metres above the highest high-water mark to allow ambient light to reach the seafloor; and
- Docks, ramps, and gangways will be surfaced with aluminium grating (or other light permeable material), allowing ambient light to reach the benthic communities below.

Stormwater contact/non-contact water will be managed during the construction phase as outlined in the CEMP and further detailed in an application for a Waste Discharge Authorization, currently under review by BCER. Surface drains and ditches constructed as part of the Project will be graded according to BMPs and vegetated or lined to minimize erosion and increase the retention time of runoff. Particular attention will be given to the construction methodology and design of new or upgrades to access roads to avoid the potential to alter existing drainage patterns by collecting overland drainage and concentrating it at specific locations, which may result in localized erosion.

7.1.4 Operation Phase

To avoid mortality through impingement of forage sts'úkwi7 (fish) and their larvae, the seawater cooling system has been replaced with an upland air cooling system.

Stormwater that does not come into contact with the LNG facility process areas (e.g., roads, material storage areas, roof areas) will be collected in ditches and catch basins. It will then be directed through a stormwater treatment system to remove any oil and sediment prior to discharge into Nexwnéwu7ts Átlk'a7tsem (Howe Sound).

Stormwater that comes into contact with the LNG facility or other process areas will be captured in the new lined stormwater retention pond. The water will be tested for compliance with the BC water quality guidelines. If it meets guidelines, stormwater will be discharged directly into Nexwnéwu7ts Átlk'a7tsem (Howe Sound); if not, stormwater will be pumped to the water treatment plant prior to being discharged into Nexwnéwu7ts Átlk'a7tsem (Howe Sound).

To avoid scour of the potentially contaminated sediments during maneuvering to and from the FSO/FST, the LNG carriers will be assisted by tugboats; therefore, the carriers will not use their own propellers, except for emergency or safety requirements, or will use them at a considerable slower speed. In addition, the tugs will have smaller draft and smaller propellers. The resulting stress on the seafloor at the berth will be considerably lower than if the LNG carriers were moving at a transit speed. Water depth at the LNG berth is between 50 m and 100 m, which is a sufficient depth to allow jets produced by ship propellers to dissipate through the water column before reaching the seafloor.

7.2 General Mitigation Measures

7.2.1 Tree and Vegetation Protection

The majority of proposed works are located in areas of previous disturbance as a result of past land uses (e.g**.,** right of ways, roads), and are typically dominated by invasive and early seral native species. Impacts to existing vegetation may occur in areas of existing native vegetation and riparian vegetation bands such as along East Creek and Mill Creek.

To protect native vegetation and avoid damage to areas beyond the project area, the Contractor shall abide by the following measures:

- Delineate extents of vegetation clearing in the field (such as for the new intake access road adjacent to Woodfibre Creek). Temporary exclusion fencing should be installed to delineate and protect native riparian vegetation and bylaw size trees (>0.2m DBH) and their root zones.
- Field-fit machine access locations to minimize the clearing of trees and shrubs to the greatest extent possible.
- Limit grubbing of tree and shrub roots to areas where soil removal is necessary.
- The EM will monitor vegetation removal, grubbing, and replanting activities in proximity to existing trees to be retained within riparian areas.
- Take care when clearing vegetation to maintain slope stability to minimize sloughing and soil erosion.

7.2.2 Erosion and Sediment Control

A site-specific Erosion and Sediment Control Plan (ESCP) for the proposed works has been developed by a Qualified Professional (Stantec 2023). The ESCP includes the instream/near-stream works locations and considers the following example measures to be implemented under the guidance of a QP:

- Material stockpiles will be covered with plastic tarps or polyethylene sheeting when not in use.
- Material must be stockpiled outside of the riparian zone to prevent it from entering a watercourse. Contractor to confirm riparian zone with QEP.
- Effective erosion and sediment control measures must be maintained until proposed works are completed.

7.2.3 Invasive Species Management

A site-specific Invasive Species Management Plan (ISMP) has been developed and will be implemented prior to the start of works and will include measures to prevent the introduction and spread of invasive species during proposed works. Measures in the ISMP include, but will not be limited to, the following best management practices (BMPs):

- Clearly delineate the extent of invasive plant infestation (i.e., with flagging tape).
- Document inspections of all machinery and equipment for invasive plant material prior to mobilization to the Woodfibre site to ensure no invasive plant material is brought from off-site locations. Machinery and equipment must be clean and free of soil or vegetative debris prior to arrival onsite. The equipment must also arrive on site clean and in good working order (no observed leaks). The inspections will be documented, and the Contractor must provide the documentation upon request by Woodfibre LNG or the EM.
- Prior to mobilizing equipment and machinery from one work location to another, the Contractor will inspect equipment and machinery for the presence of invasive plant material and will clean machinery and equipment (e.g., steam clean, shovel sweep or use compressed air) including tires, tracks or undercarriage to prevent the spread of invasive plant material to other areas.
- Personnel will inspect clothing, footwear, and tools for invasive plant material and/ or soil prior to entering and exiting the Site and between borehole locations.
- Conduct clearing or handling of invasive plants under the supervision of the EM to confirm they are removed in a manner that minimizes impacts to native species.
- Invasive species plant material that requires removal will be stockpiled on poly and covered with poly where required to prevent from mixing with native vegetation or soils. Small fragments can cause new plants to grow if they re-enter the environment. The invasive material should be inspected by an environmental monitor. The invasive plant material will be disposed of at an appropriate location capable of receiving those materials (some facilities only accept some species; separation on-Site may be required) or managed on-site using methods capable of preventing the spread of those species as determined by a QEP.
- Use machinery or hand tools to remove Himalayan blackberry roots and invasives where possible. Using methods that prevent the re-establishment of invasive species, the roots should be excavated to a depth

of at least 10 cm and disposed of offs-site at a previously approved disposal facility, or at an approved on-site incineration location. When grubbing and clearing near trees marked to be retained the EM will be present on Site Ínexwantas (monitoring) the project works to prevent tree and tree root damage.

- During the clearing of invasive species, an EM will be present on-Site to monitor project works.
- Soils suspected of containing invasive plant material (e.g., root fragments or seeds) or associated with Japanese knotweed (as determined by the EM) will be separated from non-affected soils for disposal. Soils may be temporarily placed on secured tarps and covered in a fashion that reduces the likelihood of migration.
- Place removed invasive plant material and underlying soil on tarps and bag excess plant material.
- Areas of disturbed soil are to be planted as soon as possible with a QEP recommended seed mix.
- If planting cannot be conducted promptly, utilize coconut matting or other soil stabilization techniques along the bank to suppress the regrowth and minimize the reestablishment of invasive species.
- Adhere to no-go areas, which are to be clearly delineated prior to commencement of clearing.

7.2.4 Water Quality and Turbidity

Water quality will be carefully monitored during all in-water works including piling, shoreline repair, blasting, bank armouring, and fill placement. An environmental monitor will use a YSI or similar equipment to take regular measurements at pre-defined sample locations as described in an Environmental Management Plan (e.g. Marine Water Quality Monitoring and Management Plan) and/or Environmental Protection Plan. Regulatory limits will be closely followed to prevent harm to sts'úkwi7 (fish) or sts'úkwi7 (fish) habitat due to elevated turbidity. Regulatory limits are laid out in **Table 7-2**. All fill materials or materials that will contact watercourse waters, including shoreline works or surfacing, will be clean and free of organic material and deleterious substances. If water quality exceeds thresholds at any station, the extent of the impact will be defined by finding the distance at which measurements return below threshold and efforts will be made to modify contractor methods to reduce turbidity. If turbid conditions persist after modifying methods where possible, additional adaptive mitigation measures will be employed. Options include silt curtains and timing the most impactful works to coincide with low flow conditions such as slack tide to localize the effects.

Table 7-2 Water Quality Criteria for Evaluating Project Works (BCENV, 2018a and 2018b)

Water Body	Turbidity	pH
Marine/ Freshwater	Change from background of 8 NTU at any one time for a duration of 24 hours in all waters during clear flows or in clear waters. Change from background of 2 NTU at any one time for a duration of 30 days in all waters during clear flows or in clear waters. Change from background of 5 NTU at any time when background is 8–50 NTU during high flows or in turbid waters. Change from background of 10% when background is > 50 NTU at any time during high flows or in turbid waters.	7.0 to 8.7 (marine) 6.5 to 9.0 (freshwater)

- Works will be conducted in a manner to prevent the discharge or introduction, either direct or indirect, of soil, sediment, or sediment-laden water, turbid water, or any other deleterious substance into aquatic environments. All discharges from construction activities shall meet BC water quality guidelines or CCMP water quality guidelines unless otherwise authorized through an OGC Waste Discharge Permit (WDA). The BC OGC is currently reviewing a WDA application from Woodfibre LNG which contemplates discharge limits for TSS of 75mg/L and pH limits of 5.5 – 9.0 based off baseline data presenting lower pH than existing water quality guidelines.
- Construction materials, excavation wastes, overburden, sediment, or other substances potentially deleterious to aquatic life shall be disposed of offsite in accordance with regulatory requirements or placed in such a manner by the contractor to prevent their entry into the aquatic environment.
- Silt control measures will be installed within marine waters around in-water construction activities with the potential to adversely affect water quality to contain suspended sediment. Silt control measures will be maintained and/or replaced by the Contractor as needed to maintain their effectiveness.
- Where there is potential for fish to be harmed by changes in water quality (e.g., fish observed inside a silt curtain used to contain high turbidity), fish salvage may be required. An activity specific marine fish exclusion and salvage work plan will be developed by a QEP with the Contractor and submitted for review and approval by Woodfibre LNG prior to works commencing. The work plan will meet the requirements of applicable fish salvage permits.
- Water-based equipment (i.e., boats and barges) shall manage runoff from deck surfaces such that it meets the BC WQG.
- The Environmental Monitor, the Woodfibre LNG Environmental Representative, and the Contractor will discuss the upcoming work schedule and construction activities to assess when adverse weather conditions are forecast that have the potential to impact marine water quality. These conditions will be documented in the environmental protection plan (EPP).
- When construction vessels are required to operate in shallow water, maneuvering will take care not to cause direct physical disturbance to the seabed from propeller scour. Ongoing turbidity Ínexwantas (monitoring) will be targeted during times of shallow water vessel operations, with additional mitigation being developed and deployed as required to avoid resuspension of marine sediments resulting from seabed scouring.

7.2.5 Spills from Industrial Equipment

The following measures will be employed to comply with provisions of the *Fisheries Act* related to protection of sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat from release of deleterious substances. All contractors working on or near water will supply and implement an EPP that includes spill response measures.

- Contractors will develop a spill response plan to be enacted in the event of a release and will ensure that all staff are familiar with it and capable of executing it.
- Emergency spill kits of appropriate size and number for the planned activities will be present, clearly marked and easily accessible.
- If a spill occurs, work will be paused until the spill has been contained and/or cleaned.

- Spills will be reported to the Provincial Emergency Program if the spill enters or is likely to enter a body of water or the quantity spilled is greater than the quantity listed for that substance in Schedule 1 of the Spill Reporting Regulation (2017).
- Maintain the cleanliness of all machinery and equipment on site and ensure it is properly maintained to prevent leaks or other failures that may enable deleterious substances to enter the marine environment.
- Use of secondary containment measures for all fuel and chemical storage, underneath powered equipment, and in areas where refuelling or fuel transfers are conducted.
- Ensure that building materials used are of a nature and handled in a manner that prevents release or leaching of deleterious substances into the water.
- Where possible, all equipment working on or near water will use bio-degradable hydraulic fluid unless the specifications of the equipment preclude its use (i.e., extreme high heat or high-pressure applications).
- Shore based equipment maintenance and fuelling will be conducted greater than 30 m from marine water, or as approved by the Environmental Monitor.

7.2.6 Site Stabilization and Restoration

Site stabilization and restoration measures will be completed for the work areas associated with the marine in-water/near water works.

Disturbed areas associated with the marine in-water/near water works will be stabilized and restored promptly following completion of the works. The following measures will be implemented:

- Promptly re-seed disturbed zones with a custom seed mix. The QEP will provide a reclamation seed mix specification (e.g., custom native seed mix, Premier Pacific Coastal Revegetation Mix, or Ministry of Transportation Vancouver Island/Coast Mix) and application rate that the Contractor will use to reseed disturbed areas. Seed grade will be Common No. 1 Forage or better as determined by QEP.
- Selected seed species should provide short-term soil stability, and not prevent the successful re-establishment of native herbs, shrubs, and trees. For example, include ecologically appropriate bunchgrasses (e.g., *Agrostis exarata, Bromus sitchensis*) instead of sod forming grasses, forbs (e.g., *Epilobium angustifolium*), and tree (e.g., *Alnus rubra*) seeds within a custom seed mix.
- Effective erosion and sediment control measures must be maintained until proposed works are completed.

A QEP will monitor restored areas associated with the marine in-water/near water works on an annual basis for two years following planting to confirm an acceptable level of planting survival and native recruitment has occurred. Ínexwantas (monitoring) will also guide remedial treatments, such as supplementary planting and invasive species removal.

7.2.7 Environmental Monitoring

An approved Environmental Monitor will be on-Site during Construction with the following roles and responsibilities:

- Oversee site environmental compliance for the Project including stopping project work if activities are not in compliance with applicable permits, authorizations, EMPs, or EPPs and stopping work is necessary to prevent or reduce significant harm to sts'úkwi7 (fish) or sts'úkwi7 (fish) habitat.
- Support development of EPPs and contact Qualified Environmental Professionals (QEPs) to provide discipline-specific support as needed.
- Immediately report environmental incidents to Woodfibre LNG's Environmental Representative.
- Construction will be monitored by a QEP, who will be on-Site, or supervise an approved Environmental Monitor on-Site. The frequency of Ínexwantas (monitoring) will be daily during in-water works and at all times when construction is to occur outside the timing work window, or if high risk to sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat are determined by the QEP. Adverse effects will be reported to DFO.

7.3 General Marine Works Management and Timing Windows

The following general mitigation measures for the protection of marine sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat will be adhered to during marine construction works.

- Marine construction activities will adhere to applicable work timing windows unless additional mitigation measures are developed and implemented in agreement with skwxwú7mesh Úxwumixw (Squamish Nation), Tsleil-Waututh Nation, Fisheries and Oceans Canada (DFO) and in consultation with Indigenous Groups, as defined by the FDS.
- Construction and operation phases of work will be monitored by a QEP, who will be on-Site, or will have an approved Environmental Monitor on-Site. The frequency of Ínexwantas (monitoring) will be daily during in-water works and works outside the timing work window, or if high risk to sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat are determined by the QEP. Adverse effects will be reported to DFO as outlined in **Section 7.**
- All in-water works will be monitored full time by an environmental monitor. If in-water works are required to be completed outside of the timing window of least risk, the work will be reviewed by a QEP and supplemental mitigation will be developed and agreed to with Squamish Nation, Tsleil-Waututh Nation, and Fisheries and Oceans Canada prior to executing any in-water works outside to the timing window of least risk.
- The supplemental mitigation will be consulted on with Aboriginal Groups, as defined by the FDS. Potential supplemental mitigations are provided in **Sections 7.3.3 and 7.3.4** for consideration if in-water works outside of the MLRW are deemed appropriate and a detailed supplemental mitigation plan is required development. WLNG is committed to working with DFO, Squamish Nation, and other Indigenous groups to implement measures that will mitigate negative impacts to juvenile salmon and slhawt' (herring).
- If aggregations of slhawt' (herring) and salmonids are observed in the work area the specific measures as outlined in **Section 7.3.3** and **Section 7.3.4** will be followed.

- Where there is potential for marine sts'úkwi7 (fish) to be harmed, stranded, or captured within marine Project activities or by changes in marine water quality (e.g., construction of MOF followed by infilling, observance of sts'úkwi7 (fish) in high turbidity areas), sts'úkwi7 (fish) exclusion and sts'úkwi7 (fish) salvage may be required. An activity specific marine sts'úkwi7 (fish) exclusion and salvage work plan will be developed by the QEP with the contractor and submitted for review and approval by Woodfibre LNG prior to works commencing and meet requirements in salvage permits.
- Salvage of non-mobile and less mobile sts'úkwi7 (fish) species (e.g., starfish, sea urchins, crabs) will be completed in the intertidal by the Environmental Monitor, or in the subtidal by an approved dive team prior to the commencement of marine Construction activities such as infilling/dewatering, dredging or marine blasting activities.
- Construction equipment operating within 30 metres of marine water will use biodegradable or vegetable based hydraulic oil, unless in transit proximal to the marine environment.
- Shore based equipment maintenance and fuelling will be conducted at a distance of greater than 30 m from marine water, or as approved by the Environmental Monitor.
- The duration of necessary activities, including both dismantling and constructing structures, which must occur within watercourses and within the 30-m riparian setback, will be minimized to avoid potential sts'úkwi7 (fish) mortality and changes in sts'úkwi7 (fish) presence, the quality and quantity of sts'úkwi7 (fish) habitat, habitat availability, and riparian habitat.
- Works will be conducted in a manner to prevent the discharge or introduction, either direct or indirect, of soil, sediment, or sediment-laden water, turbid water, or any other deleterious substance into the marine environment. All discharges from construction activities shall meet BC water quality guidelines or CCME Water Quality Guidelines (except as consistent with the guidelines application background concentrations allow for a modification to the guideline).
- Construction works within intertidal work zones will be scheduled during low tide periods. If works cannot be scheduled during low tide periods, an Environmental Monitor will provide justification during reporting. Ínexwantas (monitoring) will occur as per **Section 7.3.3** and **Section 7.3.4** if outside the least-risk fisheries work window.
- Construction materials, excavation wastes, overburden, sediment, or other substances potentially deleterious to marine life shall be disposed of off-Site in accordance with regulatory requirements or placed in such a manner by the contractor to prevent their entry into the marine environment.
- Silt control measures will be installed within marine waters around in-water construction activities with the potential to adversely affect water quality to contain suspended sediment, if reasonably possible based on currents and weather. Silt control measures will be maintained and/or replaced by the Contractor as needed to maintain their effectiveness.
- Water-based equipment (i.e., boats and barges) involved in pile driving and construction activities will be positioned in a manner that will prevent disturbance of the seafloor or shoreline.
- Water-based equipment (i.e., boats and barges) shall manage runoff from deck surfaces such that it meets the BC Water Quality Guidelines outlined in the Marine Water Quality Guidelines Environmental Management Plan (Keystone Environmental, 2023).

- Work will be scheduled to avoid adverse weather conditions (e.g., wind, rain) that may increase the potential for environmental incidents to occur. The Environmental Monitor, the Woodfibre LNG Environmental Representative (the Environmental Representative), and the Contractor will discuss the upcoming work schedule and construction activities to assess when adverse weather conditions are forecast that have the potential to impact marine water quality.
- Marine works will meet water quality protections and mitigations as outlined in the MWQMMP.

7.3.1 Marine Work Timing Windows

The DFO window of least risk for fisheries in Area 28 – Nexwnéwu7ts Átlk'a7tsem (Howe Sound) is August 16 through January 31 (DFO 2014).

Intertidal works below HHWL, even at low tide, qualify as marine works. **Figure 7-1** illustrates the least risk (unshaded) and high risk (shaded) timing windows for types of species that may potentially be affected by Project effects.

Species Type	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Salmonids-juvenile												
Slhawt' (herring) Spawning												
Lingcod												

Figure 7-1 Summary of Marine Timing Windows

7.3.2 Construction Scheduling

The Project is being planned to complete all marine construction work within least risk windows. While Project scheduling is intended to complete work during the MLRW, it may not be possible to complete all marine construction work during the least risk windows. A list of planned activities and schedules are presented in **Section 3**.

Marine works are anticipated to commence in the 2023 MLRW and continue in the 2024 and 2025 MLRWs. Marine construction activities will adhere to applicable work timing windows unless additional mitigation measures are developed and implemented in agreement with sḵwx̱wú7mesh Úxwumixw (Squamish Nation), Tsleil-Waututh Nation, DFO and in consultation with Indigenous Groups, as defined by the FDS. To protect sensitive life stages, outside of the least risk windows, the following mitigations for the slhawt' (herring) spawning and sts'úkwi7 (fish), including salmonids, are proposed.

In the event work must occur outside least risk windows additional mitigation measures have been developed as outlined below.

7.3.3 Pacific Herring Protection Measures

During in-water works in the slhawt' (herring) spawning season (approximately February 1 to May 15) an environmental monitor will record daily observations for slhawt' (herring) spawning activities to identify if slhawt' (herring) eggs are present on equipment, materials, or observable natural areas such as rockweed growing on riprap armoured shoreline within the work area. Since slhawt' (herring) spawning has historically occurred below easily observable areas (i.e., the low-water level), weekly surveys using a boat, camera (i.e., drop camera), and GPS will be completed between February 1 and May 15 to document where slhawt' (herring) spawn may occur. Based on observations, the following measures will be implemented:

- If spawning Pacific herring or slhawt' (herring) spawn are observed at any time during in-water works, the environmental monitor shall be notified immediately, followed promptly with notification to DFO, skwxwú7mesh Úxwumixw (Squamish Nation) and Tsleil-Waututh Nation. Notifications will include the specific in-water works being undertaken and adaptive management measures that are being implemented, as determined by a QEP.
- All in-water work with potential to negatively impact slhawt' (herring) spawn, egg masses and/ or emergent larvae will cease for 14 days from spawning to allow larvae to emerge, or until mitigation measures can be implemented as confirmed by a QEP. If ch'ém̓esh (herring roe) are present, the environmental monitor will continue to monitor as required until the eggs have hatched and larvae from hatched eggs is no longer present in the work area.
- In-water work activities halted due to slhawt' (herring) spawn or egg mass presence will not recommence until egg hatching is complete and associated larvae are no longer present within work areas, or mitigation measures have been implemented as confirmed by a QEP to prevent negative impacts to slhawt' (herring) spawn, egg masses and/or emergent larvae. For example, if slhawt' (herring) spawn has been detected within a portion of the Site but is not present within close proximity to active work areas, then works may proceed provided appropriate mitigation measures are in place.
- Work areas, activities, and timing may be modified to avoid adverse effects to spawning slhawt' (herring).
- Under the direction of a QEP, isolation curtains may be employed to prevent the attachment of eggs directly to equipment (e.g., barge) and materials. Consult the EM for appropriate mitigation and actions should slhawt' (herring) spawn be observed on isolation curtains.

These are mitigation measures that will be implemented in addition to the other mitigation measures described in this Plan.

7.3.4 Juvenile Salmonid Protection Measures

During in-water works when juvenile salmonids may be present (approximately February 1 to August 15) the environmental monitor will record daily observations of juvenile salmon. Since juvenile salmon may not always be visible from the surface (e.g., due to rainfall or windy conditions) an underwater camera (e.g., drop camera) will be utilized to look for juvenile salmon in addition to observations from above the water surface. Based on observations, the following measures will be implemented:

- Environmental monitor to conduct daily checks for fish presence including juvenile salmon. It is acknowledged that if fish are not observed during daily checks, they may still be present. Daily checks will involve the following:
  - Visually looking for evidence of fish presence near the surface of the water (daily).

- Using underwater cameras to periodically check for fish. Frequency to be adaptively managed by a QEP based on information being obtained and the specifics of in-water works being conducted.
- Netting may be utilized if the environmental monitor is specifically interested in obtaining additional.
- data that cannot be obtained by visual or camera study. Frequency to be adaptively managed by a QEP based on information being obtained and the specifics of in-water works being conducted.
- Environmental monitor has authority to stop work if juvenile salmon may be harmed by work being conducted.
- DFO, Squamish Nation, Tsleil-Waututh Nation and Aboriginal groups as defined by the FDS will be notified of any work stoppages implemented to prevent negative impacts to juvenile salmon. Notifications will include the specific in-water works associated with the work stoppage and adaptive management measures that are being implemented prior to any recommencement of work, as determined by a QEP.

- If juvenile salmon are present, or may be present, but cannot be reliably detected (as determined by a QEP), all in-water work with potential to negatively impact juvenile salmon will cease. In-water work activities will not recommence until it has been confirmed that juvenile salmon are absent from the work area or mitigation measures have been implemented as confirmed by a QEP to avoid adverse impacts to juvenile salmon. This may include modification of work areas, activities, and timing.
- DFO, skwxwú7mesh Úxwumixw (Squamish Nation), Tsleil-Waututh Nation and Indigenous groups as defined by the FDS will be notified of any work stoppages implemented to prevent negative impacts to juvenile salmon. Notifications will include the specific in-water works associated with the work stoppage and adaptive management measures that are being implemented prior to any recommencement of work, as determined by a QEP.

7.3.5 Fish Protection Measures

During construction and operations, protection measures will be put in place to prevent harm to sts'úkwi7 (fish) due to Project activities. The following are described herein and below and include:

- Conducting works during timing windows, unless otherwise agreed upon by regulators and Indigenous groups (**Section 7.3**)
- Mitigate change to water quality that could adversely affect sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat (**Sections 7.2.4, 7.7, 7.9, 7.11, 7.12**, MWQMMP)
- Avoid marine sts'úkwi7 (fish) mortality, physical injury, and behavioural change by isolating in water works, salvaging and relocating sts'úkwi7 (fish) during construction (**Section 7.6**)
- Use appropriate BMPs when removing or installing piling (**Sections 7.5, 7.8 and 7.9**)
- Implement low-noise methods and Ínexwantas (monitoring) or sound dampening technologies if underwater pressure pulse levels exceed 30 kilopascals (**Section 7.5, MMMMP**)
- If blasting, avoid destruction of sts'úkwi7 (fish) by following mitigation measures during all phases of the Project (**Section 7.12**)
- Removal of creosote piles shall be done in a manner to minimize sediment disturbance (**Section 7.9**)
- Any loss of sts'úkwi7 (fish) and/or sts'úkwi7 (fish) habitat will be offset using measures agreed upon with DFO and Indigenous groups (**Section 7.2**)

7.4 Marine Shading and Lighting

The effects of marine shading and overwater structures have been assessed and mitigated during the design phase of the Project. The project's design incorporates various structures such as docks, ramps, gangways, transfer platforms, trestles, and floating structures (e.g., Floatel, MOF, bridges over Mill Creek, and Floating Storage Tanks), each potentially leading to either temporary or permanent changes in shading conditions.

Temporary reduction in eyesight, lasting around 10-15 minutes, has been observed in juvenile salmonids due to changes in light (Tutáw) conditions caused by shading. Such changes may induce disorientation or alterations in fish behavior, including temporary pauses in migration until nighttime. Fish circling behavior around shadows or structures during daylight hours due to shading could lead to heightened vulnerability to predators. Furthermore, artificial lighting has the potential to influence fish behavior by attracting prey to the water surface.

Shading effects from overhead structures can extend to photosynthetic organisms, potentially leading to modifications in the abundance and distribution of riparian vegetation or marine macroalgae. These changes have the potential to impact fish habitat. However, the proposed structures are not anticipated to significantly impact fish habitat through shading, as most subtidal areas consist mainly of soft sediment with limited marine vegetation. Notably, nearshore structures like ramps, gangways, transfer platforms, and Marine FST terminal mooring structures that are positioned over existing or proposed hard substrates with algae may have localized shading effects.

To avoid shading impacts on marine habitats, the project employs strategic design principles. Essential access points like ramps and gangways for floating facilities are designed to be installed at least two meters above the highest high-water mark. This design choice ensures that ambient light (Tutáw) can reach the seafloor and benthic communities, thereby minimizing shading effects. Additionally, docks, ramps, and gangways are surfaced with aluminum grating or other light-permeable materials. This surface material allows ambient light (Tutáw) to penetrate and illuminate the benthic communities beneath, further reducing shading effects.

The project's approach to habitat placement and impact reduction supports shading avoidance. The Floatel and Offloading Platform have been positioned in historically impacted areas with relatively low-quality benthic habitat. This strategic placement not only minimizes shading but also takes advantage of areas less sensitive to ecological disturbance. Furthermore, the utilization of piles instead of fill materials for supporting marine structures not only reduces the marine footprint but also introduces additional hard substrate, encouraging colonization by sessile benthic invertebrates.

Elevating structures mitigates shading while ensuring safe access for personnel. Ramps and gangways are installed at a height of at least two meters above the highest high-water mark, accommodating both ecological considerations and safety requirements. Light-permeable surfacing materials not only mitigate shading but also contribute to safety by allowing adequate ambient light (Tutáw) to reach the seafloor, enhancing visibility in the area. Daily Ínexwantas (monitoring) during construction, infrastructure installation/removal, and in-water works, in addition to adaptive management measures, ensures safety protocols are followed, and any potential environmental or safety concerns are promptly addressed.

- Artificial lighting along the shoreline and docks has been carefully positioned and reviewed during the design stage to minimize potential adverse effects. Throughout the construction and operation phases, adherence to a range of safety requirements will be implemented:

- International Commission on Illumination's CIE 150:2003 Guide on the limitation of the Effects of Obtrusive Light (Tutáw) from Outdoor Lighting installation.
- Navigable Waters Works Regulations from the *Navigable Waters Act*.
- Canadian Aviation Regulations Standard 621 – Obstruction Marking and Lighting; and
- All applicable aviation and navigable water safety requirements.

Marine shading effects have been assessed in detail in the *Fisheries Act* Authorization, with habitat offsetting being constructed for residual effects associated with shading that could not be mitigated. Except for the floatel which will be a temporary flexi-float dock, mitigation includes elevating ramps and structures at least 2 m from the water along the shoreline where fish migrate and utilizing light penetrating materials such as aluminium grating. Few areas of sensitive habitat have been identified in the footprint of the Floatel during marine surveys by divers. The Floatel itself is not expected to cause HADD of fish habitat as a result of shading and light attenuation, however the access ramps/walkways have the potential to destroy or alter the associated areas of tidal habitat.

7.5 Underwater Noise

Project-related marine Construction activities that generate underwater noise and may adversely effect sts'úkwi7 (fish) are expected to be marine pile driving and blasting. Underwater noise mitigation measures included in the Marine Mammal Management and Ínexwantas (monitoring) Plan (MMMMP) that are also considered suitable for sts'úkwi7 (fish) and will be implemented accordingly.

- The BMPs for Pile Driving and Related Operations (BC Marine and Pile Driving Contractors Association, 2003) will be taken into consideration during pile driving.
- The use of vibratory pile installation and down-the-hole rotary drill methods will be preferentially used, where practical and feasible, as impact pile installation is associated with louder sound pressure levels underwater. The Contractor will determine when substrate conditions and Project design require the use of impact pile installation. The Environmental Monitor, or designate, will record changes in hammer type, size, and use.
- If impact pile installation occurs, prior to the change, the contractor will advise Woodfibre LNG, and a notification will be made to Squamish Nation (and really to all parties involved in Environmental Ínexwantas (monitoring)).
- A ramp-up period (soft start) will be utilized where equipment allows prior to the start of pile installation each day, or after a period of 30 minutes or more where there has been no pile installation. The ramp up period begins with less frequent or continuous strikes of lower force, which is intended to provide marine sts'úkwi7 (fish) and sekw'ekw'inexw (wildlife) in the area sufficient time to leave prior to peak pressure and noise levels.
- Near-shore blasting and pile installation will be phased such that areas further from the shore are prioritized first as a precautionary principle, allowing site specific field measures to inform adaptive measures for subsequent works.
- Underwater noise ínexwantas (monitoring) and/or recording will be conducted during in-water construction and near-shore blasting by the Environmental Monitor under the direction of the QP. This

will be carried out on a continuous basis for the purposes of maintaining appropriate exclusion zones for sts'úkwi7 (fish) and marine mammals, to ensure peak sound pressure levels are not exceeded. ínexwantas (monitoring) will be adaptive and directed by the QP based on ínexwantas (monitoring) results and construction activities.

- The EM will take baseline or ambient sound recordings at least 10 minutes in length prior to the start of works to qualify the readings taken during works. The hydrophone will be calibrated by a professional technician and the calibration will be verified and documented in the field by the EM daily prior to deployment.
- Underwater noise will be monitored by the EM during near-shore blasting and pile installation to verify that the peak sound pressure level (SPL) shall not exceed 207 dB re: 1µPa to minimize potential project effects to sts'úkwi7 (fish). Underwater noise will be monitored using a two-hydrophone configuration with one hydrophone at the mid-point of the water column (e.g., equal distance between the surface and shx̱weṉ (ocean) floor) and another hydrophone within 2 m of the shx̱weṉ (ocean) floor. If underwater noise ínexwantas (monitoring) indicates that sound is not in accordance with these thresholds or evidence of dead or injured sts'úkwi7 (fish) is observed, work shall be suspended and additional measures and/or alternative pile installation methods shall be implemented to effectively reduce sound levels below these thresholds prior to pile installation recommencing.
- Should underwater noise levels reach 90% of 207 dB re: 1µPa at 10 m from the source or an equivalent threshold at an alternate distance, works will be paused immediately, and the Contractor will implement additional mitigation measures (i.e., deploying additional bubble curtains, applying a lower hammer energy level). This step is to lessen the likelihood of an exceedance occurring.
- Should hydrophone data exceed the criteria specified above, works will be halted immediately. Following an exceedance, the EM will monitor the immediate area for at least 15 minutes for any signs of deceased or distressed sts'úkwi7 (fish), marine mammals, and other sekw'ekw'inexw (wildlife) such as diving birds (Sekw'ekw'inexw tl'a shkwen). If no signs of deceased or distressed sekw'ekw'inexw (wildlife) are observed, the works may resume after implementing additional mitigations as recommended by the EM.
- If pile driving methods change, i.e., a new hammer, additional barge, or additional or different explosives are to be used, noise ínexwantas (monitoring) must be conducted at the currently established exclusion zone boundaries to ensure they are still adequate for the protection of marine mammals.
- A quality assurance and control program will be implemented to ensure hydrophones are properly calibrated, in good working condition and collecting consistent and verifiable data from control and test locations.

In order to further address uncertainty associated with harming sts'úkwi7 (fish) as a result of near-shore blasting and pile installation, WLNG will implement the following adaptive management strategy to ensure sts'úkwi7 (fish) and marine mammals are protected from above water blasting. Prior to any available on-site blasting noise data becomes available during the initial blasting, a bubble curtain and silt curtain will be installed as follows:

- Unconfined bubble curtains are documented to reduce underwater noise by 15 dB per bubble curtain (pers. comms. Jasco 2023b). The curtain will be installed 5m below the water level. Bubble curtains have the added benefit of being a sts'úkwi7 (fish)-exclusion device.

- An effective sound attenuation device (e.g., bubble curtain) shall be procured and installed by the Contractor and used around each pile greater than 24 in (61 cm) in diameter prior to and during pile driving. The sound attenuation device will be installed around the full circumference of the pile and will be positioned on the sea floor and throughout the water column as required such that the sound attenuation device covers the full wetted length of the pile. The sound attenuation device will be multi-ringed and include pressure gauges on each hose to monitor whether air is being delivered to each ring. The sound attenuation system may require a bubble curtain containment device (e.g., rubber shroud) to further reduce underwater noise effects, as directed by the QP and informed by underwater noise ínexwantas (monitoring). The area that is effectively enclosed by the sound attenuation device is considered the sts'úkwi7 (fish) exclusion zone.
- As an avoidance measure, non-essential floating infrastructure (i.e., barges) will be re-positioned outside of the fish exclusion zone during pile driving and blasting work to reduce the amount of cover for fish.
- A full height silt curtain will also be deployed around the blasting area enclosing the bubble curtain to (1) act as a 2nd barrier to sts'úkwi7 (fish) passage and (2) to provide a confinement function for the bubble curtain. The bottom of the curtain will be weighted (e.g.: steel cable or chain) and held against the bedrock. Anchors and lines may be required to hold the silt curtain in place.
- Hydrophones will be used to either directly measure or back-calculate the pressure wave levels both (1) outside of the sts'úkwi7 (fish) exclusion device, and (2) 1m from the shoreline during near-shore blasting and pile installation.
- Sts'úkwi7 (fish) salvage or relocation will be conducted for the area enclosed by the bubble curtain and silt curtain. The enclosure will be inspected by a drop camera to confirm sts'úkwi7 (fish) exclusion. This may include methods like the use of sts'úkwi7 (fish) deterrents.
- Sts'úkwi7 (fish) salvage will be conducted to confirm mitigation is effective in preventing sts'úkwi7 (fish) mortality. This will include both visual investigation from a boat and drop camera surveys under water. Indigenous monitors will be given an opportunity to participate in the survey. Results will be communicated to DFO and Indigenous Groups through ínexwantas (monitoring) reports.
- Based on underwater noise ínexwantas (monitoring) and performance of mitigation is proven (i.e. the QEP confirms no mortality and that peak pressure waves were less than 207 dB at 1m from the shoreline), the use of bubble curtains and silt curtains may be discontinued unless concurrent activities not previously ínexwantas (monitoring) change. However, if mortality is confirmed or peak sound pressure level exceeded 207 dB outside of the sts'úkwi7 (fish) exclusion device, adaptive measures will not be removed and additional contingency measures provided below will be incorporated until these criteria are met. Blast mats will be used as required to control fly-rock.

Additional contingency measures are available and can be employed as underwater noise Ínexwantas (monitoring) results dictate. These contingency measures include:

- A second line of bubble curtain would be deployed. Unconfined bubble curtains are documented to reduce underwater noise by 15 dB per bubble curtain (pers comms. Jasco 2023b). Therefore, installation of two bubble curtains is anticipated to reduce underwater noise by 30 dB. Curtains would be installed at least 2m apart to spread out the bubbles. The first curtain would be installed 5m below the water, and the second would be around 6m below the water.

- Curtains would be installed at least 2m apart to spread out the bubbles. Preferentially, the first curtain would be installed 5m below the water, and the second would be around 6m below the water. Site conditions will ultimately dictate the installation method.
- Near-shore blasting would be scheduled to occur during lower tides, when the tide level is within 2m of the lowest tide. Amounts of change in blast holes would be reduced.
- Temporary debris nets anchored to the rock face will be installed as an adaptive measure if existing measures are found ineffective at mitigating blast debris entering the marine environment. Actual field data suggests that underwater noise will be less than modelled.
- Near-shore blasting and pile installation activities can be scheduled to occur during lower tides, when the tide level is within 2m of the lowest tide. Amounts of change in blast holes would be reduced. In addition, temporary debris nets anchored to the rock face will be installed as an adaptive measure if existing measures are found ineffective at mitigating blast debris entering the marine environment.
- Actual field data collected during pile installation to repair the existing passenger dock in 2023 suggests that underwater noise will be less than modelled. With the above mitigation measures, a reduction in underwater noise could be expected to provide a significant safety buffer to protect sts'úkwi7 (fish). It is unlikely that the upland blasting works will result in the death of sts'úkwi7 (fish) with the successful implementation of these mitigation measures.

With the above adaptive mitigation strategy for underwater noise, it is unlikely that near-shore blasting and pile installation works will result in the death of sts'úkwi7 (fish) with the successful implementation of these mitigation measures.

7.6 Fish Exclusion and Fish Salvage

Where there is potential for marine sts'úkwi7 (fish) to be stranded, captured, or negatively affected by water quality within a sediment contained area (e.g., silt curtain containment) in marine Project activities (e.g., construction of Offloading Platform followed by infilling), sts'úkwi7 (fish) exclusion and sts'úkwi7 (fish) salvage may be required. An activity specific marine sts'úkwi7 (fish) exclusion and salvage work plan will be developed by the QEP with the contractor and submitted for review and approval by Woodfibre LNG prior to works commencing. Sts'úkwi7 (fish) exclusion will avoid stranding sts'úkwi7 (fish) where an area may be dewatered (e.g., by low tide) or potentially lethal conditions may arise (e.g., high turbidity) and sts'úkwi7 (fish) mortality may occur. During activities of high risk, a qualified team will capture and salvage sts'úkwi7 (fish) by means approved by the QEP (e.g., seining, trapping), and sts'úkwi7 (fish) will be identified and transferred to a pre-determined safe and suitable area as determined by the QEP. Sts'úkwi7 (fish) will be handled with care to not harm or damage individuals and minimize time out of marine water, and holding tanks should be kept cool, out of the sun and replenished with fresh marine water after each translocation. Sts'úkwi7 (fish) will be released to similar habitat at an appropriate location depending on active works.

A salvage of non-mobile and less mobile sts'úkwi7 (fish) species (e.g., starfish, sea urchins, crabs) will be completed in the intertidal by the Environmental Monitor, or in the subtidal by an approved dive team prior to the commencement of marine Construction activities such as infilling/dewatering, dredging or marine blasting activities. Sts'úkwi7 (fish) will be handled with care to not harm or damage individuals and minimize time out of marine water, and holding tanks should be kept cool, out of the sun and replenished with fresh marine water after each translocation. All sts'úkwi7 (fish) will be translocated to a similar environment to where they were taken from.

Prior to the salvage the Contractor and/or the QEP will obtain appropriate licences to sts'úkwi7 (fish) for scientific, experimental, educational or public display purposes. All salvages will be conducted in compliance with applicable legislation and permits.

7.7 Concrete Works

The Contractor will develop and will implement a Concrete Works Environmental Protection Plan (EPP) describing specific mitigation measures and environmental protection procedures for works that involve concrete cutting, chipping, grinding, grouting, or pouring within or in proximity to the marine environment.

Consistent with, and in addition to, the Best Management Practices provided in BCMPDCA and DFO (2003), the following mitigation measures for water quality effects from concrete works will be implemented:

- Equipment used in concrete pouring will be inspected daily to confirm it is in good working order and free of leaks;
- Concrete materials will be securely stored to reduce the probability of accidental spills e.g., this maybe achieved through location of storage or secondary containment.
- Concrete forms will be constructed in a manner to prevent concrete or cement laden water from leaking into the marine environment whether piped or poured e.g., checking lines for leaks as well as confirming forms are not overflowing.
- Barriers will be used as appropriate to prevent splashing over forms and into the water.
- Concrete will be covered while curing if significant rainfall (25 mm within a 24hr period) is forecast to prevent inducing alkalinity in stormwater runoff. Concrete or cement laden water from runoff or washing will be retained or treated if required to maintain accepted criteria (CCME 1999a; BC Water Quality Guidelines 2018 a, b; also see **MWQMMP**).
- If it is necessary to pour concrete within the intertidal or subtidal zones (e.g., piling installation), contact between cementitious materials and surrounding seawater will be avoided by using careful and monitored procedures (e.g., pump hose in form/pipe with shut off valves) and utilizing barriers (e.g., installation of poly sheeting) and full-time ínexwantas (monitoring) for pH and turbidity levels will occur.
- Excess or spilled concrete will be contained, immediately cleaned up, and disposed of in an environmentally acceptable manner.
- Containment (e.g., poly sheeting) will be suspended under work areas during concrete cutting, chipping, or grinding to contain dust and debris where required to support marine water quality remaining within accepted criteria (CCME 1999a; BC Water Quality Guidelines 2018 a, b; also see **MWQMMP**);
- Equipment used for pouring or finishing concrete will be cleaned in a way that prevents wash water from entering the marine environment.
- In the event accepted marine water quality criteria are exceeded, remedial measures will be applied, e.g., pH adjustment, cessation of work or sts'úkwi7 (fish) exclusion measures will be applied. Refer to **Section 8** for additional information on ínexwantas (monitoring). If there is the possibility of contaminants entering water, pH levels will be monitored to confirm pH remains between 7.0 and 8.7 as per the BC Water Quality Guidelines described in detail in the **MWQMMP**.

7.8 Pile Driving

The Contractor will be responsible for developing a Pile Driving EPP. During development of the EPP for approval by Woodfibre LNG, the Contractor shall follow and incorporate the applicable procedures from *Best Management Practices for Pile Driving and Related Operations* (BCMPDCA and DFO 2003), as well as the **MMMMP**. The BMPs for Pile Driving and Related Operations lists mitigation measures for timber piling (creosote), concrete piling, steel pipe piling, steel sheet and H-piling and stone column construction, any of which, except installation of creosote piling, maybe used during construction.

For piling activities, the following mitigation measures will be implemented to prevent adverse effects to water quality:

- Implementing the BC Marine and Pile Driving Contractors Association's *Best Management Practices for Pile Driving and Related Operations*
- General Marine Works Management and Timing Windows will be applied (**Section 7.3**);
- Pile cut-offs, waste or any miscellaneous unused materials will be recovered for either disposal in a designated facility or placed in storage;
- Grounding of water borne equipment will not occur in order to minimize disturbance of the seabed and resuspension of sediment.;
- Silt control measures will be installed around the marine work area during pile driving;
- Pile driving equipment will be inspected daily to confirm that it is in good working order and free of leaks or excess grease that may impact water quality; and
- If clean-out of pipe piles is required (i.e., air lifting), the sediment will be contained (e.g., on a scow) and appropriately disposed of.

To prevent the entrapment of wildlife, hollow pipe piles will be capped.

7.9 Creosote Pile Removal

A creosote pile removal plan was developed by Keystone Environmental for the marine infrastructure works conducted during the fall of 2018 (Keystone Environmental 2015a and 2018) and the relevant requirements for creosote pile removal are provided below. The Contractor will develop and EPP that addresses how they will comply with these Creosote pile removal requirements:

- General Marine Works Management measures will be applied (**Section 7.2**).
- In the event of mass pile removal, efforts will be made to conduct the removal during the least-risk fisheries work window specified by DFO for the region, unless an assessment QEP determines that the work will not cause serious harm to fish or their habitat. Similarly, should any residual single piles need to be removed, QEP will conduct an assessment and piles will be as accordingly.
- Creosote timber removed from site will be tracked by the Contractor.
- Piles will be removed by a slow, steady pull to minimize disturbance of seafloor habitats and to avoid bringing creosote-contaminated sediments to the surface.

- A reasonable attempt will be made to remove the entire creosote-treated pile using a vibratory hammer, clamshell bucket, cable pulls, or other method.
- Broken off creosote piles may only remain below the biologically active zone (EAC commitment 5.10-3).
- Used or decommissioned piles will be disposed of on temíxw (land) in an appropriate waste management facility (Hutton and Samis 2000).
- Absorbent booms shall be used around areas where creosote piles are removed (Hutton and Samis 2000). The booms shall remain in place until no visible evidence of wood-treatment chemicals is present.
- Works should avoid, where possible, installation of creosote piles (Hutton and Samis 2000). Promptly collect any cut wood, chips or sawdust that enters the aquatic environment (Hutton and Samis 2000).
- Cut wood in upland areas, where possible (for example, if piles need to be cut into smaller segments to go to a waste management facility (Hutton and Samis 2000).
- A sediment containment system (e.g., silt curtains) may be installed as appropriate (as determined by a QEP) during piling removal to prevent the dispersion of suspended sediments.
- Decking structures will be swept prior to demolition to restrict sediment or debris from falling into the aquatic environment. Debris and sediment swept from structures will be contained and appropriately disposed of.
- Works within intertidal zones will be scheduled during low tide periods to the extent feasible as determined by the QEP in consultation with the Contractor.
- Stak̲w (water)-based equipment (i.e., boats and barges) involved in pile removal and construction activities will be positioned in a manner that will prevent damage to the seafloor or shoreline.
- The contractor will develop an activity specific EPP that addresses how they will comply with these creosote pile removal requirements and implement best management practices as outlined by the Washington Department of Natural Resources (WDNR 2017).

7.10 Ballast Water Management – Marine Construction Vessel, Construction and Operations

Ballast water will potentially be generated by the marine construction vessels (MCV), during both the construction and operation phases of work. Consistent with statements in the EA, Woodfibre LNG will comply or require its contractors to comply with all legislated shipping requirements, including those related to the management of ballast water during construction and operation phases of work:

- Ballast Water Control and Management Regulations (Government of Canada 2021) under the Canada Shipping Act, SC 2001, c. 26
- International Maritime Organization Resolution A. 868(20): Guidelines for the Control and Management of Ships Ballast Water to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens, in particular section 7.1 (IMO 2004)
- Model Ballast Water Management Plan developed by the International Chamber of Shipping and the International Association of Independent Tanker Owners (IMO 2004)
- Regulation B-1 of the International Maritime Organization's Regulations for the Control and Management of Ships' Ballast Water and Sediments (IMO 2004)
- Part B of the Annex to Resolution MEPC.127 (53), Guidelines for Ballast Water Management and Development of Ballast Water Management Plans (IMO 2004)

Vessel owners and operators are legally responsible for ensuring that the vessels are in compliance with federal ballast water regulations and international convention; however, the site monitor can randomly select a vessel to confirm the water treatment has met the requirement for the water to be discharged in Canadian coastal water. In the event if any MCV do not meet applicable standards, then the ballast water will not be permitted to discharge without presenting a threat of harm to the environment. The WLNG Environmental Representative, in consultation with vessel owner/operator, may defer the decision to Transport Canada on what would be the appropriate next steps for the vessel. Additional information with regards to ballast water management can be found in the ballast water management program that is in currently in consultation phase.

Woodfibre LNG acknowledges that Squamish Nation has an interest in a ballast water monitoring program as it relates to federal Ballast Water Regulations and Woodfibre LNG's approved Ballast Water Management Plan for the Construction phase of the Project. An Operations-phase Ballast Water Management Plan will require approval from Squamish Nation prior to Project commissioning. Ballast water or receiving environment water sampling, eDNA testing, or other forms of AIS monitoring will remain under consideration during the Construction phase and may form monitoring components of the Operations Ballast Water Management Plan.

7.11 Seabed Disturbance and Placement of Materials

The Contractor will develop an EPP for approval by Woodfibre LNG and will implement specific mitigation measures and environmental protection procedures for works that involve activities with potential to disturb the seabed including placement of anchor blocks, riprap for shoreline armouring, and placement of sand and rock for sts'úkwi7 (fish) habitat offsetting measures.

Seabed disturbance by boats during construction may also occur from propwash directed at the seabed or shoreline including boats/ tugs moving barges supporting equipment, larger barges/ships bringing equipment to and from the Site, and boats transporting workers. The following mitigation measures for placement of materials or works that can cause disturbance of the seabed will be implemented:

- General Marine Works Management and Timing Windows will be applied (**Section 7.3**) for physical works in the marine environment.
- Use of a fully enclosed silt control measure (i.e., silt curtain) during infill and shoreline repair works, as determined by the QEP, to help reduce the spread of sediment-laden waters and reduce the deposition of sand and silt to adjacent areas. Silt curtains should be deployed around the placement area or rig, and around scows where material is deposited;
- Propeller wash, where safe to do so, will not be directed towards the seabed and will be minimised in shallow areas (<50m water depth) through limiting amount of wash or acceleration to areas of deeper water ~300m from shore to minimize wake and potential for scour.
- If scour is observed through the ínexwantas (monitoring) program, it must be reported and adaptive measures will be added in the form of limiting propwash flow to surficial (i.e., horizontal) flows, adding flow reduction measures around work zones including curtains or shears, or increasing the stability of the sediments through temporary or permanent caps (i.e., scour blanket).

- The placement of gravel-cobble blankets for offsetting will occur in a manner that minimizes seabed disturbance, i.e., releasing materials close to the seabed as opposed to dropping from the upper portion of the water column.
- The placement of materials in the subtidal will occurs during periods of low water movement (to be determined during installation) and during calm weather to reduce environmental factors influencing material installation (i.e., swaying from crane).
- Slow, controlled placement of materials on the seafloor will allow mobile organisms such as crabs and sts'úkwi7 (fish) to exhibit avoidance behaviour if present, and as such they should not be impacted.

7.12 Upland Mitigations

Terrestrial mitigation measures (e.g., erosion prevention and sediment control) will be implemented to avoid or mitigate potential impacts to the marine environment. These mitigation measures are described in detail in the respective applicable plans (i.e., CEMP, activity specific EPPs), with key mitigations summated in this Plan for compliance with EAC condition 6.

7.12.1 Erosion Prevention and Sediment Control

Erosion and Sediment Control Measures are included as part of the Project CEMP, and locations and specifications for upland sediment control facilities (e.g., silt fence, interceptor trenches) will be described in Erosion and Sediment Control Plans prepared by a Professional Engineer**.**

The following measures and general procedures will be implemented to reduce potential impacts to marine water quality resulting from erosion or sedimentation:

- Disturbance of vegetation will be minimized to the extent required for construction as determined by the EM through consultation with the Contractor;
- When soil disturbance works are undertaken, they will be pursued to completion to limit the duration of potential effects associated with large areas of exposed soil;
- Construction activities will be planned to minimize the generation of sediment-laden water within the work site (i.e., by staging work and/or only undertaking that portion that can be reasonably completed within a work shift);
- Soil disturbance works should be avoided during periods of heavy precipitation to minimize soil erosion and potential sedimentation of marine waters;
- Silt fencing will be installed at the toe of slopes and up-gradient of watercourses;
- Upland material stockpiles will be located away from watercourses or the foreshore, and will be covered when not in use;
- Stormwater will be diverted around exposed work areas where possible to reduce erosion caused by overland flow; and
- Stormwater interceptor trenches will be constructed in a manner to prevent erosion/ mobilization of sediment and will include check dams at regular intervals to reduce the erosive energy of runoff.

7.12.2 Stormwater Management

Stormwater Management for the Project Construction phase will be addressed through implementation of the mitigation measures described in the CEMP as part of the stormwater management plan. As noted in the environmental assessment this includes:

- Stormwater that does not come into contact with the LNG facility process areas (e.g., roads, material storage areas, roof areas) will be collected in ditches and catch basins. It will then be directed through a stormwater treatment system to remove any oil and sediment prior to discharge into Nexwnéwu7ts Átlk'a7tsem (Howe Sound).
- Surface drains and ditches constructed as part of the Project will be graded according to best management practices and vegetated or lined to minimize erosion and increase the retention time of runoff.
- Particular attention will be given to the construction methodology and design of new or upgrades to access roads to avoid the potential to alter existing drainage patterns by collecting overland drainage and concentrating it at specific locations, which may result in localized erosion.
- Stormwater that comes into contact with the LNG facility or other process areas will be captured in the new lined stormwater retention pond. The water will be tested for compliance with the BC water quality guidelines. If it meets guidelines, stormwater will be discharged directly into Nexwnéwu7ts Átlk'a7tsem (Howe Sound); if not, stormwater will be pumped to the water treatment plant prior to being discharged into Nexwnéwu7ts Átlk'a7tsem (Howe Sound).

7.12.3 Waste Management Plan

Woodfibre LNG will implement a Waste Management Plan as part of the CEMP for hazardous and non-hazardous waste to mitigate potential impacts to the marine environment from waste material leaching. Generation of waste will be minimized, and waste will be properly stored and disposed of during the Construction phase of the Project.

The following measures will be adhered to prevent marine water quality effects related to waste:

- Used oil filters must be drained into a waste oil container and drained filters placed in an appropriate labelled container (i.e., drum) before disposal at a recycling facility or other approved facility.
- Waste-oil and antifreeze must be collected and recycled/disposed of at an approved facility.
- Concrete cuttings and wash will be collected, treated, or disposed such that the works are in compliance with Section 35 and 36 of the *Fisheries Act*.
- General waste will be contained in sealed containers or indoor garbage cans and will be removed off-Site as required.
- Used acid-lead batteries must be stored on an impervious surface, under cover, and disposed of at an approved recycling facility.
- Liquid waste, wastewater, and sewage from the Floatel will be contained and removed when necessary to an offsite disposal facility to ensure holding capacity is maintained.

7.13 Verification Monitoring Overview

This section will be superseded by a stand-alone Marine Fish and Fish Habitat Follow-Up Monitoring Protocol in 2024

Verification ínexwantas (monitoring) for impacts to sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat will be led by the EM in the active work zone during Project-related marine construction and operation activities with the potential to adversely impact sts'úkwi7 (fish) or sts'úkwi7 (fish) habitat, including pile driving and infilling. Verification monitoring will be directed by detailed monitoring protocols being collaboratively developed with Squamish Nation.

The effectiveness of the MFFHMMP will be assessed on an ongoing basis, to ensure compliance with applicable legislation and confirm the effectiveness of BMPs and mitigation that has been undertaken. The results of each study will be incorporated into the Adaptive Management Program. A list of potential effects include:

- Shading of the marine environment negatively impacting marine vegetation or sts'úkwi7 (fish) behaviour (i.e., juvenile salmonid migration along the shoreline)
- Change in habitat quality from various sources including water quality, sediment mobilization, seabed disturbance, and resultant mortality
- Potential direct loss of habitat (i.e., net loss of sts'úkwi7 (fish) habitat, slhawt' (herring) spawning area)
- Potential mortality and behavioural changes from noise including juvenile salmonid migration and slhawt' (herring) spawning
- Potential introduction of invasive species from ballast water exchange

Table 7-3 Summary of Proposed Verification Monitoring Programs for Marine Fish and Fish Habitat

Potential Adverse Residual Effect	Mitigation	Metric	Phase
Potential direct loss of habitat from shading of marine vegetation	Structures will be placed in marine areas of low habitat quality where possible (i.e., low species diversity and abundance). (Section 7.1)	Decrease in area and abundance of marine vegetation around structures due to reduced light compared to preconstruction conditions	Construction/ Operations
	Measures to minimize marine shading (Section 7.4)	Decrease in area and abundance of marine vegetation around structures due to reduced light compared to preconstruction conditions	Operations
Potential remobilization of legacy contaminants from the sea bottom from ship propeller scour	Placement of Project works; minimise propeller use inshore where scour can remobilize sediments; add scour protection (Section 7.11, MWQMMP)	Monitor for increases in water turbidity compared to preconstruction conditions Scour observed on the seafloor	Construction/ Operations

Potential Adverse Residual Effect	Mitigation	Metric	Phase
Potential change in habitat quality due to seabed disturbance and siltation	Marine Works Management Plan (Sections 7.3, 7.11; MWQMMP)	Monitor decrease/change in marine vegetation abundance, taxa, or diversity. Observed scour on the seafloor	Construction/ Operations
Potential change in habitat quality due to accidental release of deleterious substances	Effects from accidents and malfunctions are addressed in the CEMP	Monitor decrease/change in marine vegetation, invertebrate or sts'úkwi7 (fish) abundance, taxa, or diversity compared to preconstruction conditions.	Construction/ Operations
Direct loss of habitat from construction and demolition of infrastructure	Structures will be placed in marine areas of low habitat quality (i.e., low species diversity and abundance). (Section 7.1)	Monitor decrease/change in marine vegetation, invertebrate or sts'úkwi7 (fish) abundance, taxa, or diversity compared to preconstruction conditions.	Construction/ Operations
Potential introduction of invasive species from ballast water exchange during shipping	Ballast Water Management Plan (Section 7.10)	Monitor increase in presence of aquatic invasive species in CPA compared to preconstruction conditions.	Operations
Potential mortality and behavioural changes from underwater noise	Underwater Noise Management Plan (Section 7.5, MMMP)	Monitor sts'úkwi7 (fish) mortality, presence/ absence and movement throughout site compared to preconstruction conditions.	Construction/ Operations

Data collection and environmental ínexwantas (monitoring) will continue programs established prior to and during the Construction phase to verify accuracy of the environmental assessment and to determine the effectiveness of the mitigation measures.

Mitigation measures are presented in **Section 7,** verification sampling methods for marine sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat are described in 2021 and 2022 marine sts'úkwi7 (fish) baseline data reports (Keystone Environmental 2021, 2022 (in prep.)), and the Aquatic Effects Assessment for Construction (Keystone Environmental 2022) and summarized below. Detailed survey and sampling methodology will follow the monitoring protocols established through collaboration with the Squamish Nation Environmental Working Group. Sections 7.13.1, 7.13.2 and 7.13.3 are provided below to support collaborative development of monitoring protocols and to propose methodologies that will be built upon through collaboration with the Squamish Nation Working Group.

7.13.1 Juvenile Fish and Salmonid Presence and Migration

This section will be superseded by a stand-alone Marine Fish and Fish Habitat Follow-Up Monitoring Protocol in 2024

The purpose of this ínexwantas (monitoring) plan is to verify that the presence and movement of juvenile salmonids, and other sts'úkwi7 (fish) such as slhawt' (herring) (**Section 7.3.4**), are not significantly negatively impacted by Project activities.

Juvenile salmonid abundance can be highly variable each year due to variables not related to the Project (e.g., disease, predation, overfishing), and it is understood that juvenile salmon mainly migrate through the CPA, only rearing temporarily. The verification Ínexwantas (monitoring) plan aims to confirm that the salmonids are able to move through the CPA, and that their behaviour measured by general CPA access is similar to pre-Construction conditions.

A potential Project-related effect would be a consistent change in behavior of the sts'úkwi7 (fish) such as repeated absence from an area previously and consistently frequented, or an observed inability of sts'úkwi7 (fish) to migrate through the CPA unlike before the Project (e.g., sts'úkwi7 (fish) are no longer observed west of the MOF when they had consistently been observed previously).

Juvenile salmonids (sub-yearling and yearling) originating from the Skwxwú7mesh Stakw (Squamish River) system utilize shallow shoreline habitats as they migrate out of Nexwnéwu7ts Átlk'a7tsem (Howe Sound). The presence of overwater structures through shading, and noise from industrial use may affect juvenile salmonid use of preferred nearshore habitats (Nightingale and Simental 2001).

Migration patterns of juvenile salmonids in Nexwnéwu7ts Átlk'a7tsem (Howe Sound) are not well documented at this time. A stepwise approach for ínexwantas (monitoring) juvenile salmonid movement near Woodfibre during the Construction phase of the Project has been outlined below.

1. Background review of juvenile salmonid emergence from the Skwxwú7mesh Stakw (Squamish River) and estuary to marine waters. This will help determine the timing of migration and the most appropriate times for ínexwantas (monitoring) on site.
2. Visual assessments of nearshore areas during peak migration periods to determine salmonid presence and behaviour. Observations will be recorded between February and July at pre-determined stations along the shore within, north and south of the CPA (**Section 6.2.3**).
3. Beach seine and purse seine sampling at onsite and offsite locations should also occur to identify nearshore salmonids and forage sts'úkwi7 (fish) using the area and provide an estimate of abundance (**Section 6.2.3**).
4. Visual assessment data and beach and purse seine data will be incorporated to the Adaptive Management Program (**Section 10.6**).

7.13.1.1 Monitoring Locations

Ínexwantas (monitoring) of juvenile salmon presence along the shoreline will be used to assess juvenile salmon access through the CPA, upstream (east), and downstream (west) of the facility. The sts'úkwi7 (fish) presence ínexwantas (monitoring) program will use sampling locations to monitor the presence and species of forage sts'úkwi7 (fish) and juvenile salmonids within and outside the CPA (**Figure 6-1, Table 7-4**).

This design will allow for comparisons of sts'úkwi7 (fish) presence on-Site versus off-Site and north of the MOF versus south of the MOF. Comparisons will be made among data collected in 2020, 2021, and 2022 with data collected during Construction (Years 1 and 2), and during operations (Years 1 and 2). This may be extended if sts'úkwi7 (fish) presence cannot be shown to be similar to pre-construction.

Table 7-4 Verification Monitoring Locations

Site ID	Site Location Description	Latitude Longitude	Timing
SR-BS	Beach Seine South Reference (Outside CPA)	49° 39.190'N 123° 15.540'W	Late February and mid-June
SR-P	Purse Seine South Reference (Outside CPA)	49° 39.196'N 123° 15.482'W	Late February and mid-June
1-BS	Beach Seine South of Woodfibre Creek	49° 39.630'N 123° 15.550'W	Late February and mid-June
1-P	Purse Seine South of Woodfibre Creek	49° 39.600'N 123° 15.479'W	Late February and mid-June
2-BS	Beach Seine South of Mill Creek	49° 39.895'N 123° 15.191'W	Late February to March and mid-June to early July
2-P	Purse Seine South of Mill Creek	49° 39.815'N 123° 15.303'W	Late February to March and mid-June to early July
3-BS	Beach Seine North of Mill Creek	49° 39.943'N 123° 15.078'W	Late February to March and mid-June to early July
3-P	Purse Seine North of Mill Creek	49° 39.897'N 123° 15.016'W	Late February to March and mid-June to early July
4-BS	Beach Seine Barge Ramp	49° 40.023'N 123° 14.988'W	Late February to March and mid-June to early July
4-P	Purse Seine Barge Ramp	49° 40.046'N 123° 14.643'W	Late February to March and mid-June to early July
5-BS	Beach Seine South of Mill Creek – Additional Site (2022)	49° 39.870'N 123° 15.338'W	March and mid-June to early July
5-P	Purse Seine South of Mill Creek – Additional Site (2022)	49° 39.721'N 123° 15.353'W	March and mid-June to early July
NR-BS	Beach Seine North Reference (Outside CPA)	49° 40.176'N 123° 14.237'W	Late February to March and mid-June to early July
NR-P	Purse Seine North Reference (Outside CPA)	49° 40.141'N 123° 14.247'W	Late February to March and mid-June to early July
AR-BS	Beach Seine Area Reference (Squamish Estuary, Outside CPA)	49° 40.940'N 123° 11.889'W	March and mid-June to early July
AR-P	Purse Seine Area Reference (Squamish Estuary, Outside CPA)	49° 40.909'N 123° 11.894'W	March and mid-June to early July

7.13.1.2 Visual Assessment

Visual assessment for the presence of juvenile salmonids and herring will be recorded weekly during amenable conditions (e.g., calm and sunny) at each of the ínexwantas (monitoring) locations between February and June. Visual assessments will consist of remaining stationary on shore or a vessel for five minutes to observe any sts'úkwi7 (fish) movement from the surface during calm sea conditions. Telephoto digital images will be used to aid in verifying species and numbers. This data will be supplemented by any daily observations made by the Environmental Monitors.

7.13.1.3 Beach and Purse Seining

During the construction phase of the Project, Beach and purse seining will be conducted two times during the sts'úkwi7 (fish) migration window (February/March and June/July or as determined by the QEP based on weekly visual observations) in accordance with the Fish Collection Methods and Standards (MOE 1997). Sampling in 2020 through 2022 will be used to confirm baseline conditions and continued through subsequent Project phases as defined by the QEP.

Sampling in 2020 through 2022 will be used to confirm baseline conditions prior to Construction, with additional sampling in years one and two of Construction and years one and two Post Construction. Additional years may be added after year two of Construction if it is determined necessary to implement Adaptive Management measures for sts'úkwi7 (fish) presence and migration on-Site. Beach seining should consist of the following:

- A net of appropriate length to catch fry (e.g., 30 to 50 m long and 1.8 to 2.4 m deep) with relatively small mesh in the middle (bunt) section (i.e., a mesh size of 0.4 cm). The net will be weighted on the bottom, and the top will be supported with floats.
- The net should be set from shore.
- Two sets adjacent in location, should be completed at each of the eight sample stations.
- Sts'úkwi7 (fish) collected from the first set should be held in a container during the second set to avoid being recaptured.
- Each sts'úkwi7 (fish) should be recorded to species and life stage. The first 10 individuals of each species should be measured to length and photo recorded. Observations of lesions, discolouration, parasites and/or abnormalities should be recorded for each individual.
- Sts'úkwi7 (fish) should be released, unharmed, in the location where they were caught. If any sts'úkwi7 (fish) mortality occurs, it should be documented and reported to DFO as part of regular ínexwantas (monitoring) reporting.
- The results of the surveys should be reported by the end of each year.
- Sts'úkwi7 (fish) collection must be conducted under a licence and/or permit for sts'úkwi7 (fish) collection under Section 52 of the Fishery (General) Regulations.

The results of juvenile salmon use of the nearshore area at the terminal will be incorporated into the Adaptive Management Program, which may require updates to the ínexwantas (monitoring) plan.

7.13.2 Herring Spawn and Lingcod Egg Mass Monitoring

This section will be superseded by a stand-alone Marine Fish and Fish Habitat Follow-Up Monitoring Protocol in 2024

Potential effects to slhawt' (herring) spawning due to Construction and operation of the Project were identified during the EA review process. As part of the marine sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat condition of the Environmental Assessment Certificate, Pacific slhawt' (herring) spawning ínexwantas (monitoring) will be undertaken to verify EA predictions and determine effectiveness of mitigations through adaptively managing project related effects to this species and their habitat.

A series of intertidal and subtidal surveys to document the distribution and timing of slhawt' (herring) spawning activity, and any other observed sensitive life stages of marine species (e.g., lingcod (*Ophiodon elongatus*) egg masses) along the Project area shoreline and existing marine infrastructure was undertaken in 2015, 2016, 2019, 2020, 2021, and 2022. The results of these surveys indicated that slhawt' (herring) spawn at the Site between February and April on intertidal and shallow subtidal riprap supporting rockweed and in deeper habitats that support bladed kelps and on existing infrastructure.

To assess slhawt' (herring) spawning and lingcod egg masses along the nearshore habitat within the Project area, a series of intertidal and subtidal surveys will be undertaken during the spawning window, from early February through the end of April. Surveys will take place approximately monthly to consistently monitor the presence of slhawt' (herring) spawn through the typical spawning period. Surveys will comprise two stages: (1) mapping the distribution of spawning bed, and (2) collecting more detailed information on spawning habitat, egg density and health, if eggs are observed. During distribution mapping, divers map the presence or absence of slhawt' (herring) spawn at the site and note the general characteristics of the nearshore area. If spawn is recorded and mapped during the distribution mapping, sampling to collect more information on spawning habitat and density will occur. The presence of lingcod egg masses will be recorded including location, elevation, and substrate. Surveys will be completed in 2020, 2021, and 2022 Construction (Years 1 and 2), and during operations (Years 1 and 2). This may be extended if slhawt' (herring) spawning cannot be shown to be similar to pre-Construction.

Sampling will be conducted by occupational SCUBA divers who are also trained in identifying slhawt' (herring) spawn. Distribution mapping will be conducted by swimming along the nearshore area from the water's surface to a maximum depth of 12 m (approximately -10 m chart datum (CD)); depths where slhawt' (herring) spawn are typically observed. Locations of the start and end of each survey and start and end of all spawning beds observed will be noted and recorded with a GPS unit. A high definition underwater camera will be used during the surveys to document the presence or absence of slhawt' (herring) spawn and other organisms and habitat features.

If spawn is observed during the distribution mapping, a slhawt' (herring) spawn survey is conducted to determine coverage, extent, and habitat characteristics. The recommended DFO guidelines (Fort et al. 2013) have been adapted to suit the narrow width of the historic spawn area at the Project site. The guidelines require a wider spawn distribution for data to be collected in multiple quadrats. Spawn surveys provide information on depth, distribution, and density of slhawt' (herring) spawn. The egg density, egg layers, spawning extent, depth range, and substrate type will be noted for each survey where slhawt' (herring) spawn is observed.

Slhawt' (herring) spawn ínexwantas (monitoring) will begin in February proximal to the start of the expected spawn timing window and continue intermittently for the duration of the spawning season. Typically, slhawt'

(herring) spawn surveys will take place four times per year between February and April. The long-term ínexwantas (monitoring) of this habitat and habitat use by slhawt' (herring) will occur in years one and two during Construction and years one and two post-Construction. Surveys will be expanded to on-Site and Offsite offsetting areas once each offsetting measure is constructed. The results of the surveys will be reported within 60 days of the final field visit each year to DFO, skwxwú7mesh Úxwumixw (Squamish Nation), Tsleil-Waututh Nation, and Indigenous Groups, as defined by the FDS.

The results of slhawt' (herring) surveys will be incorporated into the Adaptive Management Program.

7.13.3 Aquatic Invasive Species

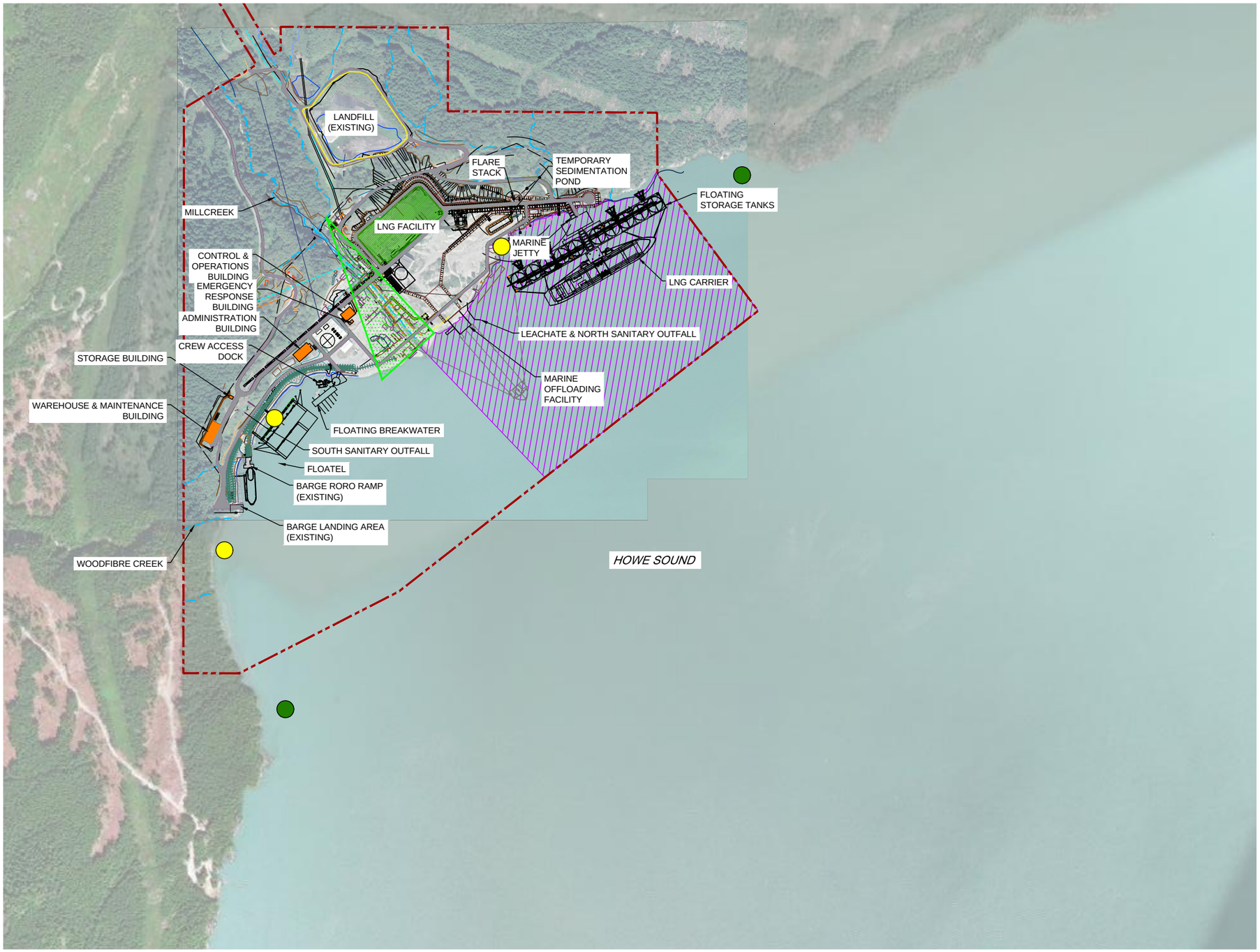
This section will be superseded by a stand-alone Marine Fish and Fish Habitat Follow-Up Monitoring Protocol in 2024

An AIS ínexwantas (monitoring) program for the Project is detailed below and will consist of a collector plate method and an annual dive survey. The AIS program will be established one year prior to operations to gain baseline data prior to the first ship-call to the Woodfibre site and will continue during operations.

Woodfibre LNG will retain a QEP to assess AIS and provide recommendations to complete the AIS ínexwantas (monitoring) and survey works without causing harm to sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat. The QEP will be knowledgeable in sts'úkwi7 (fish) and marine invertebrate species and responsible for AIS deployment, sample collection and assessment techniques that are relevant to the project. The QEP will also be familiar with applicable legislation that applies to the project (e.g., *Fisheries Act, Species at Risk Act*) and associated approvals.

The collector-plate method follows that used by DFO, as described in Sephton et al. (2011, 2014). Modified versions of this method have been used in Nova Scotia (Moore et al. 2014), coastal BC (Gartner et al. 2016) and San Francisco Bay, California (Marraffini et al. 2017) and by PRPA (Anderson and LaRoche 2018). To characterize AIS communities in the CPA and Reference locations, multiple collector-plate arrays are to be deployed off a total of three sublittoral, waterfront stations (such as floating docks) at the Site where ships will frequent (**Figure 7-2**). Two reference stations will be designated as separate control sites south and north of the CPA in Nexwnéwu7ts Átlk'a7tsem (Howe Sound). All stations are references as proposed in **Figure 7-2** and are subject to field fitting by QEP. During pre-construction baseline ínexwantas (monitoring), in the absence of infrastructure to attach collector plates, they will be attached to a post inserted into the sediment by divers with the lowest plates at least two metres above the seafloor.

The five stations will be placed where they will not interfere with site operations or personnel safety. The location of each sampling station will be geo-referenced with a handheld Garmin GPS unit. Two deployments will be carried out to target peak larval settlement, in early-spring (February) and summer (July). All collector plates installed in the spring will be retrieved in the subsequent fall (October), ideally allowing for a minimum of four months/ 16 weeks for high seasonal recruitment (Sephton et al. 2011, 2014; Moore et al. 2014; Gartner et al. 2016). In total, the project proposes two field deployments (spring and summer), two field retrieval (summer and fall) for each year the ínexwantas (monitoring) program is in place.



N

LEGEND

- CERTIFIED PROJECT AREA
- WATERCOURSE
- GREENZONE
- CERTIFIED MARINE TERMINAL AREA
- LNG FACILITY
- NON-PROCESS FACILITY
- ROADWAY
- ON-SITE AIS SAMPLE LOCATION
- OFF-SITE AIS SAMPLE LOCATION

Keystone Environmental

NOTES: ALL MAPPED FEATURES ARE APPROXIMATE AND SHOULD BE USED FOR DISCUSSION PURPOSES ONLY. PROJECT FEATURES MAY BE SUBJECT TO CHANGE.

SOURCES:

1. CERTIFIED PROJECT AREA, CERTIFIED MARINE TERMINAL AREA, GREEN ZONE, FLOATEL, AND WATERCOURSES, WERE PROVIDED BY HEMMERA, AN AUSENCO COMPANY.

2. OTHER FEATURES SHOWN WERE OBTAINED FROM McDERMOTT OVERALL PLOT PLAN, DWG NO: 239348-0000-00PI-DWG-P0A-0002, REV E.

3. DATE OF AERIAL PHOTO IS 2019, OBTAINED FROM GOOGLE MAPS.

100m 0 500m

SCALE: 1:10,000(approx.)

Squamish Pulp Mill (Woodfibre)
Squamish, B C
Woodfibre LNG Limited

REVISION No.	DATE	PROJECT No.
00	Aug. 2022	17227-109

Figure 7-2
Aquatic Invasive Species Sampling Stations in, and adjacent to, the CPA

PLOT SCALE: 1:1 DRAWN BY: TL CADD FILE No. I:\0-GIS\1-Projects\1-WLNG\GIS_CADD\17227\00109\2022_08Aug_15_MarineFishAndFishHabitat\Fig7-3-AIS Sample Location Plan-R0.dwg

A collector-plate array consists of: a) a rope-line weighted and secured at the bottom to ensure that collector-plate arrays hang vertically in the water column (**Figure 7-3**); b) three downward facing 15 cm x 15 cm square, sanded polyvinyl chloride (PVC) plates attached to the rope-line; and c) an inverted (optional) plastic flowerpot saucer (25–30 cm diameter) with three attached Petri dishes (9 cm diameter), to increase material choice and surface area for settlement.

The collector plates must remain submerged and off the seafloor bottom at low tide. The topmost plate is to be suspended one metre below the surface of the water with an approximate distance of 1 m between the top and the bottom collector-plate. At each of the four waterfront stations, a single collector-plate array will be deployed in the spring and late-summer. Water quality parameters will be measured at each station. Following each prescribed ínexwantas (monitoring) period, collector-plate arrays will be recovered, and ropes, tags, loggers, and weights will be examined in the field for AIS and native species. Plates will be photographed in the field for reference. Samples will be preserved in either 4% formalin or 70% ethanol for subsequent examination. In the laboratory, specimen (larger than 1 mm) will be sorted into the lowest taxonomic level possible. In parallel with collector-plate based ínexwantas (monitoring), rapid assessments of nearby, targeted surfaces (i.e., pilings, underside of dockside, floats, underside of boats) at the five stations can be carried out for presence of AIS.

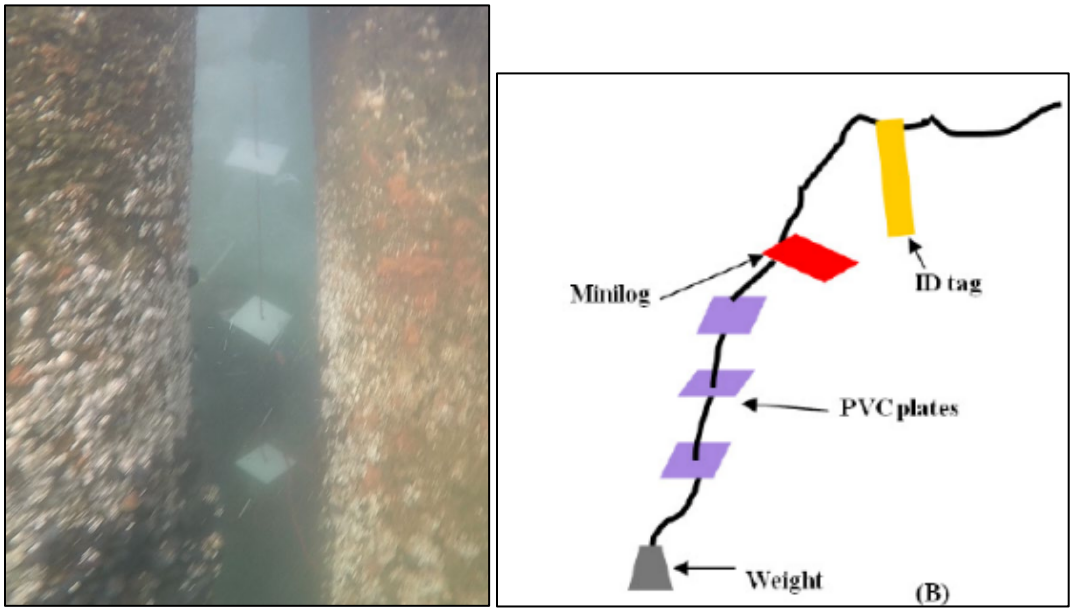


Figure 7-3 Photo of AIS collector deployed near the Ro-Ro (left) and a simple schematic of a collector-plate array design (Sephton et al. 2011)

The presence of AIS will be determined by a positive observation on either the PVC collector-plate or on station substrates. The percentage cover of both AIS and native species will be determined by visual (microscope) examination and categorization (**Table 7-5**) All taxa will be categorized into AIS (non-indigenous aquatic species), native, cryptogenic, or unknown. Identification will be determined using taxonomic descriptions. Taxa will be listed according to the World Registry of Marine Species (WoRMS). The average percent cover will be determined by calculating the average cover category from each deployment

period, then calculating the average of the two values (Sephton et al. 2011). The relationship between AIS and native species richness and percent cover will be statistically determined between seasons of deployment and sites. All records of AIS will be submitted to the DFO-Science National Aquatic Invasive Species Database.

Supplemental observations from other ínexwantas (monitoring) programs (e.g., slhawt' (herring) spawning ínexwantas (monitoring)) could also be incorporated into the AIS reporting. The results of the AIS ínexwantas (monitoring) program at the terminal will be incorporated into the Adaptive Management Program. The program will work with DFO to support actions to control AIS within the Project area. If AIS is determined to be originating from ships at Woodfibre LNG, then additional measures such as hull inspections upon arrival could be added to better track sources of AIS, as well as a review of ballast discharge procedures.

Table 7-5 Categorization of the Percent (%) Cover of AIS

Indicator value	Percent (%) coverage	Category
0	0	Absent
1	0-25	Low
2	25-50	Moderate
3	51-75	High
4	75-100	Very high

7.13.4 Environmental Monitoring to Verify Mitigation Measures

This section will be superseded by a stand-alone Marine Fish and Fish Habitat Follow-Up Monitoring Protocol in 2024

Ínexwantas (monitoring) of effectiveness of mitigation measures with respect to sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat will be led by Qualified Environmental Professional(s) (QEPs) with field data collected by the Environmental Monitor (EM)in the active work zone during Project-related marine construction and operation activities with the potential to adversely impact sts'úkwi7 (fish) or sts'úkwi7 (fish) habitat, including pile driving and infilling. The effectiveness will be assessed on an ongoing basis, to ensure compliance with applicable legislation and confirm the effectiveness of BMPs and mitigation that has been undertaken. The results of each study will be incorporated into the Adaptive Management Program. The EM will monitor compliance for the following conditions:

7.13.4.1 FDS Condition 3.1 – Timing Windows

The EM will verify conformity of in-water construction activities with timing windows as described in Section 7.3.

7.13.4.2 FDS Condition 3.2 – Marine Water Quality

The EM will verify conformity of marine water quality mitigation for erosion control (see Section 7.12), revegetation with native plant species, use of silt control measures around in-water activities and preventing wet concrete or cement-laden water from entering the marine environment (Section 7.7).

7.13.4.3 FDS Condition 3.3 – Harmful Alteration, Disruption, or Destruction of Fish and Fish Habitat

Measures to mitigate adverse environmental effects of the Project on fish during the Project will be implemented as outlined in Section 7. This includes verification monitoring as outlined in Section 7.13.4. An environmental monitor will be on-Site throughout the in-water construction phase of the Project to ensure the efficacy of mitigation measures. Should measures not be effective (as determined based on interpretation of the collected data by a QEP), the work shall be suspended with re-commencement contingent upon the application of an adaptive management strategy, whether through modification of existing mitigation measures or the implementation of additional mitigation measures.

8. HABITAT OFFSETTING PLAN

8.1 Habitat Offsetting Requirements

As outlined in the Aquatic Effects Assessment (AEA), the Project is expected to result in a permanent loss of marine aquatic sts'úkwi7 (fish) habitat of 15,283 m^2 (factored area) and 12,946 m^2 of riparian habitat that require offsetting. To offset the HADD, Woodfibre LNG is proposing to construct the offsetting areas proposed in **Table 8-3 and 8-4.** Initial areas are equal to, or exceed, the no-net-loss areas listed above and are expressed prior to the application of a time lag factor or a contingency factory. Final design and offsetting concepts are subject to approval of regulators, Indigenous groups, and Woodfibre LNG operations.

In addition to meeting the principle of no-net loss of HADD described above, Woodfibre LNG is also proposing:

- additional habitat offsetting equivalent to a 10% per year to account for the time-lag for the marine aquatic habitat to become established.
- an additional 25% contingency above that to account for all other aspects (for example, but not limited to, addressing potential uncertainty associated with measuring changes to sts'úkwi7 (fish) behaviour that may be low in nature as presented herein, but could be cumulative and may be difficult to account for).

The relative values used in the balance tables and contingency also account for potential time lag effects between offsetting productivity and the loss of habitat due to the Project.

Reefs are typically colonized quickly in the Salish Sea due to the annual life history pattern of many species and their robust habitat requirements (Mumford 2007; Keystone Environmental 2022), often resulting in a three year time lag for the proposed offsetting concepts to reach their full productive capacity after construction. Similarly, benthic invertebrates may colonize healthy sediments quickly (within a year) due to high flow regimes that redistribute propagules from productive to disturbed areas.

Summaries of the proposed offsetting are provided in **Tables 8-1 and 8-3**. Detailed breakdowns of the aquatic and riparian residual effects calculations are provided in **Tables 8-2 and 8-4** respectively.

Table 8-1 Summary of Proposed Marine Aquatic Offsetting

Proposed Habitat Offsetting					
Structure	Area (m^2)	Factor Time Lag	Subtotal (m^2)	Factor Contingency	Total (m^2)
Cobble Blankets	713.8	30%	928.0	25%	1,160
Shallow Reefs	1,515.7	30%	1,970.4	25%	2,463
Sand Blankets	7,965.8	10%	8,762.4	25%	10,953
Deep Reefs	5,486.5	10%	6,035.2	25%	7,544
Total Proposed Offsetting	**15,682**		**17,696**		**22,120****
Amount Required	**15,283**				
Net*	**+399**				

*Exceeds required offsetting area in Section 8. **Actual area of marine aquatic offsetting proposed on offsetting figures.

Table 8-2 Marine Aquatic Fish Habitat Summary Table

Structure	Area Before (m^2)[a]	Area After (m^2)[b]	Net Change (m^2)	Factor	Factored Area (m^2)
Marine Terminal and FSTs	1,495	1,234	-261	see T. 8-5.2	-630
MOF Subtotal	1,858	1,650	-208	see T. 8-6.2	-1,598
Floatel Subtotal	87	39	-48	see T. 8-8.2	-61
Offloading Platform Subtotal	1,565	969	-596	see T. 8-7.2	-1,190
Shoreline Work Subtotal	20,667	16,872	-3,795	see T. 8-9.2	-11,804
Ro-Ro Subtotal	0	0	0	n/a	0
Marine Aquatic Total	**25,672**	**20,764**	**-4,908**		**-15,283**

[a,b] – Does not include riparian habitat areas above the HHWL (see Table 8-3 and 8-4). A net loss in habitat would be due to conversion of aquatic habitat (below the HHWL) to degraded or disturbed Upland Industrial habitat with no value to fish.

[C] – Does not include the 10% / year for offsetting function and 25% for additional contingency yet, those are added to this total in Section 9 because they are a function of the type of offsetting.

Table 8-3 Summary of Proposed Marine Riparian Offsetting

Structure	Area (m^2)	Factor Contingency	Total (m^2)
Riparian Planting within 30m of Sḵwex̱ (ocean)	12,946	25%	16,183
Total Proposed Offsetting	**12,946***		**16,183**
Amount Required	**12,946**		
Net*	**0**		

*Equal to required offsetting area in Section 8.

Table 8-4 Marine Riparian Fish Habitat Summary Balance Table

Structure	Area Before (m^2)[a]	Area After (m^2)[b]	Net Change (m^2)	Factor	Factored Area (m^2)
Marine FST Terminal	1,478	0	-1,478	see T. 8-5.1	-2,908
MOF Subtotal	0	0	0	see T. 8-6.1	0
Floatel Subtotal	11	0	-11	see T. 8-8.1	-11
Offloading Platform Subtotal	8	0	-8	see T. 8-7.1	-8
Shoreline Work Subtotal	1,250	0	-1,250	see T. 8-9.1	-1,575
Ro-Ro Upgrade	0	0	0	n/a	0
Blasting and Other Upland Subtotal	4,595	0	-4,595	see T. 8-10.1	-8,444
Marine Riparian Total	**7,342**	**0**	**-7,342**		**-12,946**

[a,b] – Does not include aquatic habitat areas below the HHWL (see **Table 8-1**). A net loss in relative total fish habitat would be due to conversion of Vegetative Riparian habitat to degraded or disturbed Upland Industrial habitat with no value to fish or a change in function of Vegetative Riparian habitat due to shading effects of a platform or elevated structure. In the case of shading impacts, the relative habitat value was decreased by 50%.

8.2 Offsetting Approach

The offsetting measures for the Project will focus on improving the overall ecological health of the CPA by restoring seabed health (i.e., physical quality and biotic activity), promoting sts'úkwi7 (fish) rearing and spawning areas, and enhancing sts'úkwi7 (fish) migration corridors through the CPA. The following four main offsetting goals have been identified.

i. Expand existing intertidal/ shallow subtidal hard substrate to promote marine vegetation, thereby increasing areas for slhawt' (herring) spawning and juvenile salmonid rearing, while also enhancing their migration route.

ii. Improve sediment health through addition of: (i) a sand layer over existing sediments determined to be unproductive or of poor health to enhance the biologically active zone (i.e., upper 0.3 m to 0.5 of sediment), and (ii) a sparse surficial cobble blanket to promote kelp and algal growth but spaced to allow infaunal access to the sand layer (bivalves to protrude, invertebrates to migrate).

iii. Add rock reefs that will: (i) increase cover/structure for sts'úkwi7 (fish) species such as juvenile salmonids, rockfish and lingcod; spawning areas for sts'úkwi7 (fish) such as slhawt' (herring) and demersal sts'úkwi7 (fish); and (ii) marine structure/ cover to enhance invertebrate diversity (e.g., sea cucumbers, sea urchins, crabs). Shallow reefs would be expected to support kelp growth, while deeper reefs would be primarily for sts'úkwi7 (fish) and invertebrate cover.

iv. Restore degraded riparian areas focussing on the marine shoreline, lower Woodfibre Creek, and lower East Creek. Restoration of Mill Creek Green Zone will also be completed in partnership with skwxwú7mesh Úxwumixw (Squamish Nation) as agreed upon in the SNEAA and without additional offsetting credit.

8.2.1 Sediment Restoration

Wood waste in the benthic marine environment can be detrimental to marine life as it physically smothers biota on the sediment surface and can lead to the production of toxic by-products during decomposition such as hydrogen sulfide and methane. Areas of thick wood waste deposits can be unfeasible to physically remove and dispose of on land due to issues with salt contamination. In Puget Sound, methods have been proposed to remediate varying thicknesses of wood waste in the marine environment (Breems & Goodman 2009). Restoration design depends on the nature and thickness of the existing wood debris. In the areas of proposed offsetting, a relatively thin (0.2 to 0.3 m) layer of sand can be placed over a thin layer of wood particulate (i.e., less than 0.3 m) to improve the health of surficial sediments, encouraging colonization by benthic macroinvertebrates that act to mix the sand with wood waste and improve overall sediment health. As the wood waste is fine and relatively thinly layered, any decomposition is likely to have little impact on offsetting structural integrity or result in subsidence (per comm. CMO Consultants). Additionally, gravel mounds under rock reefs may be added to reduce subsidence.

8.2.2 Cobble Blanket

A mix of hard and soft substrates together allows for a high degree of biodiversity by supporting numerous target species including kelp that requires hard surfaces for attachment and infauna shellfish that need soft sediments to burrow. Kelp in turn will provide cover for sts'úkwi7 (fish) to rear and substrate to spawn on.

Shallow areas of the Project footprint near the toe of slope can support this offsetting concept. Encouraging macroalgal growth will also build up nutrient of the sediments over time and increase density and diversity of benthic invertebrates and sts'úkwi7 (fish). Using a mix of hard and soft substrates in restoration will increase diversity in the area by adding habitat complexity.

8.2.3 Rock Reefs

Rock reefs have been employed successfully in the Salish Sea region for decades (Naito 2001; Slogan 2015). Shallow rock reefs support kelp beds, shellfish and provide cover for small and large sts'úkwi7 (fish) species. Deeper reefs support diatom and hydroid cover, while providing refuge for numerous sts'úkwi7 (fish), shrimp, and crab species. Rock reefs typically fully colonize in less than three years and are generally very stable over the long-term making them good candidates for offsetting measures. Since much of the areas proposed for offsetting measures are historically soft sediments, rock reefs will be complimentary in nature to sediment restoration to increase habitat complexity and biodiversity. Riprap within the site is successfully growing sugar kelp despite the "glacial flour" deposition from the Sḵwx̱wú7mesh Staḵw (Squamish River), therefore, we do not expect this to prevent the reefs from functioning as intended.

8.2.4 Riparian Areas

Riparian habitat offsetting measures will consist of restoring degraded marine, estuarine, and freshwater riparian areas to historic vegetation communities. Riparian offsetting will target riparian areas disturbed from historical industrial use in areas cleared of vegetation and native soils, and areas covered with permanent or long lasting covers (e.g., gravel, concrete or asphalt) or non-native species.

8.3 Complementary Measures

Prior to construction, Woodfibre LNG has conducted significant Site clean-up and remediation of structures and debris that are described below. Woodfibre LNG is also restoring a large area on either side of lower Mill Creek referred to as the Green Zone. The Green Zone will be restored in consultation with sḵwx̱wú7mesh Úxwumixw (Squamish Nation) and is described in **Section 8.3.2**. While Woodfibre LNG acknowledges these complementary measures are additional to the habitat offsetting commitments outlined as part of this application, these substantial actions are important components to improving the overall health of the ecosystem and support the approach within this Offsetting Plan.

8.3.1 Site Remediation and Clean-up

As part of Woodfibre LNG's commitment to environmental responsibility and ensuring safety for its employees and the public, clean-up of structures associated with the former pulp mill operations have been undertaken in advance of construction of the LNG facility. The clean-up works involved the decommissioning and removal of marine structures including docks, diffusers, a warehouse, wharves, a barge ramp, pile supported concrete slabs, a bridge, can buoys and miscellaneous mooring dolphins and frames. These structures were comprised of steel, concrete, timber, and aluminum materials and included the removal of approximately 3,000 creosote treated timber piles from the marine environment.

Woodfibre LNG also completed clean-up activities involving the removal of multiple abandoned structures from the pulp mill operation within upland areas. In general, upland clean-up involved removal of buildings and structures, above-ground storage tanks and large waste/ debris removal.

8.3.2 The Green Zone

In collaboration with Skwxwú7mesh Úxwumixw (Squamish Nation), a restoration zone (Green Zone) has been delineated within the certified project area. The purpose of the Green Zone is help protect and re-establish vegetation to support ecological and cultural values related to Mill Creek and to acknowledge the Project as being located on the former village of Swíyat. Swiẏát and Nexwnéwu7ts Átlk'a7tsem (Howe Sound) are tied to the cultural well-being of Skwxwú7mesh Úxwumixw (Squamish Nation) members, their ancestors, and their descendants.

As part of the Woodfibre and skwxwú7mesh Úxwumixw (Squamish Nation) Environmental Working Group and following completion of construction and commissioning of the Project, a Green Zone Restoration Plan will be developed to remediate and restore Mill Creek (within the Green Zone) and the Green Zone. The objectives of this plan are anticipated to include further remediation of exposed contaminated soils as required, and measures to improve riparian habitat and instream sts'úkwi7 (fish) habitat and the visual aspect within the Green Zone.

Woodfibre LNG will incorporate the Green Zone into the site layout as part of the Project design to help protect the riparian areas of Mill Creek within the Green Zone, and to re-establish a vegetated area, and will undertake the following commitments in respect of the Green Zone to satisfy skwxwú7mesh Úxwumixw (Squamish Nation) EAC Condition #2:

- Formally recognize that the Project is located on the former village of Swíyat by installing signage or artwork in the Green Zone, with the form, design, source and cost of this recognition being determined through engagement with the skwxwú7mesh Úxwumixw (Squamish Nation) and reflected in the Impact Benefit Agreement (IBA);
- Register a covenant against the lands within the Green Zone to ensure that, subject to the requirements mandated by any Authorization, no buildings are erected in the Green Zone and that the native vegetation contemplated in the Green Zone Restoration Plan, as defined in subsection (d), is preserved; regardless of scope of work conducted under subsection (d), Woodfibre LNG will directly pay for all costs for re-vegetation and long-term maintenance (as necessary) of the Green Zone with native plants including tree and shrub species appropriate for the Project area;
- Through the Woodfibre Environmental Working Group and following completion of construction and commissioning of the Project, develop a long term plan to remediate and restore Mill Creek (within the Green Zone) and the Green Zone. Restoration will be undertaken in accordance with a budget to be agreed in the IBA. The project may include remediation of exposed contaminated soils within the Green Zone, and/or measures to improve instream sts'úkwi7 (fish) habitat (within the Green Zone); and the visual aspect of the Green Zone (the "Green Zone Restoration Plan"); and
- Work with the skwxwú7mesh Úxwumixw (Squamish Nation) following Project construction to restore Mill Creek (within the Green Zone) and the Green Zone in accordance with the Green Zone Restoration Plan.

8.4 Location

The primary areas for habitat offsetting were selected using the following criteria:

- Expanding existing sts'úkwi7 (fish) use on-Site (e.g., sts'úkwi7 (fish) spawning);
- Improving sts'úkwi7 (fish) passage through the Site (e.g., juvenile salmonids and slhawt' (herring)); and
- Restoring habitats heavily degraded from historic industrial use.

Habitat areas identified from SCUBA surveys and baseline assessments were reviewed by Woodfibre LNG operations to ensure there was no overlap with Project infrastructure or risk for either operations or the long term physical integrity of the habitat measures. The areas best suited for habitat offsetting were southwest and northeast of the Passenger Dock. To enhance sts'úkwi7 (fish) migration, shallow reefs immediately seaward of the shoreline northeast of the MOF and behind the Marine FST Terminal were selected (**Figures 8-1, 8-2A, 8-3A**) Specific coordinates of each offsetting area are provided in **Tables 8-3** and **8-4**.

8.5 Marine Offsetting

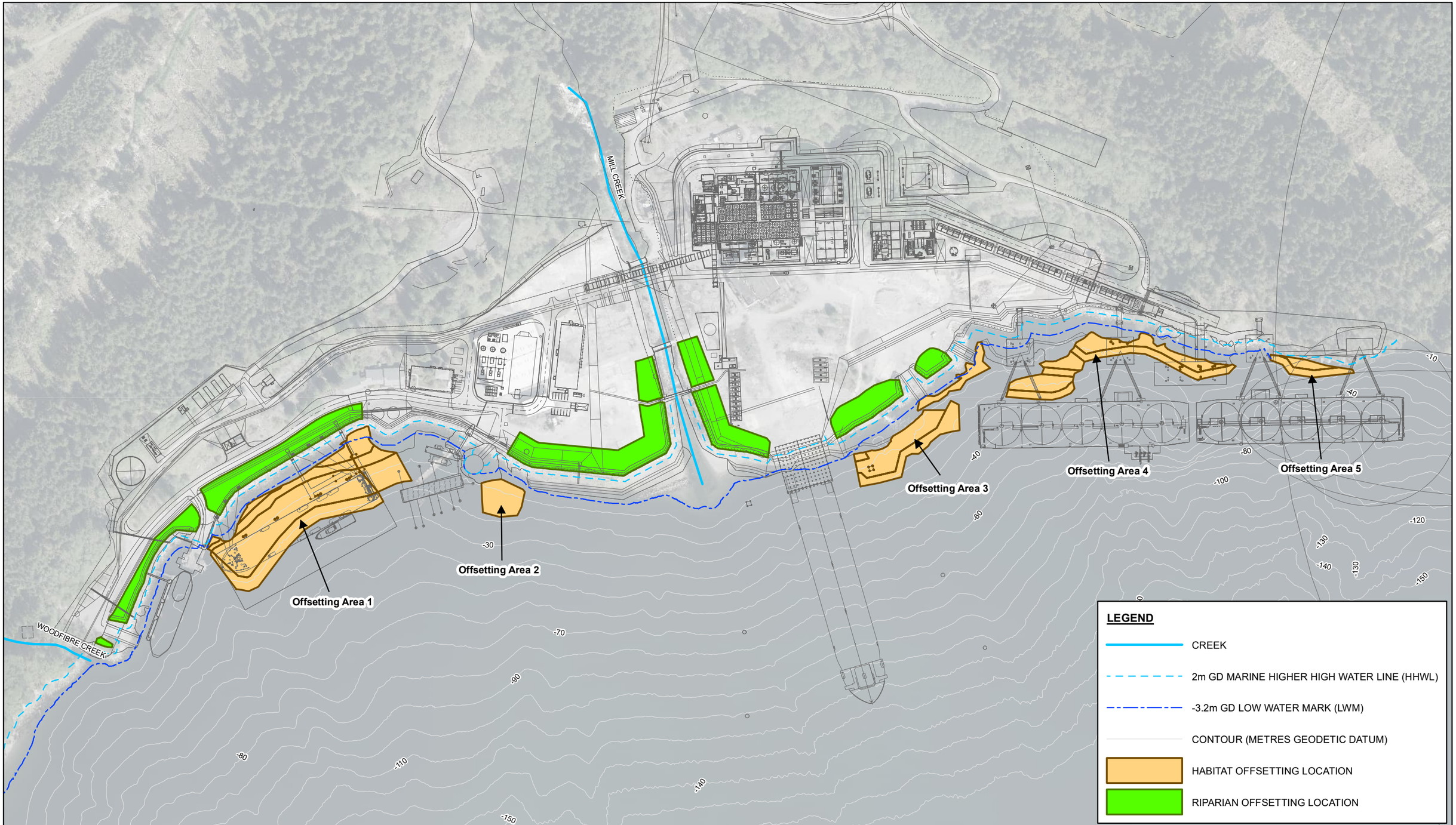
There are four marine aquatic habitat concepts proposed to offset the residual effects associated with the Project (**Table 8-5**) across five areas (Areas 1 through Area 5). These habitat offsetting areas are shown in **Figure 8-1, 8-2A, 8-2B, 8-3A, 8-3B,** and **8-3C** and are summarized below.

Table 8-5 Habitat Offsetting Measures Including Area, Habitat Types, and Location

Habitat Type	Marine Aquatic Offsetting Areas (m^2)					Total Area (m^2)
	Area 1	Area 2	Area 3	Area 4	Area 5	
Cobble Blanket	1,159.7	0	0	0	0	**1,160**
Shallow Rock Reefs	1,599.0	0	864.3	0	0	**2,463**
Sand Blanket	6,116.9	0	1870.1	2,654.4	311.7	**10,953**
Deep Rock Reefs Deep	2,507	1,274	1,311	1,881	571	**7,544**
Total	**11,383**	**1,274**	**4,045**	**4535**	**883**	**22,120**

8.5.1 Offsetting Concept A – Deep Rock Reefs and Fish Habitat Enhancement

Offsetting Concept A is proposed to be constructed between the Ro-Ro and Access Dock, and between the Access Dock and Mill Creek. The concept consists of rock reefs over a sand/ sparse cobble cap and is designed to improve habitat conditions for benthic infauna[12] (e.g., clams and worms), as well as to create hard substrate and increase density and diversity of epifauna[13] (e.g., sea cucumbers, sea urchins, crabs), and provide habitat for sts'úkwi7 (fish) species such as juvenile salmonids, rockfish and lingcod. Offsetting Concept A is lower in elevation and continuous with Offsetting Concept B (**Figure 8-2A, Figure 8-2B, Figure 8-3A**).



Woodfibre LNG

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NOTES:
1. ALL MAPPED FEATURES ARE APPROXIMATE AND SHOULD BE USED FOR DISCUSSION PURPOSES ONLY. PROJECT FEATURES MAY BE SUBJECT TO CHANGE.
SOURCES:
1. DATE OF AERIAL PHOTO IS 2019, OBTAINED FROM DISTRICT OF SQUAMISH.

20 0 100 m

SCALE: 1:0 (approx.)

Woodfibre
Squamish, B C
Woodfibre LNG Limited

REVISION No.	DATE	PROJECT No.
00	Jun. 2023	17227-100

Figure 8-1
Habitat Offsetting Overview

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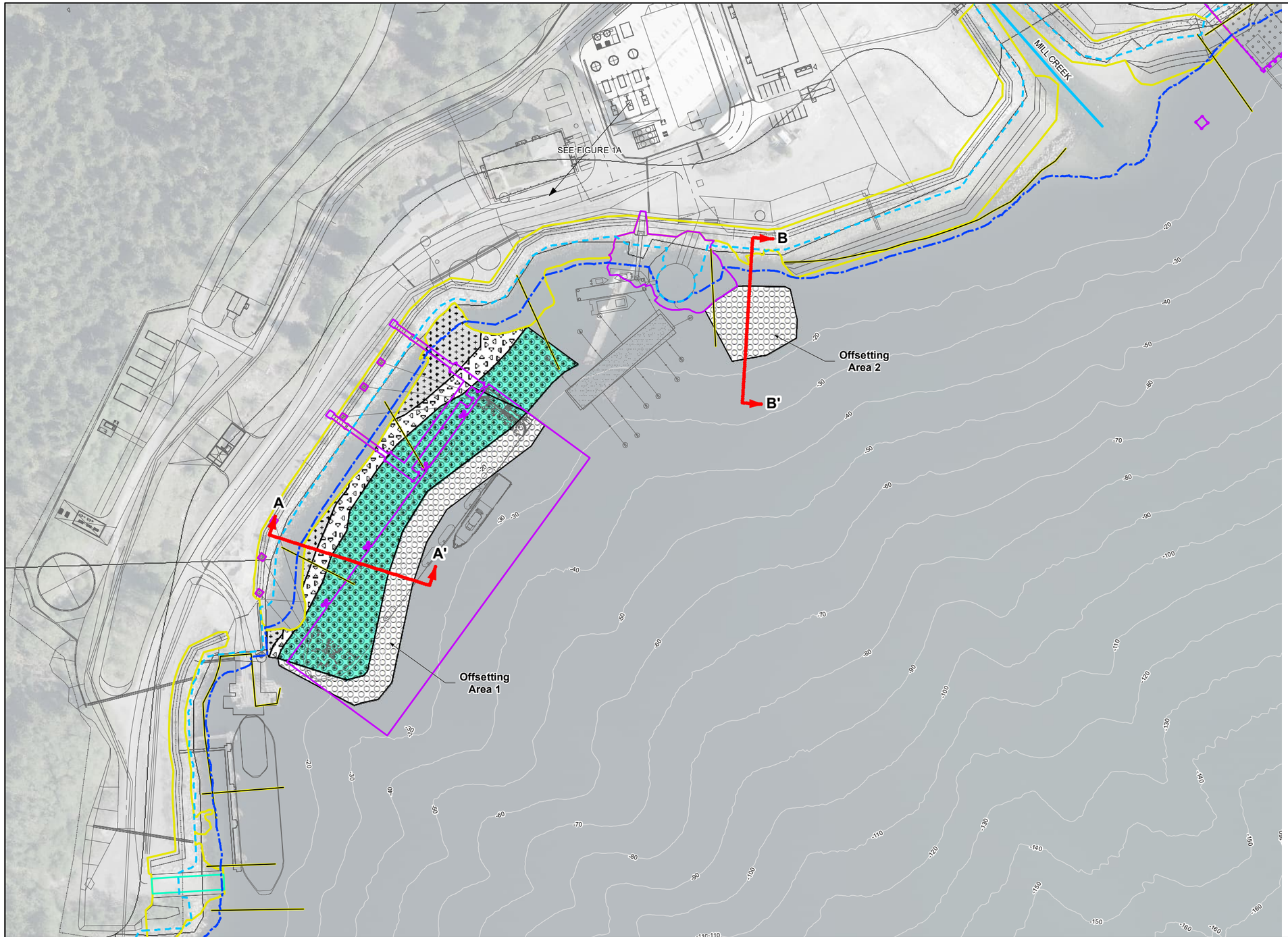

LEGEND

- LOT LINES & WATER LOT
- NEW STRUCTURES
- RAMP
- SHORELINE WORK
- COBBLE BLANKET
- DEEP REEF
- SAND BLANKET
- SHALLOW REEF
- 2m GD MARINE HIGHER HIGH WATER LINE (HHWL)
- -3.2m GD LOW WATER MARK (LWM)
- CREEK
- TRANSECT (KEYSTONE ENVIRONMNETAL MAY 2019)
- CONTOUR (METRES GEODETIC DATUM)
- CROSS SECTION

Woodfibre LNG

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NOTES:
1. THIS DRAWING IS FOR GENERAL INFORMATION ONLY. LOT BOUNDARIES AND FEATURES ARE APPROXIMATE.
2. DATE OF AERIAL PHOTO IS 2016.

Data collected from:
-Keystone Environmental Ltd. 2019 Dive Surveys at Woodfibre, Squamish, BC. Data Collected for Woodfibre. May 2019
-Hemmera. 2016. Figure 1 - Benthic Habitat Survey Summary Report. Prepared for Woodfibre LNG. September 2015
-Golder Associates Ltd. 2014. Marine Resources Baseline Study. Prepared for Woodfibre LNG. October 2014

15 0 75 m

SCALE: 1:1,500 (approx.)

Woodfibre
Squamish, B C
Woodfibre LNG Limited

REVISION No.	DATE	PROJECT No.
00	Jun. 2023	17227-100

Figure 8-2A

Habitat Offsetting Options
(Southwest of Mill Creek)

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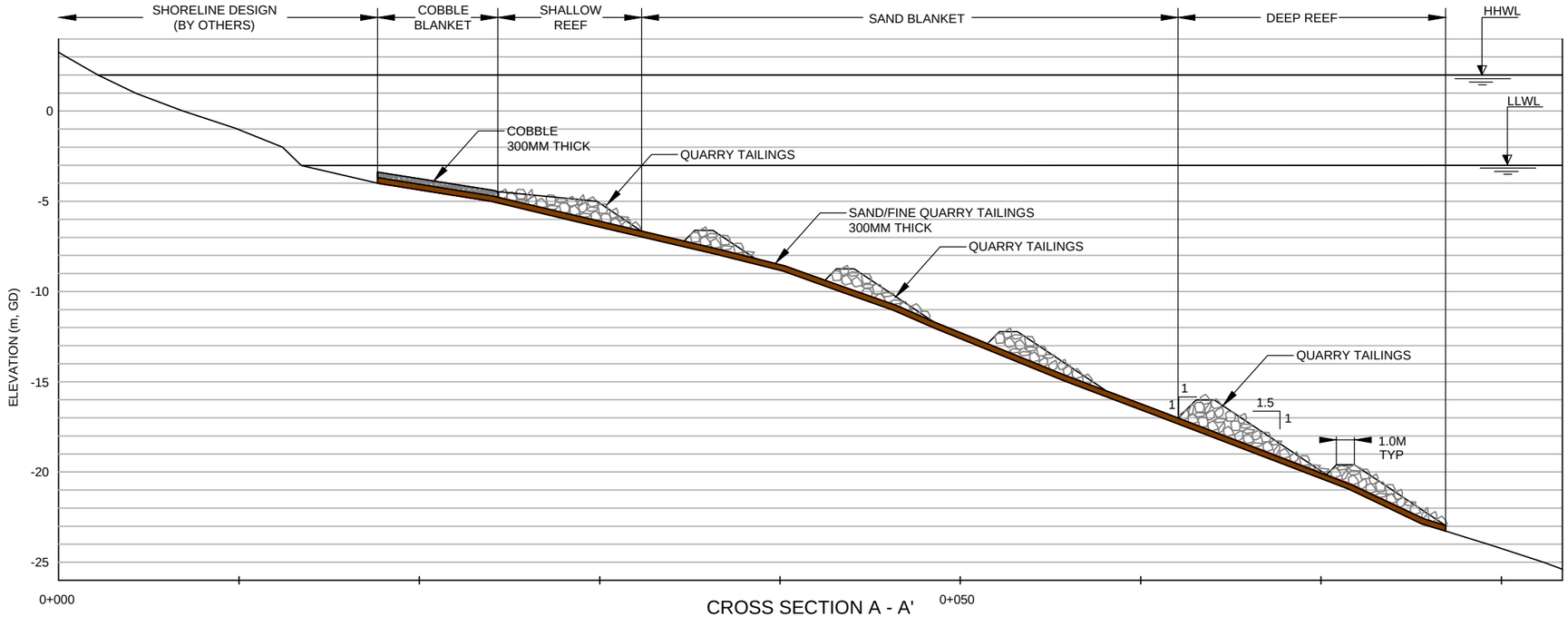
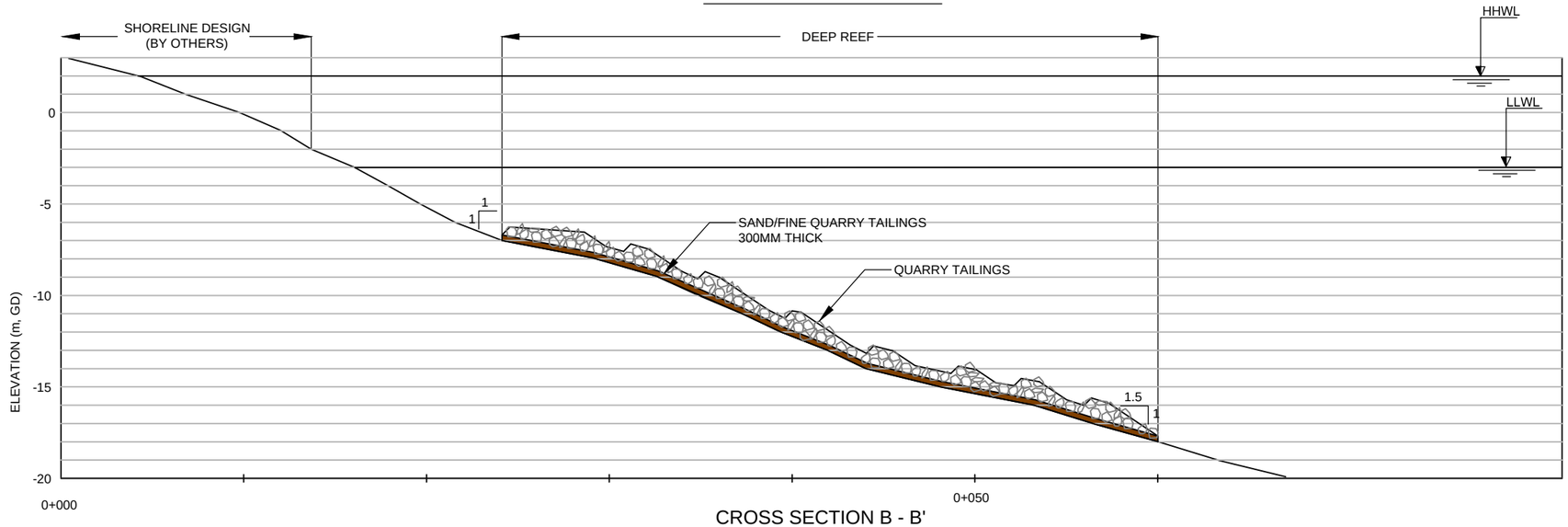


CROSS SECTION A - A'



CROSS SECTION B - B'

Keystone Environmental

5m 0 10m

SCALE: 1:300(approx.)

Squamish Pulp Mill (Woodfibre)
Squamish, B C
Woodfibre LNG Limited

REVISION No.	DATE	PROJECT No.
01	June 2023	17227-100

Figure 8-2B
Habitat Offsetting Sections A and B

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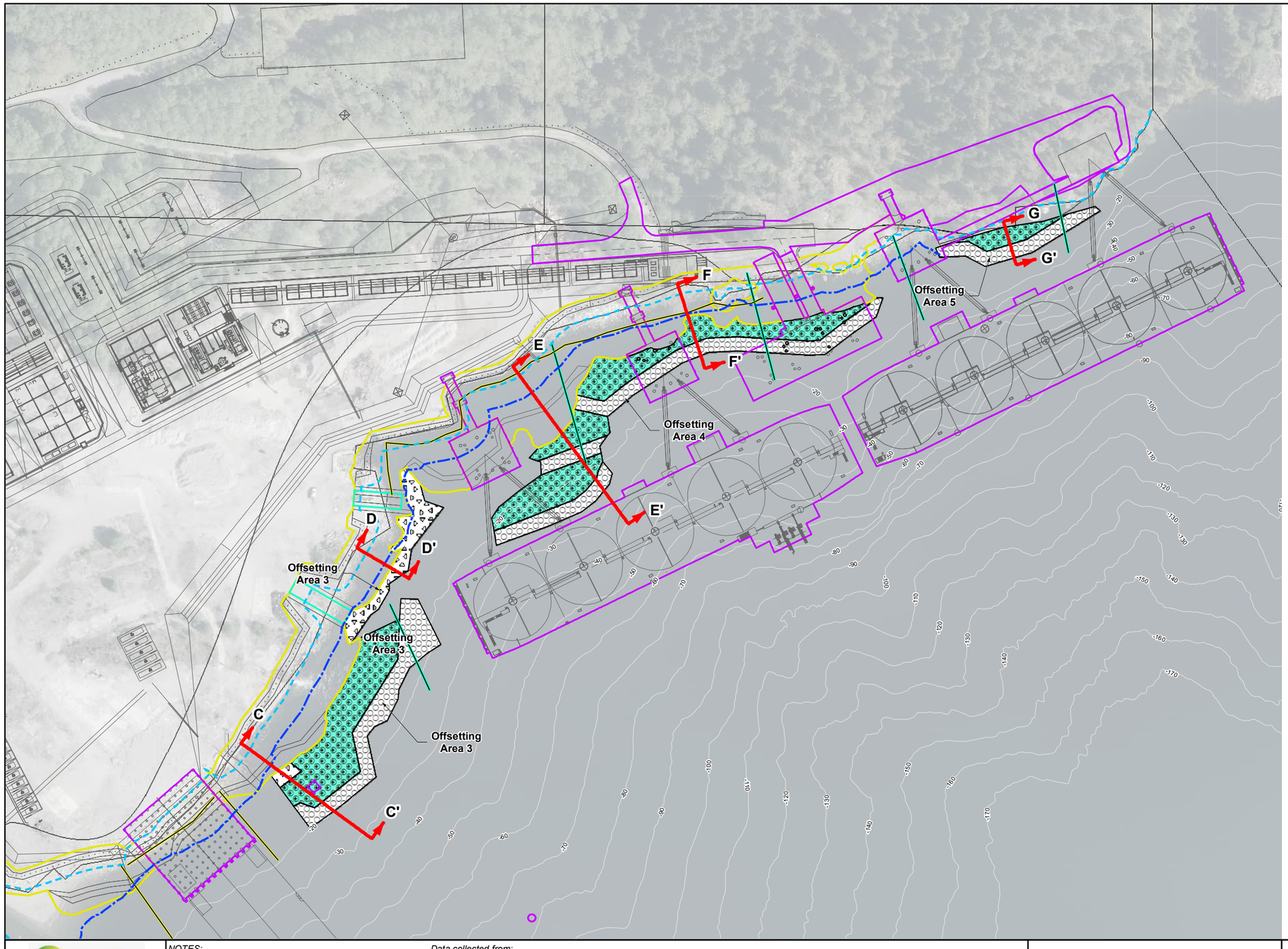

Woodfibre LNG

HATCH Keystone Environmental

NOTES:
1. THIS DRAWING IS FOR GENERAL INFORMATION ONLY. LOT BOUNDARIES AND FEATURES ARE APPROXIMATE.
2. DATE OF AERIAL PHOTO IS 2016.

Data collected from:
-Keystone Environmental Ltd. 2019 Dive Surveys at Woodfibre, Squamish, BC. Data Collected for Woodfibre. May 2019
-Hemmera. 2016. Figure 1 - Benthic Habitat Survey Summary Report. Prepared for Woodfibre LNG. September 2015
-Golder Associates Ltd. 2014. Marine Resources Baseline Study. Prepared for Woodfibre LNG. October 2014

15 0 75 m

SCALE: 1:1,500 (approx.)

Woodfibre
Squamish, B C
Woodfibre LNG Limited

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00	Jun. 2023	17227-100

Figure 8-3A

Habitat Offsetting Options
(Northeast of Mill Creek)

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Concept A consists of 5,203 m^2 of 0.3 to 0.4-m-thick layer of sand placed over the existing substrate between water depths of -6 m CD and -15.5 m CD (**Figure 8-2B, Figure 8-3A**). Material for the sand cap will incorporate gravel (to 38 mm diameter) to provide stability under wave and currents (CMO Consultants Ltd). In its shallower section (2 to -6 m CD) the sand cap will be continuous with Concept B.

A rock reef (1,572 m^2) will be constructed on top of the sand/ cobble cap at the deep edge of Concept A between 12.5 and -15.5 m CD running parallel to the shore. Smaller rock reefs/mounds will be placed between Concept B and Concept A, consisting of a deep rock reef covering approximately 10% of Concept A sand cap area. Rock reefs will be constructed of quarry tailing rock of a maximum diameter (D_{Max}) of 0.5 m piled in a stable triangular cross-sectional form. **Figure 8-2B** shows a generalized cross-section of Offsetting Concept A.

A total area of 6,775 m^2 is proposed for Offsetting Concept A.

8.5.2 Cobble Blanket

Offsetting cobble blankets are proposed to extend along the Project shoreline south of Mill Creek along the Floatel shoreline as shown in **Figure 8-2A**. The concepts are proposed as a band of sand with cobble substrate on top in the shallow subtidal zone to provide both infauna and epifauna habitat and substrate for algae growth and slhawt' (herring) spawning.

A 0.3 m to 0.4 m thick sand cap layer will be placed on the existing substrate totalling 1,160 m^2 from a depth of -1 m to -2 m to CD (-4m to -5m GD)(**Figure 8-2B)**. A single layer of cobble (technically small boulders) with a median diameter (D_{50}) of 0.3 m will be placed on the sand cap to provide attachment substrate for algae and sessile invertebrate species such as sugar kelp and anemones, while allowing bivalves (e.g., clams) access to the sand below.

8.5.3 Shallow Rock Reefs

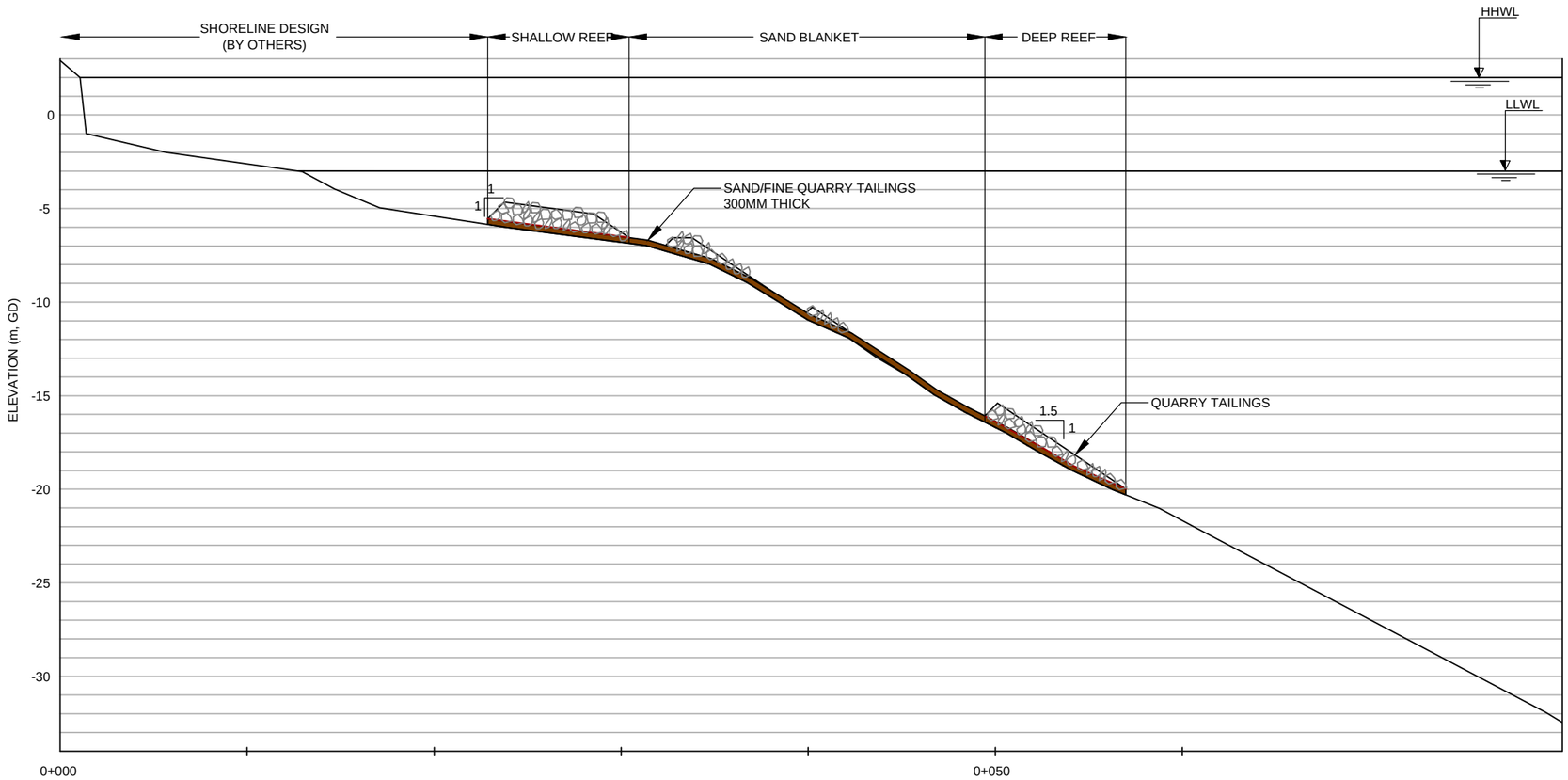
The shallow rock reef will be 2,463 m^2 and constructed of quarry tailing rock (D_{Max}=0.5 m) at -2 to -4 CD (-5 to -7m GD) as shown on **Figures 8-2B and 8-3B**. The top of the reef will generally be around -2 m CD to provide adequate insolation for kelp growth. The berm will act as a stabilizing rock reef to anchor the sand and cobble layers.

8.5.4 Sand Blanket

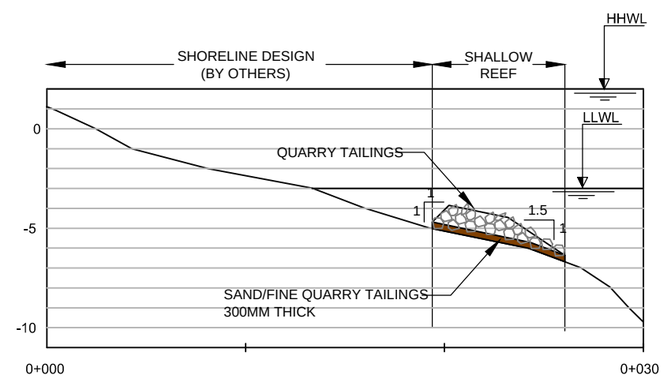
Sand blankets are proposed to be constructed on both sides of Mill Creek (**Figure 8-2A and 8-3A)**. The concept consists of a sand/ sparse gravel cap and is designed to improve habitat conditions for benthic infauna[3] (e.g., clams and worms).

The sand blanket consists of 10,953 m^2 of 0.3 to 0.4m thick layer of sand placed over the existing substrate at various depths between water depths of -4 to 18.5m CD (-7 to -21.5m GD)(**Figure 8-2B, 8-3B and 8-4C**). Material for the sand cap will incorporate gravel (to 38 mm diameter) to provide stability under wave and currents (CMO Consultants Ltd). Throughout the sand blanket, half metre tall rock mounds are also to be constructed (included in the 10,953 m^2 area) generally spaced greater than 2m apart as shown in **Figures 8-2B**, **8-3B** and **8-3C**. Areas where the existing grade is near 1.5 horizontal to 1 vertical will not contain rock mounds because it is too steep to construct them. Rock mounts will be constructed from the same material as the deep rock reefs (quarry tailings). The rock mounds will also be evaluated in a similar manner as the deep rock reefs for effectiveness.

[3] Organisms dwelling in the bottom substrate/ sediment.



CROSS SECTION C - C'



CROSS SECTION D - D'

Keystone Environmental

5m 0 10m

SCALE: 1:300(approx.)

Squamish Pulp Mill (Woodfibre)
Squamish, B C
Woodfibre LNG Limited

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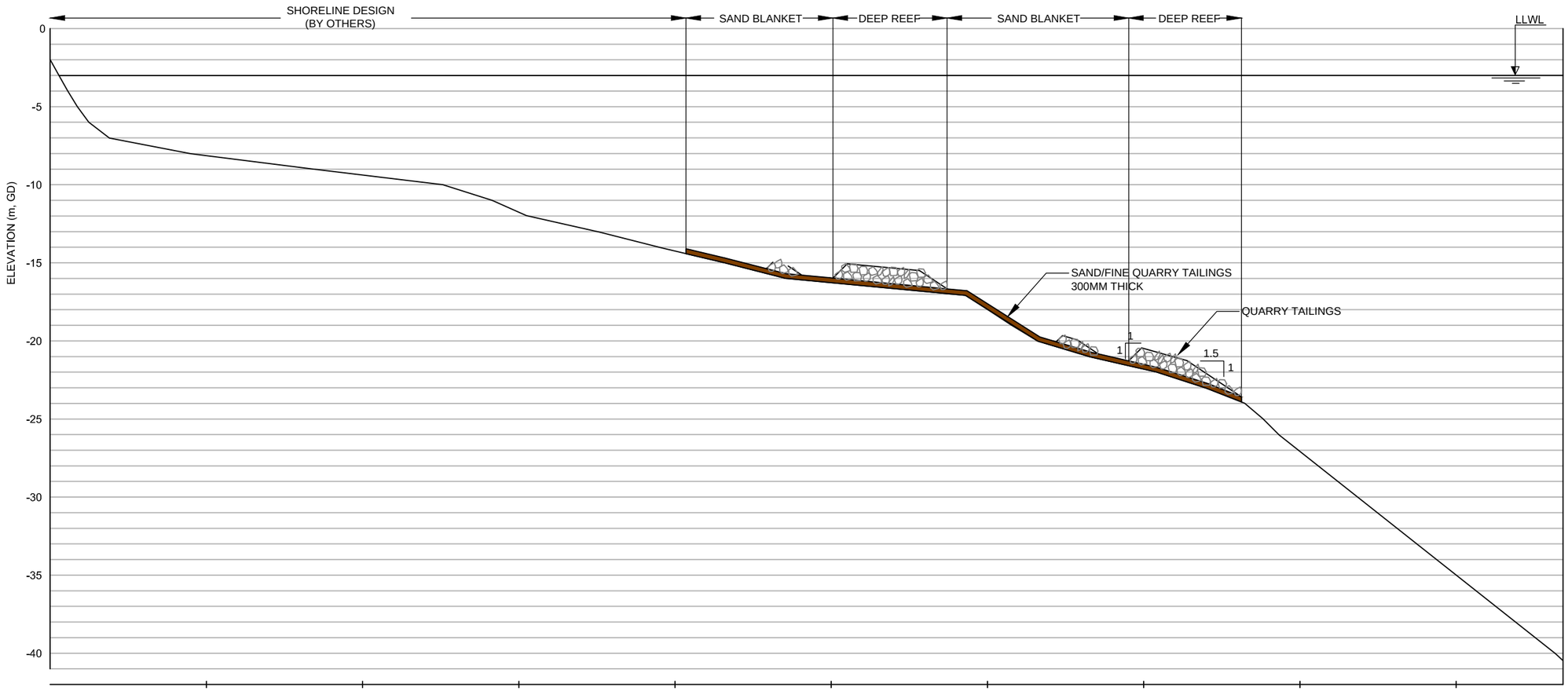
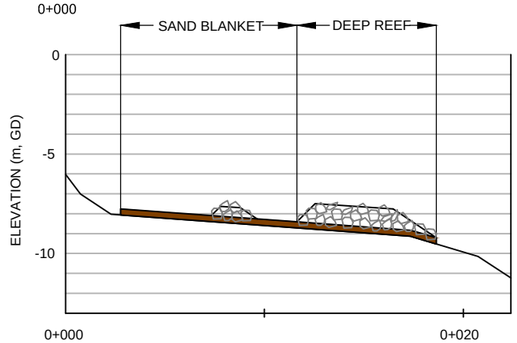
Figure 8-3B
Habitat Offsetting Section C and D

PLOT SCALE: 1:1 DRAWN BY: TL CADD FILE No. C:\Users\wappleton\Desktop\New folder\WLNG\Fig9-2B-Habitat Offsetting Concepts R0.dwg



CROSS SECTION E - E'



CROSS SECTION F - F'

Keystone Environmental

5m 0 10m

SCALE: 1:300(approx.)

Squamish Pulp Mill (Woodfibre)
Squamish, B C
Woodfibre LNG Limited

REVISION No.	DATE	PROJECT No.
01	June 2023	17227-100

Figure 8-3C
Habitat Offsetting Section E and F

PLOT SCALE: 1:1 DRAWN BY: TL CADD FILE No. C:\Users\wappleton\Desktop\New folder\WLNG\Fig9-2B-Habitat Offsetting Concepts R0.dwg

8.5.5 Deep Rock Reefs

Deep rock reefs (7,544 m^2) will be constructed on top of the sand/ cobble cap at the deep edge between -4 and -21 m CD (-7m and -24m GD) running parallel to the shore.

As mentioned in Section 8.5.3, smaller rock mounds will be placed within the sand blanket area consisting of a deep rock reef, which are expected to cover more than 10% of the sand blanket area (e.g. 10% of 10,953 m^2) but will vary based on how much the contractor can construct as a result of the steep nature of the foreshore. Note the area of rock mounds within the sand blanket is in the sand blanket area in Section 9.5.3, and not included in the areas provided in Section 8.5.4).

Rock reefs will be constructed of quarry tailing rock of a maximum diameter (D_{Max}) of 0.5 m piled in a stable triangular cross-sectional form. **Figure 8-2B, 8-3B and 8-3C** shows cross sections of the various reef configurations.

8.5.6 Materials and Methods for Offsetting Construction

Material for sand substrate will be sand mixed with fine quarry tailings (provided the silt content is washed out) to incorporate gravel with grain size of up to 38 mm for stability under waves and currents. Cobbles will have median diameter (D50) of 0.3 m and will be evenly graded between 0.2 and 0.4 m. Reefs and berms/mounds will be constructed of quarry tailings with a maximum rock diameter of 0.5 m and median rock diameter of 0.075 to 0.35 m. Rock materials will be rough angular blasted quarry rock to provide good filtering and good frictional strength along contact surfaces.

Sand and fine quarry tailings will be placed on the slope starting at the deeper end of each concept area and working up the slope. Finer material will be in contact with the seabed and uniformly distributed over the surface of existing substrate being covered. Cobbles will be placed on top of sand/fine quarry tailings on the slope starting at the top of the deep rock reefs/berms and working up the slope to the underside of the rip rap protection, where such exists, slightly overlapping its lower part.

Reef construction will begin with placement of rock material at the deeper end (toe) of each area and continue working up the slope. Rock to be lowered with a clam shall or excavator on a barge or from shore depending on what is feasible and the contractor's preference. Rock shall be lowered in a controlled manner and placed as specified.

Material will be handled, stored and transported in a way that fines are not separated from coarser fractions. Materials will not be dropped through the water column but placed on the seabed with a bucket to prevent separation of finer material from coarser material.

8.6 Riparian Offsetting

Riparian habitat offsetting measures will consist of restoring degraded marine, estuarine, and/or freshwater riparian areas to historic vegetation communities. The proposed areas to be planted are shown in **Figure 8-4**. Criteria for marine riparian planting included the following:

- Riparian planting to be within 30m of the marine environment (HHWL).

LOCATION MAP

N

LEGEND

- LNG CERTIFIED PROJECT AREA
- SPEA (PRELIMINARY)
- RIPARIAN OFFSETTING LOCATION

STREAMS (CHANNEL MIDPOINT) AND DITCHES (CLASSIFIED ACCORDING TO DoS DITCH MATRIX)

- NON FISH HABITAT
- NON PERMANENT NON FISH BEARING
- PERMANENT FISH BEARING
- PERMANENT NON FISH BEARING
- DITCH - MODERATELY PRODUCTIVE
- DITCH - MINIMALLY PRODUCTIVE
- DITCH - NON FISH HABITAT

Woodfibre LNG

HATCH Keystone Environmental

NOTES:
1. THIS DRAWING IS FOR GENERAL INFORMATION ONLY. LOT BOUNDARIES AND FEATURES ARE APPROXIMATE.
2. DATE OF AERIAL PHOTO IS 2019.

50 0 250 m

SCALE: 1:4,750 (approx.)

Woodfibre
Squamish, B C
Woodfibre LNG Limited

REVISION No.	DATE	PROJECT No.
00	Jun. 2023	17227-100

Figure 8-4

Riparian Offsetting

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- Riparian offsetting will target riparian areas disturbed from industrial use, cleared of vegetation and the native soils covered with permanent or long-lasting covers (e.g., gravel, concrete or asphalt), and areas colonized by nonnative species.
- Planting will follow restoration specifications based on DFO Riparian Revegetation Guidelines with modification for local Site conditions.
- Species composition and densities will mimic local habitats where possible.

Woodfibre LNG is currently reviewing whether operational constraints pertaining to safety and security requirements may limit riparian offset planting prescriptions and field fit changes may be required to adjust the riparian planting locations to work around final design infrastructure, roads, fences and ditches. If required, changes to any planting specification, species, or plan, will be determined through consultation with a QEP. A total area of **16,183 m^2** will be planted (**Table 8-6**).

Table 8-6 Proposed Riparian Planting from Figure 8-4

Polygon	Area of Riparian Planting (m2)
MR1	91.1
MR2	1,646.6
MR3	3,371.0
MR4	4,629.1
MR5	830.9
MR6	991.7
MR7	2,165.9
MR8	1811.2
MR9	645.2
	16,183

8.6.1 Site Preparation

8.6.1.1 Clearing and Grubbing

If clearing and grubbing is required (e.g. to prepare riparian offset areas for restoration):

- Prior to clearing, verify the limits of clearing with the owner's representative, and determine restrictions regarding preservation of existing trees, shrubs, natural features, and improvements within or adjacent to specified limits of clearing.;
- Prevent damage to all adjacent natural growth, landscaping, building structures, and underground and overhead utilities;
- Preserve all trees (≥ 20 cm diameter DBH) that are located around the perimeter of the work area;
- Retain trees to be removed as sekw'ekw'inexw (wildlife) trees where appropriate per assessment by QEP; and

Any vegetation, stumps, roots, and other organic and inorganic waste shall be cleared and disposed of off-site, except those that are approved as coarse woody debris/large woody debris/sekw'ekw'inexw (wildlife) trees.

8.6.1.2 Removal of Non-Native Species

Vegetation clearing is required for the majority of the Sites to facilitate development. Clearing is anticipated to be conducted using a combination of mechanical and manual removal dependent on the habitat type, invasive plant species and abundance. The following general measures are recommended prior to habitat enhancement works where invasive plants have been identified for removal:

- The Environmental Monitor will be present during clearing within 30m of riparian areas to assess potential root damage or tree mortality, and an arborist may be required to determine extent of disturbance if extensive root structure or debris is noted by the monitor.
- All vegetation removal should be avoided during the bird nesting window (March 1 – August 31) if feasible. Vegetation clearing scheduled during the bird nesting window should be preceded by a pre-clearing tsíptspí7lhtn (bird nest) survey conducted by a QEP.
- Clearing and grubbing in riparian forest will be conducted in the fall, to the extent feasible.
- An amphibian salvage will be conducted according to the terms and conditions of a General Wildlife Permit. Design of a salvage program will be prepared to support the permit application, if necessary once the project receives approval and habitat offsetting is finalised.
- Native trees and shrubs to be retained that are located adjacent to project activities will be protected through the installation of exclusion fencing extended to the tree drip line.
- Machinery and equipment must be clean and free of soils and plant materials prior to mobilization and demobilization to and from the Site to avoid or reduce the potential for the spread or introduction of invasive plant species.
- Machine operators will take care when backing up or swinging around to reduce damaging overhanging limbs and nearby trees marked to be protected.
- Disturbance to naturally vegetated work areas outside the project footprint will be restored through native plantings and seedings.
- The removal of the invasive species on Site will be the responsibility of the Contractor and/ or Subcontractor with guidance from the Environmental Monitor to aid them in following the appropriate BMPs for each species. Measures for the removal of Japanese knotweed and Himalayan blackberry are provided in the following sections.

8.6.1.3 Japanese Knotweed

Japanese knotweed has been observed on Site and treated. Should knotweed be identified on Site, the following mitigations, at a minimum, will be implemented:

- Removal of noxious weeds must be conducted according to the BC Weed Control Regulation and *Integrated Pest Management Act*.

- Mechanical removal of non-native Japanese knotweed should be undertaken by hand. Japanese knotweed can reproduce from stalks and rhizomes in the soil; therefore, removal solely with an excavator could increase the risk of reestablishment or transport off-site. Japanese knotweed may require multiple rounds of removal.
- The contractor may apply a foliar herbicide, if approved by the District of Squamish.
- Where knotweed and soil removal is required, an Environmental Monitor trained in knotweed root identification should be present to assess the extent of soil contamination and to assist the contractor in targeting and removing knotweed roots and immediately adjacent soils.
- Knotweed will be contained, transported, and disposed of off-Site. An approved disposal facility will be contacted prior to removal of knotweed materials to coordinate a disposal location and time. The agreed upon disposal facility will be indicated during the kick-off meeting prior to the knotweed removal works.
- Plant debris/seeds must be immediately bagged before transporting to a preapproved and designated licensed disposal site. This disposal facility will be indicated during the kick off meeting prior to the plant removal.
- Chemical treatment (e.g., foliar spray or stem injection with an approved herbicide) by a certified pesticide applicator may be conducted. If herbicide treatment is conducted it will be performed in accordance with the requirements of the BC *Integrated Pest Management Act*. Stem injection is to be used for plants located within 1 m of the high water mark opposed to spray or wipe-on pesticide methods. Herbicide treatment will not occur within one metre of the high water mark.
- Separate trucks will be used for hauling of knotweed soil and backfilling to prevent cross contamination.
- Hauling trucks should have loads tarped when removing materials off-Site.
- Infested areas will be restricted to vehicles and equipment used in removal/excavation, which will be inspected for loose soil and plant material before leaving the infested area, and thoroughly cleaned if required.
- Material remaining after vehicle or equipment cleaning will be contained, collected, and disposed of along with other Japanese knotweed material (soil/clippings).
- Delineate infested area with temporary exclusion fencing or tape to minimize risk of accidental spread of seeds and plant material to other project areas.
- Post-treatment ínexwantas (monitoring) should be conducted for a period of three years to document conditions potential re-growth of invasive plant species where further maintenance may be required. If regrowth of Japanese knotweed is observed it will be treated chemically or mechanically, in accordance with applicable regulations.

8.6.1.4 Himalayan Blackberry

The following measures will be implemented during Himalayan blackberry removal within the Site:

- Environmental ínexwantas (monitoring) will be conducted during blackberry removal to confirm that invasive plants are removed in a manner that reduces potential for regrowth or spreading to other areas.

- Mechanical removal of non-native species, including Himalayan blackberry should target shoot and root materials and be disposed offsite.
- When removing Himalayan blackberry, initial clearing should be attempted with an excavator to remove all material, including root crowns located just below the soil to effectively kill the plant. Any remaining plants adjacent to the cleared area should be removed by hand with care to remove both shoots and root systems.
- Contact a disposal facility prior to removal of the Himalayan blackberry to coordinate disposal.
- Use machinery or hand tools to remove the roots of Himalayan blackberries where possible. The roots should be excavated to a depth of at least 0.1 m and disposed of off-Site at a previously approved disposal facility.
- All plant material should be collected in bags or tarps and incinerated or transported to a designated landfill. If invasive plant material and underlying soil is to be stockpiled before bagging and loading onto trucks, it should be placed on, and covered by, tarps or polyethylene sheeting. Care should be taken to ensure that the plant parts are secured during transport.

8.6.1.5 Soil Remediation and Regrading

Supplemental topsoil is required for planting areas where specified and will, at a minimum, consist of 0.2 m of topsoil containing particulates, microorganisms and organic matter, which provides suitable medium for supporting intended plant growth will be spread evenly across the Site. Topsoil will not contain toxic elements or growth inhibiting materials.

Site micro-topography should be left rough and loose with low mounds and hollows measuring up to 0.1 m in height above and below grade.

Once vegetation is cleared, with ESC measures in place, the landscape will be regraded to the design specification. Offsetting areas will be replanted after regrading and prior to the rainy season (November through March), or appropriate erosion control structures will be installed such as erosion control blankets.

8.6.2 General Planting Requirements

Planting should follow restoration specifications for each area, which are based on DFO Riparian Revegetation Guidelines with modification for local Site conditions. If required, changes to any planting specification, species, or plan, will be determined through consultation with a QEP.

The following general measures will be implemented for all on-Site and off-Site revegetation works unless otherwise indicated by a QEP or a Site-specific requirement:

- Revegetate disturbed areas immediately following completion of work in riparian zones; plant stock should be planted in the fall (September to October) or spring (March to April) in consultation with a QEP to determine optimal planting timelines based on recent weather data.
- The correct botanical name should be used to order planting stock and tags should be left attached for field identification.
- All plant material should be nursery stock, guaranteed for 1 year after successful transplanting.

- Tree stock should be a minimum of 1.2 metres in height when purchased and planted at the width suitable for the mature stock (no greater than 3.5 metres apart or a minimum stocking rate of 800 trees per hectare). Red alder may be included in a seed mix as they grow at a rapid rate of approximately one metre per year. Red alder must be thinned to a maximum of one red alder per two square metres during the ínexwantas (monitoring) period.
- Planting density for shrubs should equate to a minimum of one 1-gallon-sized pot per square metre (0.3 m in height). Four 10-cm-sized plugs per square metre may be substituted for aquatic graminoid species such as sedges and rushes.
- The quantity of stock planted should ensure at least 90% for trees, as well as 90% overall survivorship, or replanting will be required at the end of five years.
- Live staking may be incorporated in planting plans by substituting a minimum of four (4) stakes per shrub of rooted or unrooted cuttings of willow (*Salix* spp.) for the prevention of erosion and protection of streambanks. Locations and abundance of staking will be determined in consultation with a QEP where there is potential for erosion or stability issues along streambanks.
- Protection for trees from sekw'ekw'inexw (wildlife) such a sḵeĺáẃ (beavers), voles, and deer will be added and included in costing.

The contractor will revegetate all marine riparian planting areas with shrub species associated with the CWHdm subzone. The marine riparian zone will be treated with rip rap around the top of bank. Voids should be filled with sand and dunegrass (*Leymus mollis*) should be pocket planted between the interstitial spaces. Beyond the top of bank, the contractor will revegetate with native salt tolerant shrub species associated with the CWH shoreline subzone which should include: salal (40%), salmonberry (40%), red huckleberry (20%). A mix of red alder (10%) and Sitka spruce (5%) or shore pine (5%) should be planted in place of red huckleberry (-10%) and salmonberry (-10%), if allowed by Woodfibre LNG operations as per their safety requirements.

8.6.3 Habitat Features

Rock mounds should be added to the Site wherever possible. The Contractor may use large boulders/cobble excavated during site clearing. Rock mounds should be installed using a minimum of 0.3 m diameter rock, with an overall minimum dimension of three-square metres horizontal by up to one metre vertical at the mounds centre. Rock mounds may occur at a frequency of one per 1,000 square metres.

Coarse woody debris (CWD) in riparian areas and sekw'ekw'inexw (wildlife) corridors will equate to a minimum of one percent of area. CWD can be any tree species and a variety of sizes with a minimum of 3 m length and 0.2 m diameter.

During construction of offsetting areas, sekw'ekw'inexw (wildlife) trees will be preserved wherever possible and where they do not act as a hazard tree. Sekw'ekw'inexw (wildlife) trees installed as an offsetting measure should be 3 to 5 m long, 30% below ground (i.e., 1.5 m in ground and 3 m above ground), and 0.3 m in diameter. Sekw'ekw'inexw (wildlife) trees may occur at a frequency of one per 1,000 square metres.

8.7 Offsetting Construction Schedule

Construction of the offsetting habitat is expected to begin throughout Project's construction phase (September 2023 – January 2028). Placement of the rock reefs, sediments caps, and extension of the shallow

hard substrate will be done within MLRW. Offsetting measure Concept A and B will be coordinated with or after shoreline work. Shallow reefs in the northeast will be constructed prior to, or at the same time as the marine terminal to avoid potential future access restrictions. Offsetting measures in Area 1 will be coordinated with the decommissioning of the Floatel.

Upland riparian offsetting areas will also be coordinated near the end of Project works to avoid disturbance and allow for efficiencies. Marine riparian areas will be constructed after shoreline works are complete and upland grading finalized. Offsetting along Woodfibre and Mill Creek Creeks will be completed prior to completion of Construction. Timing of riparian area preparation and planting will be guided by the offsetting plan and specifications (see **Table 8-7**)

Table 8-7 Estimated Construction Schedule for Offsetting Areas

Offsetting Measure	Estimated Start	Estimated Finish	Maintenance Period	Monitoring Period[4]
Area 1	2026	2027	2028	2028 – 2035
Area 2	2024	2025	2026	2026 – 2033
Area 3	2024	2025	2026	2026 – 2033
Area 4	2024	2025	2026	2026 – 2033
Area 5	2024	2025	2026	2026 – 2033
MR[5]1-9	2026	2026	2027-2028	2027 – 2034

8.8 Cost Estimate

Based on $150/m2 for marine works and $50/m2 for riparian works, the total estimated cost for construction of the marine and riparian habitat offsetting concepts, inclusive of a 25% contingency, is $5,158,938 (**Table 8-8**).

Table 8-8 Cost Estimate for Offsetting Construction at Woodfibre LNG.

Offsetting Measure	Area with Habitat Contingency	Cost Estimate
Area 1	11,383	$1,707,450
Area 2	1,274	$191,100
Area 3	4,045	$606,750
Area 4	4,535	$680,250
Area 5	883	$132,450
MR1-9	16,183	$809,150
Total	**38,303**	**$4,127,150**
Costing Accuracy +/-25%	**-**	**$1,031,788**
Total Cost Estimate (+/-25%)	**-**	**$5,158,938**

[4] Monitoring is proposed for 5 periods over 7 years including years 1, 2, 3, 5, and 7 post-construction.
[5] MR: Marine riparian

8.9 Existing Conditions in Habitat Offsetting Areas

Locations of the offsetting measures have been determined based on enhancing areas of low value sts'úkwi7 (fish) habitat or improving sediment health from historically industrial processes such as wood processing and handling. Marine substrate and biological features mapping for the Project area has been consolidated based on baseline assessments, slhawt' (herring) ínexwantas (monitoring) surveys, and specific follow-up dive assessments as presented in **Section 6**.

Substrates within the subtidal zone of the CPA consist mostly of silt and sand mixed with wood waste (**Figure 6-3A, 6-3B, and 6-3C**). Patches of cobble and boulder were observed near the toe of slope of the shoreline armouring throughout the Site, and at the subtidal base of the steep bedrock landscape in the northeast. Bacterial mats of *Beggiatoa* spp. Were observed throughout the area and indicate decomposition of organic matter. Shallow sediment cores in areas identified for offsetting measures confirm that fine wood waste exists below a thin layer of silt in the southwestern portion of the site, and thick layers of wood debris exist in the northeast.

Marine vegetation and sessile invertebrate community mapping for the Project area has been consolidated based on studies identified above. In general, the intertidal zone (approximately 5.1 m to 0.0 m chart datum [CD]) contained a low diversity of benthic invertebrates and a greater amount of macroalgae compared to the subtidal zone ((**Figure 6-4A, 6-4B, and 6-4C**)). Productive marine communities are mainly limited to a narrow band of rockweed associated with the intertidal shoreline armouring or bedrock.

Taxonomic analysis of benthic macroinvertebrate samples (Golder 2014) revealed that lower benthic invertebrate density was observed in samples that contained higher proportions of wood debris. This was confirmed by follow-up sampling in areas of the proposed offsetting measures in December 2019 (Keystone Environmental 2019).

Marine sts'úkwi7 (fish) including slhawt' (herring) and juvenile salmonids primarily use the site as a migration corridor and rearing for species such as perch and lingcod. Surf smelt and sand lance have not been observed within the CPA; however, slhawt' (herring) spawn has been documented within the CPA boundaries. Juvenile salmonids have been observed migrating through the site by the access dock and rearing in front of the old timber wharf. Rockfish were not noted in the historic surveys; however, lingcod are common throughout the site and egg masses have been observed in the northeast. Offsetting is proposed in the shallow subtidal zone along the Project shoreline both southwest and northeast of Mill Creek at depths from approximately -1 m CD (toe of shoreline armouring) to -4 m CD; extending approximately five metres seaward. Currently, this area is generally of low productivity as it transitions from large boulder to silt and sand. Rockweed and kelps were sparse in this area.

This area proposed for offsetting is north of the Ro-Ro and north of the access dock at depths of from approximately -4 m to approximately -21 m CD. Shallow sediments (-4 m CD) in this area were silt and sand with small fragments of wood debris. Deeper sediments (-10 m CD) were mainly silt with some sand and clay, and higher amounts of fine wood particulate throughout. Few biotas were observed in this area below -4 m CD other than diatoms and a single aẏx (dungeness crab). Benthic macroinvertebrates samples did not show any infaunal communities.

8.9.1 Marine Habitat Offsetting Reference Areas

This section will be superseded by a stand-alone Offset Effectiveness Monitoring Plan in 2024

A single reference location does not contain all of the habitat types proposed as part of the habitat offsetting; therefore, several reference sites are required in order to complete the evaluation. In 2023, 13 reference site locations were considered prior to conducting fieldwork to ground-truth their ability to be reference sites (**Figure 8-5**). Keystone Environmental conducted dive surveys of 4 of the 13 locations and were able to find references sites to compare the offsetting to through Site 7 and 12. Additional dives were not conducted because suitable reference sites were found.

- Site 1: Not examined.
- Site 2: Not examined.
- Site 3: Dives determined that suitable habitat was not present and therefore should not be used.
- Site 4: Not examined.
- Site 5: Not examined.
- Site 6: Not examined.
- Site 7: Provides adequate habitat to compare to the deep rock reef.
- Site 8: Not examined.
- Site 9: Not examined.
- Site 10: Not examined.
- Site 11: Dives determined that suitable habitat was not present and therefore should not be used.
- Site 12: Provides adequate habitat for all offsetting components except the deep rock reef.
- Site 13: Not examined.

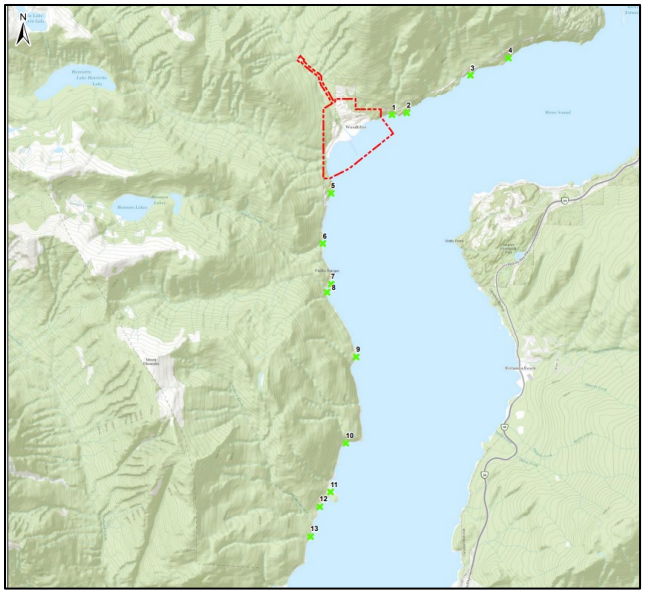

Figure 8-5 Potential offsetting reference site locations considered.

8.10 Potential Effects of Offsetting Habitats

As part of the FDS Condition 3.12 for the Project, determination of the potential for adverse effects is required to be considered as part of the Offsetting Plan for the following components:

- Migratory birds and their habitats ;
- Terrestrial species, including amphibians and reptiles, and their habitats ;
- Listed species at risk and their habitats ;
- The current use of lands and resources for traditional purposes by Indigenous peoples
- The flow rates, water depths or water widths that may affect the passage of a vessel including a vessel used by Indigenous peoples in the context of their current use of lands and resources for traditional purposes ;
- Physical and cultural heritage and structure, site or thing that is of historical, archaeological, paleontological, or architectural significance to Indigenous peoples (**;** and
- From potential sources of contamination including polycyclic aromatic hydrocarbons, dioxins, furans, copper, lead, zinc, tri-n-butyltin, arsenic, cadmium, and methylmercury in the receiving environment.

8.10.1 Migratory Birds and Their Habitats

Migratory birds and their habitats are not expected to be adversely affected by the offsetting works. The foreshore is currently mostly unvegetated and clearing of upland vegetation is not planned. Offsetting habitat will not involve structures above the HHWL and pose low risk for collisions. With the application of mitigation measures, marine sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat that migratory birds may use for feeding are expected to be positively affected by increasing overall health of the environment, increased macroinvertebrates in sediments which function as a source of food for higher trophic levels. Marine birds can also be present within CPA but impacts on these birds is unlikely as the habitat suitability within the CPA is low thus the potential for nesting is low as well. Further information regarding impacts to birds and the associated mitigations can be found in the *Wildlife Management and Monitoring Plan* (Woodfibre LNG General Partners Inc. 2023).

8.10.2 Terrestrial Species, including Amphibians and Reptiles, and Their Habitats

Terrestrial species including amphibians and reptiles and their habitats are not expected to be adversely affected by the offsetting works. The foreshore is currently mostly unvegetated and clearing of upland vegetation is not planned. Freshwater wetlands that may support these species are not present in offsetting habitat or in access areas. Offsetting works will enhance subtidal habitats and are likely to be constructed from marine-based equipment. The foreshore in the area of the proposed offsetting works is disturbed and amphibians and reptiles are unlikely to occur. If land-based equipment is used in offsetting habitat construction, clearance surveys for terrestrial species will be conducted prior to works as a part of BMPs.

8.10.3 Listed Species at Risk and Their Habitats

Listed species at risk in section 6.8 and their habitats are not expected to be adversely affected by the offsetting works. The only marine species at risk that are likely visit areas near or within the Site are yéwyews (killer whale) from the transient and southern resident populations, both of which have been observed in Nexwnéwu7ts Átlk'a7tsem (Howe Sound) (Keple 2002). Protection for marine mammals with

respect to expected construction activities are described in Section 7. Offsetting measures are expected to contribute to the overall increase in health of Nexwnéwu7ts Átlk'a7tsem (Howe Sound) and prey of both populations of yéwyews (killer whale) and are therefore seen as a net benefit to species at risk.

Additionally, marine birds could be present within the CPA including Piyís (Marbled murrelet [Brachyramphus marmoratus]) which is provincially Blue-listed and federally designated as threatened on Schedule 1 of SARA. These species could be found in the watershed of Woodfibre and Mill C; however, the deep bathymetry of the marine environment does not provide a high value foraging habitats such as mudflats. Further details about the impact on marine and shorebirds and the associated mitigation of offset those impacts can be found in the *Wildlife Management and Monitoring Plan* (Woodfibre LNG General Partners Inc. 2023).

8.10.4 Current Use of Lands and Resources for Traditional Purposes by Indigenous Peoples

The current use of lands and resources for traditional purposes by Indigenous peoples is not expected to be adversely affected by the offsetting works. Offsetting works are being completed within subtidal areas and do not involve excavation of upland areas, therefore should not affect any potential undocumented archaeological sites, including subsurface resources, surface lithic scatters, culturally modified trees, intertidal features and heritage wrecks.

Offsetting measures are designed to enhance natural habitat and increase health and populations of sts'úkwi7 (fish) used for traditional purposes by Indigenous people, therefore will positively affect current use of land and resources for traditional purposes by Indigenous peoples. Indigenous peoples will be consulted on the proposed offsetting plan prior to construction with an opportunity to comment and inform changes in design, if necessary.

8.10.5 Flow Rates, Water Depths or Water Widths that May Affect the Passage of a Vessel including a Vessel Used by Indigenous Peoples in the Context of Their Current Use of Lands and Resources for Traditional Purposes

There is no expected adverse effect from the proposed offsetting works on the flow rates, water depths or water widths that may affect the passage of a vessel, including a vessel used by Indigenous peoples in the context of their current use of lands and resources for traditional purposes. Woodfibre LNG operations has reviewed offsetting measures as it pertains to ship and small watercraft operations on Site. Indigenous peoples will be consulted on the proposed offsetting plan prior to construction with an opportunity to comment and inform changes in design if vessel passage may be impacted. The offsetting works have been designed to prevent contact with vessels and operational structures. Shallow reefs will be positioned near shore and away from boat traffic with the highest point planned for -1.5 m CD.

8.10.6 Physical and Cultural Heritage and Structure, Site or Thing that is of Historical, Archaeological, Paleontological or Architectural Significance to Indigenous Peoples

Offsetting measures are not expected to have adverse affects on physical and cultural heritage and structure, site or thing that is of historical, archaeological, paleontological, or architectural significance to Indigenous peoples. Indigenous peoples will be consulted on the proposed offsetting plan prior to construction with an opportunity to comment and inform changes in design, if necessary.

8.10.7 From Potential Sources of Contamination including Polycyclic Aromatic Hydrocarbons, Dioxins, Furans, Copper, Lead, Zinc, Tri-n-butyltin, Arsenic, Cadmium and Methyl-mercury in the Receiving Environment

Habitat offsetting measures are being designed to reduce potential contact of marine sts'úkwi7 (fish) with sediments containing various levels of contamination through the addition of sand layers to create a new, uncontaminated biologically active zone. Mitigation measures are outlined in Section 7 to minimize disturbance of sediments that may contain contamination during construction of offsetting measures.

9. HABITAT OFFSETTING EFFECTIVENESS PERFORMANCE OBJECTIVES, MONITORING, AND ADAPTIVE MANAGEMENT PLAN

This section will be superseded by a stand-alone Offset Effectiveness Monitoring Plan in 2024

9.1 Performance Objectives

Habitat offsetting has been designed to create sts'úkwi7 (fish) habitat for species that are affected by the works. Target species are identified in the **Section 6.3** (for example, Pacific slhawt' (herring) spawning, juvenile salmon, trout, lingcod) and the habitat that they depend on is described in **Section 6.2**. Project impacts will affect riparian habitat, hardened shoreline habitat and soft substrates. The proposed habitat offsetting intends to incorporate all of these habitat types to achieve like-for-like benefits to the extent possible like:

1. restoring sts'úkwi7 (fish) rearing and spawning areas;
2. restoring sts'úkwi7 (fish) migration corridors through the CPA;
3. restoring seabed health (i.e., physical quality and biotic activity); and
4. restoring riparian areas in the CPA.

These objectives will be accomplished through construction of:

- Riparian planting
- Shallow cobble blanket habitat for marine vegetation establishment (e.g. sugar kelp), which provide habitat for slhawt' (herring) spawn and refuge areas for juvenile sts'úkwi7 (fish)
- Shallow reefs for marine vegetation establishment (e.g. sugar kelp), which provide habitat for slhawt' (herring) spawn and refuge areas for juvenile sts'úkwi7 (fish)
- Sandy subtidal habitat with added clean sediment to improve function for infauna populations (e.g. clams, worms)
- Deeper unvegetated rock mounds and reefs to support deeper sts'úkwi7 (fish) populations (e.g. lingcod).

An as-built inspection and survey will be completed after offsetting habitat construction is complete to confirm the work constructed and document any field fit adjustments. A pilot survey will be conducted prior to effectiveness ínexwantas (monitoring) to assist with adaptive management of the proposed metrics. Habitat effectiveness ínexwantas (monitoring) assessments will be conducted one, two, three, five, and seven years post-construction between February 1 and September 30 to observe offsetting measures during spawning season and the summer growth period. Observations of offsetting measures during other environmental and verification ínexwantas (monitoring) will be incorporated in effectiveness assessment and reporting.

Ínexwantas (monitoring) metrics and performance criteria (**Sections 9.2 – 9.6; Tables 9-1 to 9-5**) will be used to evaluate the effectiveness of the offsetting measures during the ínexwantas (monitoring) program. Metrics were divided into primary and secondary metrics. The primary metrics identify factors that must be met for the habitat to be deemed successful. The secondary metrics are additional information that must be collected, but may be difficult to quantity, collect data, or may require adjustments in how the data is collected or processed. Secondary metric data is still to be collected because it could provide insight into the effectiveness of the offsetting, but the criteria may require adjustment. For example:

- It may be difficult to demonstrate similar sts'úkwi7 (fish) abundance between the habitat offsetting and the reference site.
- Pacific slhawt' (herring) may not spawn on site and at a reference site in a given assessment year.
- There could be natural variation in invertebrate abundance and diversity that varies by location more than can be captured by comparison to a reference site.

If, after year three, overall performance is considered to be not being met, adaptive management measures (**Section 9.7**) may be considered for implementation in year four, to re-assess effectiveness during ínexwantas (monitoring) years five and seven post-construction.

A habitat effectiveness ínexwantas (monitoring) report will be prepared that describes the objectives, methods, results, and conclusions of the ínexwantas (monitoring) program, complete with site photographs, species list and a drawing to scale delineating the offsetting habitat area and elevations in chart datum. The proposed effectiveness ínexwantas (monitoring) program report will be completed by December 31 of years one, two, three, five, and seven post-construction.

9.2 Riparian Offsetting

Riparian areas will target re-establishment of native riparian plant communities in similar proportions as found at a reference site.

9.2.1 Criteria

Only primary metrics will be used to evaluate the riparian areas, including survivorship planting after the 1st year and comparison to a reference site by the 7th year. Invasive species percent cover must remain below 5% of the reference sites percent cover throughout the effectiveness ínexwantas (monitoring) period. The riparian area must maintain physical integrity (e.g. no drilling, no erosion, no loss of topsoil, sekw'ekw'inexw (wildlife) trees still intact) and area (m^2) required in the Fisheries Act Authorization must be present or more area must be created.

Table 9-1 Riparian Habitat Offsetting Metrics Summary Table

Primary			
Item	**Desired Metrics**	**Method**	**Frequency**
Plant Survivorship	Survivorship in year 1: 80% for graminoids, forbs and shrubs, 90% for trees. Matching appropriate riparian habitat offsetting reference site plants / diversity.	Conduct 10m x 10m plots, every 500 m2, to conduct plant counts and systematically walking non-plot areas to identify dead plants. Only healthy plants to contribute to total plant count. If measures can be implemented to revitalize plants in poor health, the qualified environmental professional to include recommendations to be executed by the following assessment year. If metrics fall below required values, additional plants to be installed before subsequent assessment year.	One visit in summer each assessment year.
Non-Native Plants	Year 7: areal coverage of non-native plants is less than 5% of total area.	Visually assess by walking riparian area and mapping any invasive species by GPS.	One visit in summer each assessment year.
Physical Integrity	Area of offsetting habitat meets design/construction parameters.	Visually assess by walking riparian area, looking for evidence of erosion or physical instability.	One visit in summer each assessment year.
Area	Minimum area required by the Fisheries Act Authorization must be present.	Visual assessment. Provide a map identifying polygon(s) for the habitat feature over top of as-built bathymetry. If there is variability in the functionality of the habitat feature, the areas may be divided up to show areas of different functionality. Generally, an interpretation should be provided for why areas with lower productivity are not performing as intended and proposed remedies as required.	One visit in summer each assessment year.
Secondary			
Item	**Desired Metrics**	**Method**	**Frequency**
None			

Table 9-2 Shallow Cobble Blanket Offsetting Metrics Summary Table

Primary			
Item	**Desired Metrics**	**Method**	**Frequency**
Macroalgae Cover	Total percent coverage of marine algae on rock surface (combined total). Coverage to be compared to natural range of reference site(s). Must be at least 95% of the percent cover expected.	Divers. Minimum 10 quadrats. Must be within middle of growing range of sugar kelp (between -3m and 0.5m chart datum). Must be on rock substrate. Transects to be used to locate quadrats. GPS to be used to locate transect starting locations. At least one transect every 25m of shoreline with rock reef enhancement. At least 2 quadrats per transect (paired). After year survey, place quadrats in subsequent surveys in same locations. For both the site and the reference site(s), record total percent coverage on rock by all marine vegetation (out of 100%). Provide statistical comparison to range observed within reference site(s). For qualitative purposes, also provide the percent coverage for each species (e.g. sugar kelp, sea lettuce, rockweed, coralline algae, bull kelp, other red, green or brown algae) and provide a professional opinion on how the rock is functioning. Include a map with transect and quadrat locations. Include description of methods and limitations.	One visit in summer each assessment year.
Invertebrate Presence Except Infauna	Abundance of invertebrates on rock surface (combined total). Abundance to be compared to natural range of reference site(s). Must be at least 95% of expected abundance.	Same quadrats to be used as those used to identify Marine Algae (above). At both the site and reference site, provide abundance for each species (e.g., sea stars, sea cucumbers) and percent coverage where more appropriate (e.g., barnacles, mussels) and provide a professional opinion on how the cobble is functioning. Include description of methods and limitations.	One visit in summer each assessment year.
Physical Integrity	Depth of sand of 0.3 m must be present. Cobble must be present at density on design drawings over top of sand. Areas that revert back to wood waste will be deemed non-functional.	Divers to visually inspect cobble blanket. Cobble density to be estimated visually along each transect by divers. The presence of sand layer beneath cobble layer to be confirmed as present by divers. Describe observations related to the stability of the habitat feature. For example, are there signs of erosion, are soft sediments becoming exposed without cobble to protect it from erosion. Include description of methods and limitations.	One visit in summer each assessment year.

Primary			
Item	**Desired Metrics**	**Method**	**Frequency**
Area	Minimum area required by the Fisheries Act Authorization must be present.	Visual assessment with divers. Provide a map identifying polygon(s) for the habitat feature over top of as-built bathymetry. If there is variability in the functionality of the habitat feature, the areas may be divided up to show areas of different functionality. Generally, an interpretation should be provided for why areas with lower productivity are not performing as intended and proposed remedies as required.	One visit in summer each assessment year.
Secondary			
Item	**Desired Metrics**	**Method**	**Frequency**
Sts'úkwi7 (fish) Abundance and Diversity	Compare abundance and diversity to reference site.	Divers, seining, and underwater cameras. Conduct pilot ínexwantas (monitoring) prior to effectiveness ínexwantas (monitoring) program implementation and adjust methods and frequency depending on results (for example, remove if not providing valuable data, increase if could benefit from greater frequency).	Initial program: diving 1 day x 2 seasons seining 1 day x 2 seasons u/w camera 1 for week x 2 seasons. Adjust as necessary
Slhawt' (herring) Spawn	Compare abundance and diversity to reference site.	Additional dive surveys shall be conducted specifically for evaluating pacific slhawt' (herring) spawn.	Two shoreline swims each year in late February/ early March and late March/ early April.
Presence of invertebrate holes and siphons	Compare abundance and diversity to reference site.	Presence within quadrats or as observed by divers or other methods (e.g., drop camera). Area will be mostly cobble (small boulders) therefore may be difficult to measure infauna below the cobble and therefore may require adaptive management to determine if this method provides meaningful information.	One visit in summer each assessment year

Table 9-3 Shallow Rock Reef Offsetting Summary Table

Primary			
Item	**Desired Metrics**	**Method**	**Frequency**
Macroalgae Cover	Total percent coverage of marine algae on rock surface (combined total). Coverage to be compared to natural range of reference site(s). Must be at least 95% of the percent cover expected.	Divers. Minimum 10 quadrats. Must be within middle of growing range of sugar kelp (between -3m and 0.5m chart datum). Must be on rock substrate. Transects to be used to locate quadrats. GPS to be used to locate transect starting locations. At least one transect every 25m of shoreline with rock reef enhancement. At least 2 quadrats per transect (paired). After year survey, place quadrats in subsequent surveys in same locations. For both the site and the reference site(s), record total percent coverage on rock by all marine vegetation (out of 100%). Provide statistical comparison to range observed within reference site(s). For qualitative purposes, also provide the percent coverage for each species (e.g. sugar kelp, sea lettuce, rockweed, coralline algae, bull kelp, other red, green or brown algae) and provide a professional opinion on how the rock is functioning. Include a map with transect and quadrat locations. Include description of methods and limitations.	One visit in summer each assessment year.
Invertebrate Presence	Compare abundance and diversity to reference site.	Divers. Minimum 10 quadrats. Must be within middle of growing range of sugar kelp (between -3m and 0.5m chart datum). Must be on rock substrate. Transects to be used to locate quadrats. GPS to be used to locate transect starting locations. At least one transect every 25m of shoreline with rock reef enhancement. At least 2 quadrats per transect (paired). After year survey, place quadrats in subsequent surveys in same locations.	One visit in summer each assessment year.
Voids in Rock	Voids are present (Pass or Fail)	Visual assessment with divers. Measure and describe size of voids in rock.	One visit in summer each assessment year.

Primary			
Item	**Desired Metrics**	**Method**	**Frequency**
Physical Integrity	Rock must be present within elevation range of constructed reef.	Divers to visually inspect reefs for stability along each transect. Evidence of gross damage to reef structure or mobilization of rocks to other areas to be noted. Describe observations related to the stability of the habitat feature. E.g., note signs of erosion, whether the reef is maintaining its design shape. Include descriptions of methods and limitations.	One visit in summer each assessment year.
Area	Minimum area required by the Fisheries Act Authorization must be present.	Visual assessment with divers. Provide a map identifying polygon(s) for the habitat feature over top of as-built bathymetry. If there is variability in the functionality of the habitat feature, the areas may be divided up to show areas of different functionality. Generally, an interpretation should be provided for why areas with lower productivity are not performing as intended and proposed remedies as required.	One visit in summer each assessment year.
Secondary			
Item	**Desired Metrics**	**Method**	**Frequency**
Sts'úkwi7 (fish) Abundance and Diversity	Compare abundance and diversity to reference site.	Divers, seining and underwater cameras.	Initial program: diving 1 day x 2 seasons seining 1 day x 2 seasons u/w camera 1 for week x 2 seasons. Adjust as necessary.
Slhawt' (herring) Spawn	Compare abundance and diversity to reference site.	Additional dive surveys shall be conducted specifically for evaluating pacific slhawt' (herring) spawn.	Two shoreline swims each year in late February/ early March and late March/ early April.

Table 9-4 Sand Blanket Summary Table

Primary			
Item	**Desired Metrics**	**Method**	**Frequency**
Stability	Depth of sand being maintained.	Divers to collect cores of top 0.3m of sand. A minimum of two cores per transect. Transects shall be spaced no further than 25m apart.	One visit in summer each assessment year.
Area	Minimum area required by the Fisheries Act Authorization must be present.	Visual assessment with divers. Provide a map identifying polygon(s) for the habitat feature over top of as-built bathymetry. If there is variability in the functionality of the habitat feature, the areas may be divided up to show areas of different functionality. Generally, an interpretation should be provided for why areas with lower productivity are not performing as intended and proposed remedies as required.	One visit in summer each assessment year.
Secondary			
Item	**Desired Metrics**	**Method**	**Frequency**
Sts'úkwi7 (fish) Abundance and Diversity	Compare abundance and diversity to reference site.	Divers, seining, and underwater cameras. Conduct pilot ínexwantas (monitoring) prior to effectiveness ínexwantas (monitoring) program implementation and adjust methods and frequency depending on results (for example, remove if not providing valuable data, increase if could benefit from greater frequency).	Initial program: diving 1 day x 2 seasons seining 1 day x 2 seasons u/w camera 1 for week x 2 seasons. Adjust as necessary.
Surface Clam Holes Analysis	Compare abundance and diversity to reference site.	Presence within quadrats or as observed by divers or other methods (e.g., drop camera). May require adaptive management to determine if meaning results are being obtained.	One visit in summer each assessment year
Sediment Core Invertebrate Analysis	Compare abundance and diversity to reference site.	Divers to collect cores of top 0.3m of sand and submit to taxonomist for assessment of infauna. A minimum of two cores per transect. Transects shall be spaced no further than 25m apart. Report to describe number of different species, or to nearest identifiable group, for both reference site(s) and offsetting sites. Results to be reviewed by qualified professional to discuss if offsetting is functional.	One visit in summer each assessment year
Benthic Invertebrate Use	Compare abundance and diversity to reference site.	Presence within quadrats or as observed by divers or other methods (e.g., drop camera).	One visit in summer each assessment year

Table 9-5 Rock Mounds in Sand Blanket Area and Deep Rock Reef

Primary			
Item	**Desired Metrics**	**Method**	**Frequency**
Voids in Rock	Voids are present (Pass or Fail)	Visual assessment with divers. Measure and describe size of voids in rock.	One visit in summer each assessment year.
Physical Integrity (Evidence of Erosion)	Rock must be present within elevation range of constructed reef.	Divers to visually inspect reefs for stability along each transect. Evidence of gross damage to reef structure or mobilization of rocks to other areas to be noted. Describe observations related to the stability of the habitat feature. E.g., note signs of erosion, whether the reef is maintaining its design shape. Include descriptions of methods and limitations.	One visit in summer each assessment year.
Area	Minimum area required by the Fisheries Act Authorization must be present.	Visual assessment with divers. Provide a map identifying polygon(s) for the habitat feature over top of as-built bathymetry. If there is variability in the functionality of the habitat feature, the areas may be divided up to show areas of different functionality. Generally, an interpretation should be provided for why areas with lower productivity are not performing as intended and proposed remedies as required.	One visit in summer each assessment year.
Secondary			
Item	**Desired Metrics**	**Method**	**Frequency**
Sts'úkwi7 (fish) Abundance and Diversity	Compare abundance and diversity to reference site.	Divers, seining, and underwater cameras. Adjust methods and frequency depending on results (for example, remove if not providing valuable data, increase if could benefit from greater frequency).	Initial program: diving 1 day x 2 seasons seining 1 day x 2 seasons u/w camera 1 for week x 2 seasons. Adjust as necessary.
Invertebrate Presence	Compare abundance and diversity to reference site.	Divers. Minimum 10 quadrats. Must be within middle of growing range of sugar kelp (between -3m and 0m chart datum). Must be on rock substrate. Transects to be used to locate quadrats. GPS to be used to locate transect starting locations. At least one transect every 25m of shoreline with rock reef enhancement. At least 2 quadrats per transect (paired). After year survey, place quadrats in subsequent surveys in same locations.	One visit in summer each assessment year.

9.2.2 Methods

Conduct a site visit during the summer of each ínexwantas (monitoring) period. Both the Project offsetting locations and riparian habitat offsetting reference site(s) will be surveyed by, or under the supervision of, a professional biologist. The following methods will be applied:

- 10 m x 10 m plots will be assessed in riparian planting areas to determine plant survivorship and health.
- A minimum of one plot per 500 m^2 will be assessed.
- Plots will be surveyed for substate and erosion, sekw'ekw'inexw (wildlife) tree stability, plant survivorship, percent cover of native ground, shrub and canopy layers, and the presence and percent cover of non-native plant species.
- A reconnaissance survey consisting of systematically walking through non-plot riparian areas will be conducted to identify other plant mortality and non-native plant colonization to allow for maintenance.
- Planted riparian habitat shall exhibit a survival rate of at least 80% for graminoids, forbs and shrubs, and 90% for trees, or additional planting will be required to achieve this threshold after the first year. Survivorship will be compared with the specified planting and documented as-built report for expected results. Changes to plant species used in replanting may be made with approval from the professional biologist to incorporate plants with higher local observed survivor rates.
- The riparian areas will be assessed annually for regrowth and establishment of invasive plants. Plots having greater than five percent cover of targeted non-native species (e.g., Himalayan blackberry, Japanese knotweed) will be actively managed to reduce invasive competition, and regrowth of non-native plant species in areas outside of ínexwantas (monitoring) plots will be marked for maintenance.
- The location of vegetation assessment plots will be chosen using a stratified random method (i.e., randomly within predetermined stratified areas) within the offsetting area, with each plot recorded using a GPS unit (±4 m).
- The physical stability of each riparian habitat will be assessed to confirm that erosional issues or anthropogenic impacts are not occurring.

9.3 Cobble Blanket

Large cobble (small boulders) will be placed in the lower intertidal and shallow subtidal areas below the toe of the shoreline stabilization works to create a cobble blanket. The area will be located where marine macro-algae (e.g. sugar kelp between 0 and -3.0m chart datum) are capable of growing macro-algae provided it provides stable attachment points.

9.3.1 Criteria

The cobble blanket will target algal/kelp production, sts'úkwi7 (fish) rearing and spawning, and invertebrate cover. Criteria to be employed to evaluate the cobble blankets is summarized in **Table 9-2**. Criteria are separated into primary and secondary metrics. In general, the habitat offsetting will be compared to a reference site for comparison purposes. The reference site to be a nearby location and have similar exposure, flow, elevation and substrate type.

9.3.1.1 Primary metrics:

Primary metrics are ones which will be evaluated first and used as the primary method of success:

- Macroalgae Cover: Percent coverage by kelp like sugar kelp. Targeting at least 95% of the natural variation that can be observed at reference site(s) natural variation.
- Invertebrate Presence (Except Infauna): May include crabs, sea stars, sea cucumbers, etc. At least 95% of reference site(s) natural variation.
- Physical Integrity: Confirmation that areas are not eroding, and cobble is sufficiently protecting 0.3m layer of soft sediment below the cobble. To be monitored to against scour.
- Area: The minimum area required in the Fisheries Act Authorization is present.

9.3.1.2 Secondary metrics:

Secondar metrics will also be used to supplement the primary metrics in determining the success of the habitat offsetting, but may require adaptive management and interpretation as they are more difficult to accurately quantify and compare to a reference site:

- Sts'úkwi7 (fish) abundance and diversity: How many and what kinds of sts'úkwi7 (fish) are present, relative to reference site.
- Slhawt' (herring) spawn: Is there evidence of slhawt' (herring) spawn on the constructed habitat, relative to reference site.
- Presence of invertebrate holes and siphons: Is there evidence of clam siphons protruding through the cobble, relative to reference site.

9.3.2 Methods

In order to collect the information required to evaluate the primary and secondary metrics, the following methods are proposed to be conducted at the offsetting site and the reference site(s):

9.3.2.1 General Requirements for All Surveys

- Assessments to be completed under the direction of a professional biologist.
- Assessment to be repeated during the following years:
  - Shortly After construction (as-built survey)
  - 1 Year After Construction
  - 2 Year After Construction
  - 3 Year After Construction
  - 4 Year After Construction.
  - 5 Year After Construction
  - 7 Year After Construction
- More than one reference site may be used as required to capture the natural variability for each type of habitat constructed and to demonstrate natural variability that may occur.

9.3.2.2 Dive Surveys

A dive survey is preferential for effectively recording kelp cover, invertebrates and sts'úkwi7 (fish) abundances. This will include completing transects within the offsetting habitat using an underwater quadrat system to estimate cover of marine vegetation, sessile invertebrates, and other species.

Dive surveys are to be conducted at least twice to cover at least two seasons, with at least one occurring during the summer. Each dive survey should cover at least a day of diving but may take more in order to gather all the information required below:

- Dives to be completed by WorkSafeBC compliant dive teams with at least one biologist diver.
- Divers to establish transects every 25 m along the proposed reefs and at least 3 transects per reference site.
- Quadrats to be positioned within each habitat type (e.g. cobble blanket) along each transect, with a minimum of 2 paired quadrats per transect.
- At least five paired quadrats (i.e. 10 quadrats 1 m^2 each) in total, required to provide meaningful results, but likely will result in much more than 10.
- Divers to GPS start position of transect. End position shall either be determined with GPS or by compass bearing off the start position.
- Along each transect, the divers shall:
  - Measure the location where the habitat feature (e.g. cobble blanket) starts and stops.
  - Measure the location of each quadrat.
  - Note if there are areas of similar composition that should be separated out into smaller polygons. If so, ensure quadrats are within each polygon and note the distances along the transect where each transitions.
  - Conduct sts'úkwi7 (fish) observations.
- While documenting sts'úkwi7 (fish) observations, the divers should:
- Remain still at least once every 5m along the transect within the habitat feature of interest (e.g. cobble blanket).
- Document sts'úkwi7 (fish) presence over a 1-minute period before continuing forward.
- Identify the species and life stage.
- Record comments on how the sts'úkwi7 (fish) are using the habitat feature.
- Within each quadrat, the divers will record:
- Distance along the transect.
- Total percent coverage of algae.
- Individual coverage by species.
- Document any evidence of spawning.
- Note any anthropogenic debris or materials that are not supposed to be present.

- Document number of type of invertebrates either through counts or percent cover.
- Count the number of siphons, and clam holes if visible, between the cobble.
- Measure the size of the primary substrate (e.g. cobble).
- Describe the average percent cobble coverage over the soft substrate below it.
- Describe if the cobble coverage is uniform.
- Document signs of instability.
- Results to be documented with a high-definition underwater camera or video, which is to be made available to DFO upon request and used to generate effectiveness ínexwantas (monitoring) reports.
- For subsequent surveys, the same quadrats used to identify marine algae will be placed in the exact same locations.

9.3.2.3 Herring Specific Dive Surveys

In addition to the dive surveys describe above, additional dive surveys shall be conducted specifically for evaluating pacific slhawt' (herring) spawn. These surveys are to be conducted with a dive team. Slhawt' (herring) surveys will consist of two shoreline swims each year in late February / early March and late March/ early April to document slhawt' (herring) spawning activity. Timing may be informed by observations of spawning activity.

Surveys will be completed throughout the offsetting locations and at a reference site(s). If slhawt' (herring) is not observed at the reference site(s), additional habitat offsetting reference sites will be assessed at locations 500 m north and south of the site, and where slhawt' (herring) has been observed in the past.

During each survey, the dive teams will:

- Map the distribution of spawning activity with a GPS by swimming along the nearshore area in a sinuous pattern from the water's surface to a maximum depth of approximately -10 m chart datum (CD).
- Establish transects perpendicular to shore through the slhawt' (herring) spawn every 25m.
- Use a GPS to identify the start of each transect. End of each transect either to be located with a GPS or determined through a compass bearing from the start of the transect.
- Paired quadrates to be placed along each transect, with a minimum of two paired quadrats per transect.
- Within each quadra, document:
  - Description of Habitat
  - Egg density
  - Egg health
  - General characteristics
- Results to be documented with a high-definition underwater camera or video, which is to be made available to DFO upon request and used to generate effectiveness ínexwantas (monitoring) reports.

9.3.2.4 Drop Camera Surveys

If dive surveys are not allowed due to operational and/or safety limitations, a comprehensive drop camera survey will be competed. All information collected with the drop camera shall follow the same procedures as the dive surveys except single quadrats will be collected instead of paired quadrats.

9.3.2.5 Underwater Video Continuous Surveys

Underwater video recorders will be tested prior to effectiveness ínexwantas (monitoring) to determine if they can be used to help determine sts'úkwi7 (fish) usage. Underwater video records to be established with at least one camera deployed within each habitat offsetting feature and within the mid-point of the feature (e.g. cobble blanket), and at least one per offsetting location habitat type. They shall be left in place for at least five days to record sts'úkwi7 (fish) use. Motion detectors may be used with 30 second clips after they are triggered. Alternatively, photographs may be automatically taken from the video at 10-minute intervals. Computer AI to identify sts'úkwi7 (fish) presence, species, etc. may be used, if possible, otherwise video or photos must be reviewed manually during post processing.

Cameras shall be anchored to the seabed or attached to a structure installed to allow for sts'úkwi7 (fish) observations within the habitat areas. GPS shall be collected to map locations of footage. Cameras may be tethered to shore with a cable along the seabed or have a digital recorder box or chip near the camera itself.

If viable data cannot be obtained, further continuous surveys will be discontinued. However, if sts'úkwi7 (fish) can be identified, the video will be processed during two separate seasons during each of the assessment years. During review of the video, the following will be recorded, where possible:

- Species
- Life stage
- How the sts'úkwi7 (fish) is interacting with the habitat

Methods and results to be adaptively managed based on technology available at the time of the work and site conditions.

9.3.2.6 Seining

Seining to be conducted from shore (beach seine) or by vessel. Seining to be conducted at low tide, mid tide and high tide during two separate seasons, with one of those seasons being summer. Seining will include conducting a pass over each habitat feature constructed and at a reference site(s).

During each day of seining, the following information shall be recorded:

- GPS to be used to determine the aerial extent that was seined.
- Sts'úkwi7 (fish) collected during seining shall be documented for species and life stage.
- Photographs shall be collected of representative sts'úkwi7 (fish).
- Works to be conducted under a valid scientific collection permit, including preparation of any reports required by those permits.
- All sts'úkwi7 (fish) to be released after collection.

9.3.3 Reporting Requirements

While assessing sts'úkwi7 (fish) abundance and diversity, including species, life history, and the level of effort will be required to qualitatively describe sts'úkwi7 (fish) use at the site and reference site(s). A detailed map will be created to indicate the sample locations, providing a visual representation of the survey area. The total percent coverage of marine vegetation on the rocks, with the results compared statistically to the observed range within the reference site(s). For qualitative analysis, the percent coverage of each species, such as sugar kelp, sea lettuce, rockweed, coraline algae, bull kelp, and other red, green, or brown algae, will be recorded. A map displaying the transect and quadrat locations will be included. For invertebrates, the abundance data will be collected for each species present, such as sea stars, sea cucumbers, barnacles, and mussels. Percent coverage will be recorded where appropriate.

Observations related to the stability of the habitat feature, including signs of erosion and whether the reef is maintaining its design shape, will be documented. For area assessment, a map overlaid with as-built bathymetry will be created, identifying the polygon(s) corresponding to different habitat features. If there is variability in the functionality of the habitat feature, the areas may be divided to show different levels of productivity. An interpretation will be provided to explain why areas with lower productivity may not be performing as intended, and proposed remedies will be suggested as necessary. The methods employed to make all observations and any limitations encountered will be explained.

9.4 Shallow Rock Reef

9.4.1 Criteria

The shallow reef will target sugar kelp production, sts'úkwi7 (fish) rearing and spawning, and invertebrate cover. Criteria to be employed to evaluate the cobble blankets is summarized in **Table 9-3**. Criteria are separated into primary and secondary metrics. In general, the habitat offsetting will be compared to a reference site for comparison purposes. The reference site to be a nearby location and have similar exposure, flow, elevation and substrate type.

9.4.1.1 Primary metrics:

Primary metrics are ones which will be evaluated first and used as the primary method of success:

- Macroalgae Cover: Percent coverage by kelp (e.g. sugar kelp). Targeting at least 95% of the natural variation that can be observed at reference site(s).
- Invertebrate Presence Except Infauna: May include crabs, sea stars, sea cucumbers, etc. Targeting at least 95% of the natural variation that can be observed at reference site(s).
- Void in Rock: To confirm that there are refuge areas for sts'úkwi7 (fish) between the rocks.
- Physical Integrity: Confirmation areas are not eroding. To be monitored to against scour of surrounding sediments. Ensure reefs are maintaining their structure.
- Area: The minimum area (m^2) required in the Fisheries Act Authorization.

9.4.1.2 Secondary Metrics

Secondar metrics are:

- Sts'úkwi7 (fish) abundance and diversity: How many and what kinds of sts'úkwi7 (fish) are present, relative to reference site.
- Slhawt' (herring) spawn: Is there evidence of slhawt' (herring) spawn on the constructed habitat, relative to reference site.

9.4.2 Methods

In order to collect the information required to evaluate the primary and secondary metrics, the following methods are proposed to be conducted at the offsetting site and the reference site(s):

9.4.2.1 General Requirements for All Surveys

- Assessments to be completed under the direction of a professional biologist.
- A pilot survey to be conducted prior to effectiveness ínexwantas (monitoring) to evaluate how successful the following methods are, which will be used to implement adaptive management where required.
- Assessment to be repeated during the following years:
  - Shortly After construction (as-built survey)
  - 1 Year After Construction
  - 2 Year After Construction
  - 3 Year After Construction
  - 4 Year After Construction.
  - 5 Year After Construction
  - 7 Year After Construction
- More than one reference site may be used in order to capture the natural variability for each type of habitat constructed.
- Written notes shall be prepared by the field personnel during the site visit before leaving the site to maintain a written record of results obtained during effectiveness ínexwantas (monitoring) surveys.

9.4.2.2 Dive Surveys

A dive survey is preferential for effectively recording kelp cover, invertebrates under cover, and sts'úkwi7 (fish) abundances. This will include completing transects within the offsetting habitat using an underwater quadrat system to estimate cover of marine vegetation, sessile invertebrates, and other species.

Dive surveys are to be conducted at least twice and cover at least two seasons, and at least one of these surveys must be during the summer. Each dive survey should cover at least a day of diving but may take more days in order to gather all the information required below:

- Dives to be completed by WorkSafeBC compliant dive teams.

- Divers to establish transects every 25m along the proposed reefs, and at least 3 transects at the reference site(s).
- Quadrats to be positioned within each habitat type (e.g. cobble blanket) along each transect, with a minimum of 2 paired quadrats per transect.
- In total, we recommend at least five paired quadrats (i.e. 10 quadrats 1 m^2 each) for comparison between the offsetting site and reference site in order to provide meaningful results. Given the length of the habitat offsetting, we expect the number of quadrats to be much higher.
- Divers to GPS the start position of the transect. End position shall either be determined with GPS or by compass bearing off the start position.
- Along each transect, the divers shall:
- Measure the location where the habitat feature (e.g. riprap) starts and stops.
- Measure the location of each quadrat.
- Note if there are areas of similar composition that should be separated out into smaller polygons. If so, ensure quadrats are within each polygon and note the distances along the transect where each transitions.
- Describe voids in rock.
- Conduct sts'úkwi7 (fish) observations.
- While documenting sts'úkwi7 (fish) observations, the divers should:
- Remain still at least once every 5m along the transect within the habitat feature of interest (e.g. riprap).
- Document sts'úkwi7 (fish) presence over a 1-minute period before continuing forward.
- Identify the species and life stage.
- Record comments on how the sts'úkwi7 (fish) are using the habitat feature.
- Within each quadrat, the divers will record:
- Distance along the transect.
- Total percent coverage of algae.
- Individual coverage by species.
- Document any evidence of spawning.
- Note any anthropogenic debris or materials that are not supposed to be present.
- Document number of type of invertebrates either through counts or percent cover.
- Measure the size of the primary substrate (e.g. riprap).
- Document signs of instability.
- Results to be documented with a high-definition underwater camera or video, which is to be made available to DFO upon request and used to generate effectiveness ínexwantas (monitoring) reports.
- For subsequent surveys, the same quadrats used to identify marine algae were placed in the exact locations.

9.4.2.3 Herring Specific Dive Surveys

In addition to the dive surveys describe above, additional dive surveys shall be conducted specifically for evaluating pacific slhawt' (herring) spawn. These surveys are to be conducted with a dive team. Slhawt' (herring) surveys will consist of two shoreline swims each year in late February / early March and late March/ early April to document slhawt' (herring) spawning activity. Timing may be informed by observations of spawning activity.

Surveys will be completed throughout the offsetting locations and at a reference site(s). If slhawt' (herring) is not observed at the reference site(s), additional habitat offsetting reference sites will be assessed at locations 500 m north and south of the site, and where slhawt' (herring) has been observed in the past.

During each survey, the dive teams will:

- Map the distribution of spawning activity with a GPS by swimming along the nearshore area in a sinuous pattern from the water's surface to a maximum depth of approximately -10 m chart datum (CD).
- Establish transects perpendicular to shore through the slhawt' (herring) spawn every 25m.
- Use a GPS to identify the start of each transect. End of each transect either to be located with a GPS or determined through a compass bearing from the start of the transect.
- Paired quadrates to be placed along each transect, with a minimum of two paired quadrats per transect.
- Within each quadra, document:
  - Habitat present (e.g., sugar kelp)
  - Egg density
  - Egg health
  - General characteristics
- Results to be documented with a high-definition underwater camera or video, which is to be made available to DFO upon request and used to generate effectiveness ínexwantas (monitoring) reports.

9.4.2.4 Drop Camera Surveys

If dive surveys are not allowed due to operational and/or safety limitations, a comprehensive drop camera survey will be competed. All information collected with the drop camera shall follow the same procedures as the dive surveys except single quadrats may be used.

9.4.2.5 Underwater Video Continuous Surveys

Underwater video recorders will be tested prior to effectiveness ínexwantas (monitoring) to determine if they can be used to help determine sts'úkwi7 (fish) usage. Underwater video records to be established with at least one camera deployed within each habitat offsetting feature and within the mid-point of the feature (e.g. riprap), and at least one per offsetting location habitat type. They shall be left in place for at least five days to record sts'úkwi7 (fish) use. Motion detectors may be used with 30 second clips after they are triggered. Alternatively, photographs may be automatically taken from the video at 10-minute intervals.

Computer AI to identify sts'úkwi7 (fish) presence, species, etc. may be used, if possible, otherwise video or photos must be reviewed manually during post processing.

Cameras shall be anchored to the seabed or attached to a structure installed to allow for sts'úkwi7 (fish) observations within the habitat areas. GPS shall be collected to map locations of footage. Cameras may be tethered to shore with a cable along the seabed or have a digital recorder box or chip near the camera itself.

If viable data cannot be obtained, further continuous surveys will be discontinued. However, if sts'úkwi7 (fish) can be identified, the video will be processed during two separate seasons during each of the assessment years. During review of the video, the following will be recorded, where possible:

- Species
- Life stage
- How the sts'úkwi7 (fish) is interacting with the habitat

Methods and results to be adaptively managed based on technology available at the time of the work and site conditions.

9.4.2.6 Seining

Seining to be conducted from shore (beach seine) or by vessel. Seining to be conducted over the course of a full day during two separate seasons, with one of those seasons being summer. Seining will include conducting a pass over each habitat feature constructed, and at a reference site(s).

During each day of seining, the following information shall be recorded:

- GPS to be used to determine the aerial extent that was seined.
- Sts'úkwi7 (fish) collected during seining shall be documented for species and life stage.
- Photographs shall be collected of representative sts'úkwi7 (fish).
- Works to be conducted under a valid scientific collection permit, including preparation of any reports required by those permits.
- All sts'úkwi7 (fish) to be released after collection.

9.4.3 Reporting Requirements

While assessing sts'úkwi7 (fish) abundance and diversity, including species, life history, and the level of effort will be required to qualitatively describe sts'úkwi7 (fish) use at the site and reference site(s). A detailed map will be created to indicate the sample locations, providing a visual representation of the survey area. The total percent coverage of marine vegetation on the rocks, with the results compared statistically to the observed range within the reference site(s). For qualitative analysis, the percent coverage of each species, such as sugar kelp, sea lettuce, rockweed, coraline algae, bull kelp, and other red, green, or brown algae, will be recorded. A map displaying the transect and quadrat locations will be included. For invertebrates, the abundance data will be collected for each species present, such as sea stars, sea cucumbers, barnacles, and mussels. Percent coverage will be recorded where appropriate.

Observations related to the stability of the habitat feature, including signs of erosion and whether the reef is maintaining its design shape, will be documented. For area assessment, a map overlaid with as-built bathymetry will be created, identifying the polygon(s) corresponding to different habitat features. If there is variability in the functionality of the habitat feature, the areas may be divided to show different levels of productivity. An interpretation will be provided to explain why areas with lower productivity may not be performing as intended, and proposed remedies will be suggested as necessary. The methods employed to make all observations and any limitations encountered will be explained.

9.5 Sediment Restoration

Performance of sediment restoration measures (including cobble blanket sand and sand blanket with gravel) will be evaluated by assessing benthic invertebrate assemblages pre- and post restoration construction in the Project habitat offsetting areas. Sediment restoration will be considered successful if an increase in density and/or diversity of benthic infaunal organisms is observed within the sand layers compared to pre-construction conditions within the post-construction ínexwantas (monitoring) period. The results will also be compared to benthic community conditions at the Cobble Blanket reference site. The sustained physical integrity of the sediment against erosion or scour will also be monitored.

Sediment samples will be collected by divers in areas of Concept A and C where safe, or a ponar of equivalent volume, and processed through a 2 mm screen to remove large debris and a 0.5 mm screen to collect infaunal samples. Samples will be analyzed in a biological laboratory for benthic invertebrate taxonomic composition (down to the lowest practical taxonomic level) and abundance. Adult values will be reported separate from juvenile or immature. Benthic community results will be analyzed using quantitative methods, interpreted and presented for each sample by site.

Same type of sampling equipment should be used among sample locations and periods. Samples should be collected using divers and corers 0.1 diameter x 0.4 m length to a depth of 0.3 m into the substrate (~0.025 m^3). Two cores should be collected per sample location and composited to improve species abundance (~0.05 m^3). This may be substituted with a ponar of equal collection volume. Five sample locations per Project habitat offsetting area should be collected and compared to the Cobble Blanket reference site.

For sorting and sampling benthic invertebrates, the same mesh size(s) must be used among locations and time periods. It is recommended that a 2 mm sieve be used to collect debris and larger invertebrates, followed by a 0.5 mm mesh size for greater species resolution. Ten percent of invertebrate samples should be verified by a re-sort. Sub-sampling may be completed if abundance is high. Sub-sampling should be within 20% of estimated levels based on full counts.

9.5.1 Criteria

The deep sandy blanket offsetting areas will target infaunal production. Criteria to be employed to evaluate the deep sand blankets is summarized in **Table 9-4.** Criteria are separated into primary and secondary metrics. In general, the habitat offsetting will be compared to a reference site for comparison purposes. The reference site to be a nearby location and have similar exposure, flow, elevation, and substrate type.

9.5.1.1 Primary metrics:

Primary metrics are ones which will be evaluated first and used as the primary method of success:

- Invertebrate Presence Except Infauna: May include crabs, sea stars, sea cucumbers, etc.
- Physical Integrity: Confirmation that areas are not eroding away. To be monitored to against subsidence, scour of surrounding sediments, and form.
- Area: The minimum area required in the Fisheries Act Authorization is present.

9.5.1.2 Secondary metrics:

Secondar metrics will also be used, but more variation may be expected or adaptive management may be required and require more interpretation than primary metrics:

- Sts'úkwi7 (fish) abundance and diversity: How many and what kinds of sts'úkwi7 (fish) are present, relative to reference site.
- Surface clam hole analysis: Abundance and diversity of clam holes and siphons.
- Sediment core invertebrate analysis: Results from a lab on invertebrates within a grab or core sample. (i.e. within the sediment).
- Benthic invertebrate use: Examination of quadrats for invertebrates that are using the sandy blanket (e.g. crabs).

9.5.2 Methods

In order to collect the information required to evaluate the primary and secondary metrics, the following methods are proposed to be conducted at the offsetting site and the reference site(s):

9.5.2.1 General Requirements for All Surveys

- Assessments to be completed under the direction of a professional biologist.
- A pilot survey to be conducted prior to effectiveness ínexwantas (monitoring) to evaluate how successful the following methods are, which will be used to implement adaptive management where required.
- Assessment to be repeated during the following years:
  - Shortly After construction (as-built survey)
  - 1 Year After Construction
  - 2 Year After Construction
  - 3 Year After Construction
  - 4 Year After Construction.
  - 5 Year After Construction
  - 7 Year After Construction

- More than one reference site may be used in order to capture the natural variability for each type of habitat constructed.
- Written notes shall be prepared by the field personnel during the site visit before leaving the site to maintain a written record of results obtained during effectiveness ínexwantas (monitoring) surveys.

9.5.2.2 Divers

A dive survey is preferential for effectively recording kelp cover, invertebrates under cover, and sts'úkwi7 (fish) abundances. This will include completing transects within the offsetting habitat using an underwater quadrat system to estimate cover of marine vegetation, sessile invertebrates, and other species.

Dive surveys are to be conducted at least twice and cover at least two seasons, and at least one of these surveys must be during the summer. Each dive survey should cover at least a day of diving but may take more days in order to gather all the information required below:

- Dives to be completed by WorkSafeBC compliant dive teams.
- Divers to establish transects every 25m along the proposed reefs, and at least 3 transects at the reference site(s).
- Quadrats to be positioned within each habitat type (e.g. cobble blanket) along each transect, with a minimum of 2 paired quadrats per transect.
- In total, we recommend at least five paired quadrats (i.e. 10 quadrats 1 m^2 each) for comparison between the offsetting site and reference site in order to provide meaningful results. Given the length of the habitat offsetting, we expect the number of quadrats to be much higher.
- Divers to GPS the start position of the transect. End position shall either be determined with GPS or by compass bearing off the start position.
- Along each transect, the divers shall:
- Measure the location where the habitat feature (e.g. cobble blanket) starts and stops.
- Measure the location of each quadrat.
- Note if there are areas of similar composition that should be separated out into smaller polygons. If so, ensure quadrats are within each polygon and note the distances along the transect where each transitions.
- Conduct sts'úkwi7 (fish) observations.
- While documenting sts'úkwi7 (fish) observations, the divers should:
- Remain still at least once every 5m along the transect within the habitat feature of interest (e.g. cobble blanket).
- Document sts'úkwi7 (fish) presence over a 1-minute period before continuing forward.
- Identify the species and life stage.
- Record comments on how the sts'úkwi7 (fish) are using the habitat feature.
- Within each quadrat, the divers will record:
- Distance along the transect.

- Number of clam holes.
- Describe if sand is at least 30cm thick, if possible.
- Number of clam hole siphons (e.g. horse clams).
- Number of shells from each species.
- Individual coverage by species.
- Note any anthropogenic debris or materials that are not supposed to be present.
- Document number of type of invertebrates either through counts or percent cover.
- Measure the size of the secondary substrate (e.g. cobble).
- Describe the average percent cobble coverage over the soft substrate below it.
- Describe if the cobble coverage is uniform.
- Document signs of instability.
- Results to be documented with a high-definition underwater camera or video, which is to be made available to DFO upon request and used to generate effectiveness ínexwantas (monitoring) reports.
- For subsequent surveys, the same quadrats used to identify marine algae were placed in the exact locations.

9.5.2.3 Sediment Grabs and Cores

- A minimum of two cores will be collected per transect.
- Transects will be spaced no further than 25 m apart.
- Grabs or cores to be collected from the 0.3 m of sediment.
- Sediment samples to be submitted to a taxonomist for assessment of infauna.

9.5.3 Reporting Requirement

For the assessment of sts'úkwi7 (fish) abundance, species diversity, and life history will be conducted, along with a qualitative description of sts'úkwi7 (fish) use at the site and a map highlighting the sample locations will be included, providing a visual representation of the survey area.

The abundance of invertebrate holes and siphons, as well as the diversity of invertebrates, will be assessed if possible, including the identification of specific features such as horse clam siphons. Abundance data will be collected for each species, such as sea stars and sea cucumbers, at both the site and reference site(s). Divers or drop camera will document the density of clam holes at the reference site and offsetting location(s). Additionally, the type of shells present will be noted to generate a potential species list. A report will be prepared to describe the number of different species or identifiable groups at both the reference site(s) and offsetting sites. These results will be reviewed by a qualified professional to discuss the functionality of the offsetting measures.

Observations related to the stability of the habitat feature will be documented. Signs of erosion or deposition related to the sand layer, if present, will be noted. The methods employed to make these observations, as well as any limitations encountered, will be described. To provide a comprehensive

understanding of the habitat feature, a map overlaid with as-built bathymetry will be created, identifying the polygon(s) corresponding to the feature. If there is variability in the functionality of the habitat feature, the areas may be divided to show different levels of productivity. An interpretation will be provided to explain why areas with lower productivity may not be performing as intended, and proposed remedies will be suggested as required.

9.6 Deep Reef Mounds and Reefs

Deep reefs will be placed below the shallow subtidal areas and below the toe of the shoreline stabilization works. The area will be located below where marine macro-algae (e.g. sugar kelp grows down to -3.0m chart datum) but will still provide benefits to sts'úkwi7 (fish) by creating voids between rocks.

9.6.1 Criteria

The deep reef will target sts'úkwi7 (fish) rearing and invertebrate cover. Criteria to be employed to evaluate the reef is summarized in **Table 9-5**. Criteria are separated into primary and secondary metrics. In general, the habitat offsetting will be compared to a reference site for comparison purposes. The reference site to be a nearby location and have similar exposure, flow, elevation and substrate type.

9.6.1.1 Primary metrics:

Primary metrics are ones which will be evaluated first and used as the primary method of success:

- Invertebrate Presence Except Infauna: May include crabs, sea stars, sea cucumbers, etc.
- Void in Rock: To confirm that there are refuge areas for sts'úkwi7 (fish) between the rocks.
- Physical Integrity: Confirmation that areas are not eroding away. To be monitored to against subsidence, scour of surrounding sediments, and form.
- Area: The minimum area required in the Fisheries Act Authorization is present.

9.6.1.2 Secondary metrics:

Secondar metrics will also be used, but more variation may be expected or adaptive management may be required and require more interpretation than primary metrics:

- Sts'úkwi7 (fish) abundance and diversity: How many and what kinds of sts'úkwi7 (fish) are present, relative to reference site.

9.6.2 Methods

In order to collect the information required to evaluate the primary and secondary metrics, the following methods are proposed to be conducted at the offsetting site and the reference site(s):

9.6.2.1 General Requirements for All Surveys

- Assessments to be completed under the direction of a professional biologist.

- A pilot survey to be conducted prior to effectiveness ínexwantas (monitoring) to evaluate how successful the following methods are, which will be used to implement adaptive management where required.
- Assessment to be repeated during the following years:
  - Shortly After construction (as-built survey)
  - 1 Year After Construction
  - 2 Year After Construction
  - 3 Year After Construction
  - 4 Year After Construction.
  - 5 Year After Construction
  - 7 Year After Construction
- More than one reference site may be used in order to capture the natural variability for each type of habitat constructed.
- Written notes shall be prepared by the field personnel during the site visit before leaving the site to maintain a written record of results obtained during effectiveness ínexwantas (monitoring) surveys.

9.6.2.2 Dive Surveys

A dive survey is preferential for effectively recording algae, invertebrate and sts'úkwi7 (fish) abundance. This will include completing transects within the offsetting habitat using an underwater quadrat system to estimate cover of marine algae, sessile invertebrates, and other species.

Dive surveys are to be conducted at least twice and cover at least two seasons, and at least one of these surveys must be during the summer. Each dive survey should cover at least a day of diving but may take more days in order to gather all the information required below:

- Dives to be completed by WorkSafeBC compliant dive teams.
- Divers to establish transects every 25m along the proposed reefs, and at least 3 transects at the reference site(s).
- Quadrats to be positioned within each habitat type (e.g. cobble blanket) along each transect, with a minimum of 2 paired quadrats per transect.
- In total, we recommend at least five paired quadrats (i.e. 10 quadrats 1 m^2 each) for comparison between the offsetting site and reference site in order to provide meaningful results. Given the length of the habitat offsetting, we expect the number of quadrats to be much higher.
- Divers to GPS the start position of the transect. End position shall either be determined with GPS or by compass bearing off the start position.
- Along each transect, the divers shall:
- Measure the location where the habitat feature (e.g. reef) starts and stops.
- Measure the location of each quadrat.

- Note if there are areas of similar composition that should be separated out into smaller polygons. If so, ensure quadrats are within each polygon and note the distances along the transect where each transitions.
- Conduct sts'úkwi7 (fish) observations.
- While documenting sts'úkwi7 (fish) observations, the divers should:
- Remain still at least once every 5m along the transect within the habitat feature of interest (e.g. cobble blanket).
- Document sts'úkwi7 (fish) presence over a 1-minute period before continuing forward.
- Identify the species and life stage.
- Record comments on how the sts'úkwi7 (fish) are using the habitat feature.
- Within each quadrat, the divers will record:
- Distance along the transect.
- Total percent coverage of algae.
- Individual coverage by species.
- Document any evidence of spawning.
- Note any anthropogenic debris or materials that are not supposed to be present.
- Document number of type of invertebrates either through counts or percent cover.
- Count the number of siphons, and clam holes if visible, between the cobble.
- Measure the size of the primary substrate (e.g. cobble).
- Describe the average percent cobble coverage over the soft substrate below it.
- Describe if the cobble coverage is uniform.
- Document signs of instability.
- Results to be documented with a high-definition underwater camera or video, which is to be made available to DFO upon request and used to generate effectiveness ínexwantas (monitoring) reports.
- For subsequent surveys, the same quadrats used to identify marine algae were placed in the exact locations.

9.6.2.3 Drop Camera Surveys

If dive surveys are not allowed due to operational and/or safety limitations, a comprehensive drop camera survey will be competed. Drop surveys also may be required in locations that are too deep for divers to conduct assessments. All information collected with the drop camera shall follow the same procedures as the dive surveys.

9.6.2.4 Underwater Video Continuous Surveys

Underwater video recorders will be tested prior to effectiveness ínexwantas (monitoring) to determine if they can be used to help determine sts'úkwi7 (fish) usage. Underwater video records to be established with at least one camera deployed within each habitat offsetting feature and within the mid-point of the feature (e.g. riprap), and at least one per offsetting location habitat type. They shall be left in place for at least five days to record sts'úkwi7 (fish) use. Motion detectors may be used with 30 second clips after they are triggered. Alternatively, photographs may be automatically taken from the video at 10-minute intervals. Computer AI to identify sts'úkwi7 (fish) presence, species, etc. may be used, if possible, otherwise video or photos must be reviewed manually during post processing.

Cameras shall be anchored to the seabed or attached to a structure installed to allow for sts'úkwi7 (fish) observations within the habitat areas. GPS shall be collected to map locations of footage. Cameras may be tethered to shore with a cable along the seabed or have a digital recorder box or chip near the camera itself.

If viable data cannot be obtained, further continuous surveys will be discontinued. However, if sts'úkwi7 (fish) can be identified, the video will be processed during two separate seasons during each of the assessment years. During review of the video, the following will be recorded, where possible:

- Species
- Life stage
- How the sts'úkwi7 (fish) is interacting with the habitat

Methods and results to be adaptively managed based on technology available at the time of the work and site conditions.

9.6.2.5 Seining

Seining to be conducted from shore (beach seine) or by vessel. Seining to be conducted over the course of a full day during two separate seasons, with one of those seasons being summer. Seining will include conducting a pass over each habitat feature constructed, and at a reference site(s).

During each day of seining, the following information shall be recorded:

- GPS to be used to determine the aerial extent that was seined.
- Sts'úkwi7 (fish) collected during seining shall be documented for species and life stage.
- Photographs shall be collected of representative sts'úkwi7 (fish).
- Works to be conducted under a valid scientific collection permit, including preparation of any reports required by those permits.
- All sts'úkwi7 (fish) to be released after collection.

9.6.3 Reporting Requirements

While assessing sts'úkwi7 (fish) abundance and diversity, including species, life history, and the level of effort will be required to qualitatively describe sts'úkwi7 (fish) use at the site and reference site(s). A detailed map will be created to indicate the sample locations, providing a visual representation of the survey area. The total percent coverage of algae, if any, on the rocks, with the results compared to the observed range within the reference site(s). Note the deeper reefs are not expected to grow macro algae that requires more sunlight to grow. A map displaying the transect and quadrat locations will be included. For invertebrates, the abundance data will be collected for each species present, such as sea stars, sea cucumbers, barnacles, and mussels. Percent coverage will be recorded where appropriate.

Observations related to the stability of the habitat feature, including signs of erosion and whether the reef is maintaining its design shape, will be documented. For area assessment, a map overlaid with as-built bathymetry will be created, identifying the polygon(s) corresponding to different habitat features. If there is variability in the functionality of the habitat feature, the areas may be divided to show different levels of productivity. An interpretation will be provided to explain why areas with lower productivity may not be performing as intended, and proposed remedies will be suggested as necessary. The methods employed to make all observations and any limitations encountered will be explained.

9.7 Adaptive Management Plan and Contingency Measures

Marine riparian, sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat management and ínexwantas (monitoring), including habitat offsetting effectiveness ínexwantas (monitoring), will be implemented following an adaptive management approach, as per condition 8 of the EAC and outlined herein. The adaptive management process requires that measures are implemented and purposefully evaluated and adjusted in order to achieve objectives. This plan is considered to be a living document and may be revised, as needed based on results of the ínexwantas (monitoring) program.

The purpose of the adaptive management plan (AMP) is to have a framework in place to manage outcomes during the Project Construction and operations phases that are not fully mitigated as expected by the EA review, and/or new impacts arise that are unexpected. The AMP will also allow for early detection of changes in local fisheries resources so that potentially significant negative ecosystem trends attributable to the project can be prevented or mitigated.

The AMP includes ínexwantas (monitoring) approaches to specifically identify and mitigate potential effects in the following subject areas:

- Riparian vegetation;
- Juvenile salmon migration;
- Slhawt' (herring) spawning; and
- Habitat offsetting effectiveness.

Further, consistent with EAC condition 8, this plan supports the management of outcomes during the Project phases for marine sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat for where effects are not mitigated to the extent anticipated by the EA review, and/or for effects not previously predicted. This is achieved by activity specific mitigation and ínexwantas (monitoring), and routine monitoring that is not task/activity specific and through evaluation of ínexwantas (monitoring) results documented in monthly and annual reports. The

adaptive management process consists of creating management and ínexwantas (monitoring) mitigations, Ínexwantas (monitoring) for effectiveness, reviewing for improvements, adjusting mitigation and management measures.

Ínexwantas (monitoring) plans with management actions will be developed in consultation with regulatory agencies and Indigenous peoples and be incorporated into the AMP. An annual review of the results of the ínexwantas (monitoring) programs will be conducted to determine if adaptive measures are necessary and which actions may be the most effective based on current conditions. Some of the topics of concern will be difficult to establish actionable thresholds or indicators as they are dependent on external environmental factors over which Woodfibre LNG has no control. Offsetting will be monitored as part of *Fisheries Act* (FA) authorization conditions. A requirement to review the need for adaptive management is written into each ínexwantas (monitoring) plan as a feedback system.

Slhawt' (herring) spawning and juvenile salmon presence and movement are the most dependent on outside factors. Year over year changes in slhawt' (herring) spawning locations may not be attributable to the Project and results will have to be interpreted in a regional context. Similarly, juvenile salmon abundance along shorelines is variable year to year and generally attributable to external drivers.

Contingency measures that may be used as part of the AMP are identified below:

9.7.1 Juvenile Salmon Migration

- Deploy additional contingency offsetting measures to improve sediment health in areas where sts'úkwi7 (fish) migrate to offset low functioning mitigation measures.
- Create/ enhance man-made structures to better support marine life and enhance juvenile sts'úkwi7 (fish) rearing in areas where juvenile sts'úkwi7 (fish) migration may be altered or delayed (i.e., sts'úkwi7 (fish) hold for periods).

9.7.2 Herring Spawning

- Deploy additional contingency offsetting measures such as extending the current actively used armoured slope, to increase hard substrate, marine vegetation and slhawt' (herring) spawning capacity.

9.7.3 Shoreline Alterations within Project Footprint

Although they are not part of the habitat offsetting, the proposed work includes the addition of slope protection along the shoreline. This assessment assumes that the shoreline would become re-established upon project completion, which informs the duration of temporary effects that may occur as a result of the work (i.e. generally three years or less). Adaptive measures that will be implemented should recolonization of the shoreline not occur within three years are:

- "Seeding" slope with rocks containing the specific target species that is performing poorly (e.g. rockweed).
- Confirming there are not permanent features that are causing the impact (e.g. shading).
- Confirming the substrates are stable and not causing erosion.
- Confirming other features are not causing disruption (e.g. excess sedimentation, fresh water sources).
- Construct additional habitat offsetting if the new shoreline results in a greater deficit of habitat function than anticipated.

9.7.4 Habitat Offsetting

In the event that all or a portion of the habitat offsetting is deemed unfunctional, or it is determined that more offsetting is required, the following will be executed:

- Riparian Offsetting:
- A qualified professional will determine if alterations to the design can be conducted in order to achieve the original design requirements. This may include replanting with species best adapted to site survivorship, soil enhancement in case of poor regrowth due to soil nutrient levels, or temporary watering in case of drought.
- It is extremely unlikely that riparian planting cannot be converted to functional habitat with the correct design and implementation, but in that unlikely scenario of the riparian area not being able to sustain life, the proponent would need to dedicate a portion of the shoreline to riparian planting within 30m of the shx̱wẏ (ocean) onsite, giving up a portion of the facility to do so (for example, **Figure 9-1**).
- Cobble Blanket:
- A qualified professional will determine if alterations to the design can be conducted in order to achieve the original design requirements.
- Conduct "seeding" involving transplanting rocks with the target species to the cobble blanket to accelerate growth.
- Construct more of another type of habitat that is functioning within the offsetting area.
- Construct additional cobble offsetting to the southwest of the site within bare areas of foreshore that are not functioning as intended (for example, **Figure 9-2**).
- Shallow Reef:
- A qualified professional will determine if alterations to the design can be conducted in order to achieve the original design requirements.
- Conduct "seeding" involving transplanting rocks with the target species to the cobble blanket to accelerate growth.
- Construct more of another type of habitat that is functioning within the offsetting area.
- Construct additional cobble offsetting to the southwest of the site within bare areas of foreshore that are not functioning as intended (for example, **Figure 9-2**).
- Sand Blanket:
- A qualified professional will determine if alterations to the design can be conducted in order to achieve the original design requirements.
- Conduct "seeding" involving transplanting rocks with the target species to the cobble blanket to accelerate growth.
- Construct more of another type of habitat that is functioning within the offsetting area.

- Construct additional cobble offsetting to the southwest of the site within bare areas of foreshore that are not functioning as intended (for example, **Figure 9-2**).
- Deep Reef:
- A qualified professional will determine if alterations to the design can be conducted in order to achieve the original design requirements.
- Conduct "seeding" involving transplanting rocks with the target species to the cobble blanket to accelerate growth.
- Construct more of another type of habitat that is functioning within the offsetting area.
- Construct additional cobble offsetting to the southwest of the site within bare areas of foreshore that are not functioning as intended (for example, **Figure 9-2**).

Figure 9-1 Continency Riparian Offsetting

Figure 9-2 Potential Contingency Offsetting Location

9.7.5 Habitat Offsetting Metrics Effectiveness Monitoring

There may be site conditions that restrict the effectiveness of some of the ínexwantas (monitoring) proposed. For example, turbidity within the water column may reduce visibility for divers and underwater cameras. Methods that are not generating meaningful results to do site conditions will be adjusted by altering the timing of those surveys or equipment being used. If it is not possible to collect meaningful data, the method will be discontinued, and results will have to rely on the other metrics proposed. An adaptive management approach will be required to evaluate the habitat offsetting.

9.7.6 Confirmation of Shoreline Protection Effects

As assumption of the effects analysis is that portions of the shoreline will result in a temporary loss of habitat function until intertidal algae and invertebrates can recolonize the shoreline. Although the habitat offsetting proposed is entirely outside of the project footprint, the project footprint should also be monitored for effectiveness in re-establishment of these marine organisms to justify the proposed temporary effects stated in the habitat balance sheet. Therefore, the same habitat surveys conducted for the cobble blanket shall be conducted for the existing shoreline in areas where recolonization was assumed in the habitat balance sheet and should be evaluated during the same years as the ínexwantas (monitoring) for the cobble blanket.

If it is determined that there is a deficit of habitat, a qualified professional will determine if alterations to the slope can be made to restore habitat function. If function cannot be restored, additional habitat will be constructed based on an updated habitat balance sheet.

10. REPORTING AND COMMUNICATIONS

10.1 Routine Reporting

Measurements and observations related to marine sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat, work activities, and employed mitigation measures will be recorded by the Environmental Monitor and will form the basis of environmental ínexwantas (monitoring) reports. The Environmental Monitor will be responsible for: (i) as needed daily communications including reporting of any non-compliance issues (emails), (ii) a weekly written ínexwantas (monitoring) report to the Woodfibre LNG Environmental Representative (Environmental Representative), (iii) monthly reports to the Environmental Representative and local Indigenous Groups, if requested, and (iv) an annual written report to the Environmental Representative.

In addition to immediate reporting of harm to sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat values, the Environmental Monitor will prepare a daily email for the Project team including a high-level summary of construction activities, environmental observations, mitigation measures, potential concerns, and upcoming tasks. The weekly environmental ínexwantas (monitoring) reports will summarize construction activities and progress, in-situ marine water quality data, photographs of site conditions, sts'úkwi7 (fish) observations, the effectiveness of avoidance or mitigation measures implemented during works, environmental concerns relevant to sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat, recommendations for adaptive management and other relevant environmental data (e.g., weather conditions).

Monthly reports will summarize weekly reports and be submitted to the Environmental Representative and local Indigenous Groups, if requested.

An annual ínexwantas (monitoring) report will be prepared by the Environmental Monitor summarizing the Fish and Fish Habitat program and reports for the year. Annual reports will be shared with skwxwú7mesh Úxwumixw (Squamish Nation) and Tsleil-Waututh Nation for review and input.

Additional reports or summaries in the final report will review mitigation as it pertains to general works and timing windows, marine shading, underwater noise, sts'úkwi7 (fish) exclusion and salvage, Pacific slhawt' (herring) mitigation measures, aquatic invasive species, and the offsetting areas.

Offsetting plans will be posted on the Woodfibre LNG website, or other widely publicly available medium, and maintained publicly available for 25 years following the end of operations or until the end of decommissioning, whichever comes first.

10.2 Non-Routine Reporting

The Contractor will be responsible for reporting on environmental incidents that adversely influence marine sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat, including spills or release of deleterious substances. Details and requirements for the environmental incident reporting program are included in the Project CEMP.

Any non-compliance with the EAC, as amended, will be reported to BC EAO by Woodfibre LNG within 72 hours of becoming aware of any such non-compliance or immediately for any non-compliance that may cause significant adverse effect.

10.3 Environmental Incident Reports

The Contractor will be responsible for reporting on environmental incidents that adversely influence water quality, including spills or release of deleterious substances. Immediately notify the EM. The EM will notify the Contractor who will notify the Woodfibre LNG Environmental Representative. Woodfibre LNG will determine if external reporting is required and will be responsible for external reporting. The EM will be available to assist with external reporting, if requested by the Environmental Representative.

11. INFORMATION MANAGEMENT

Woodfibre LNG is committed to sharing information with and engaging the public throughout the life of the Project. Woodfibre LNG will maintain an up to date and publicly available website to communicate information as required to promote public awareness and ensure safety in the project area. In order to manage potential impacts of the Project on all stakeholders and to maintain a relationship with the community.

The following telephone number and email address is available to allow for direct feedback to Woodfibre LNG:

e-mail: regulatory@wlng.ca

Woodfibre LNG will maintain a record of information related to the implementation of the conditions set out in the Federal Decision Statement reissued under Section 54 of the *Canadian Environmental Assessment Act* (2012) regarding this Decision Statement, and the results of all associated ínexwantas (monitoring), including:

- The place, date and time of any sampling, as well as techniques, methods or procedures used;
- The dates and the analyses that were performed;
- The analytical techniques, methods or procedures used in the analyses;
- The names of the persons who collected and analyzed each sample and documentation of any professional certification(s) relevant to the work performed that they might possess; and
- Results of the analyses.

This information will be made available for 25 years following the end of operation or until the end of decommissioning of the Project, whichever comes first, and includes;

- Training records will be retained by those providing training on this plan, Woodfibre LNG and the Contractor;
- Records of consultation regarding the development of this plan;
- Results of ínexwantas (monitoring) including QA/QC results; and
- Reports of water quality guideline exceedances, if any.

12. PROFESSIONAL STATEMENT

Keystone Environmental Ltd. confirms that this report titled *Marine Fish and Fish Habitat Management and Monitoring Plan* has been prepared in a manner consistent with that level of care and skill normally exercised by other members of the environmental science and engineering profession practising under similar circumstances in the area at the time of the performance of the work.

Original authors of this report include Spencer Quimby, James Slogan and Duncan Clark. This report has been reviewed and updated since the original versions with revision by Matt Husband, Varsha Rani, Nolan White, Carlos Moreno Rios, Duncan Clark and Warren Appleton.

Recommendations and guidelines presented in this report are based upon (i) a review of available documentation and records, (ii) discussions with available personnel and regulatory representatives, (iii) review of the terms and conditions for planned construction, and (iv) observations of the Site and surrounding lands. Consequently, while the recommendations and guidelines presented in this report have been prepared in a manner consistent with that level of care and skill normally exercised by other members of the environmental science and engineering profession practicing under similar circumstances in the area at the time of the performance of the work, this Environmental Management Plan is intended to provide information and to suggest mitigative strategies to reduce, but not necessarily eliminate, the potential for environmental impacts to occur as a result of planned work activities at the Site. This management plan is meant to provide guidance on the environmental protection measures that can be implemented during routine Marine Project activities, as well as unanticipated events or requirements that may arise during the course of construction.

This report has been prepared solely for the internal use of the Woodfibre LNG Limited pursuant to the agreement between Keystone Environmental Ltd. and Woodfibre LNG Limited. Any use which other parties make of this report, or any reliance on, or decisions made based on it, are the responsibility of such parties. By using the report, Woodfibre LNG Limited agrees that it will review and use the report in its entirety. Keystone Environmental Ltd. accepts no responsibility for damages, if any, suffered by other parties as a result of decisions made or actions based on this report.

October 23, 2023
Date

Keystone Environmental Ltd.

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